Aug. 16, 1932. E. A. SPERRY 1,871,476

MARINE AIRCRAFT

Filed Nov. 20, 1929 2 Sheets-Sheet 1

Fig. 1.

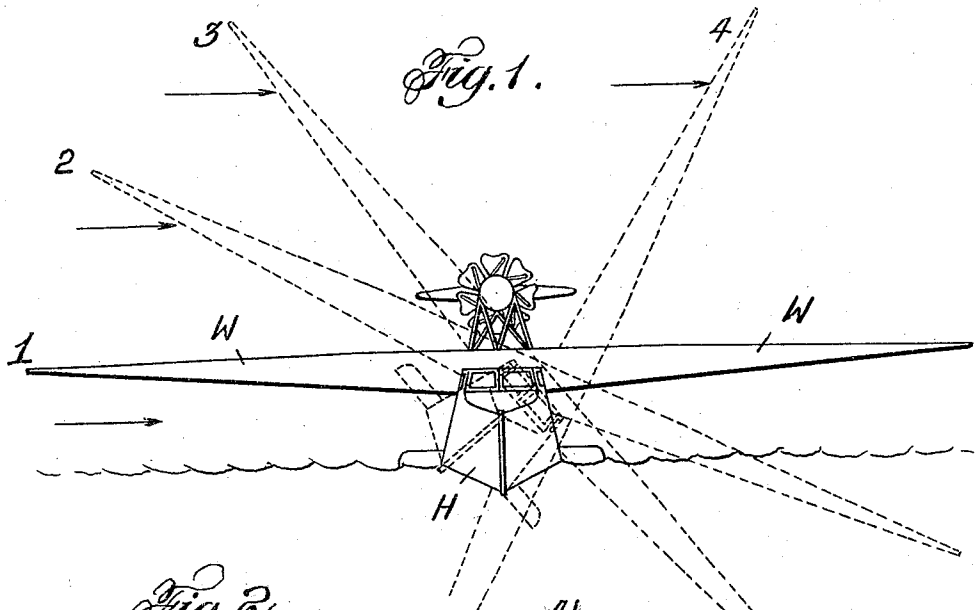


Fig. 2.

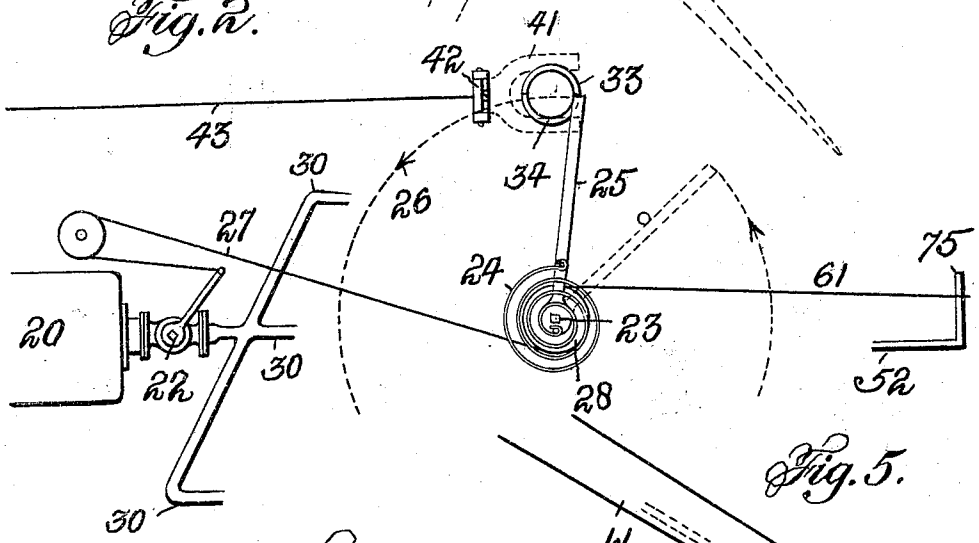


Fig. 5.

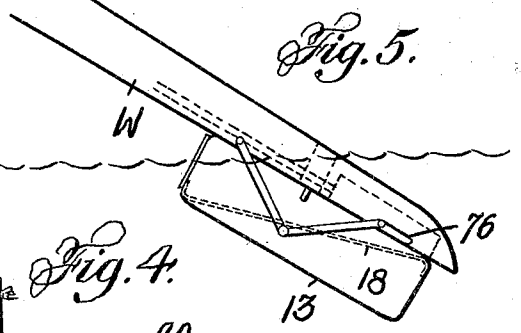


Fig. 3.

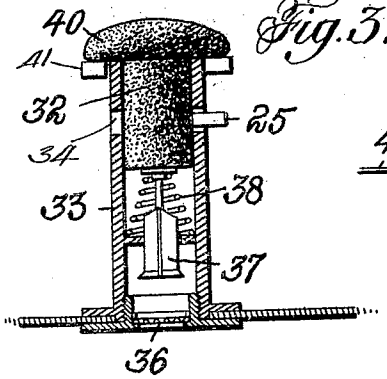
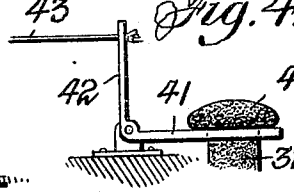


Fig. 4.



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Fig. 6.

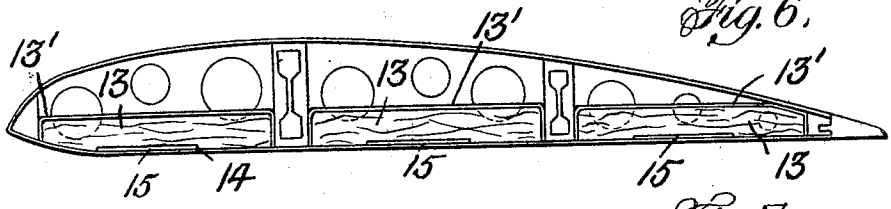


Fig. 7.

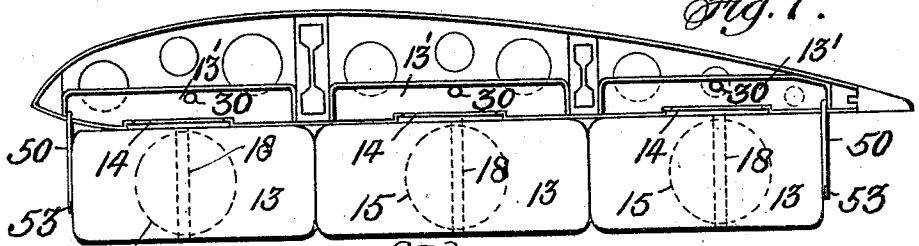


Fig. 8.

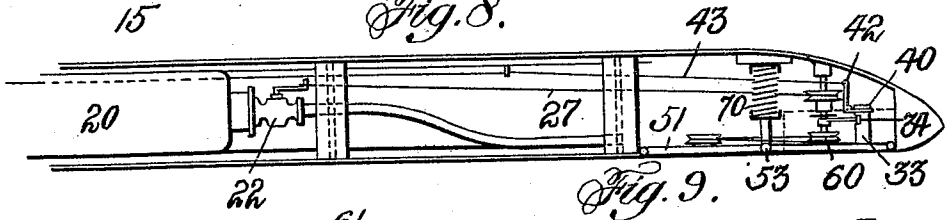


Fig. 9.

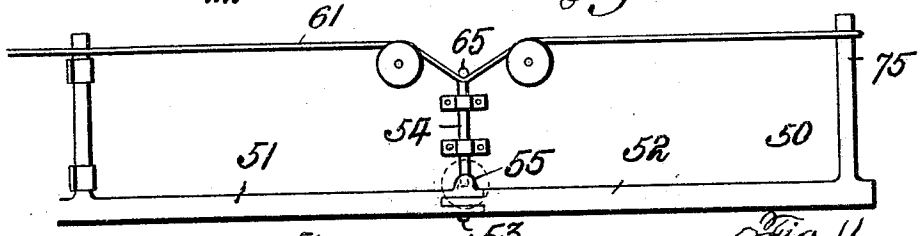


Fig. 10.

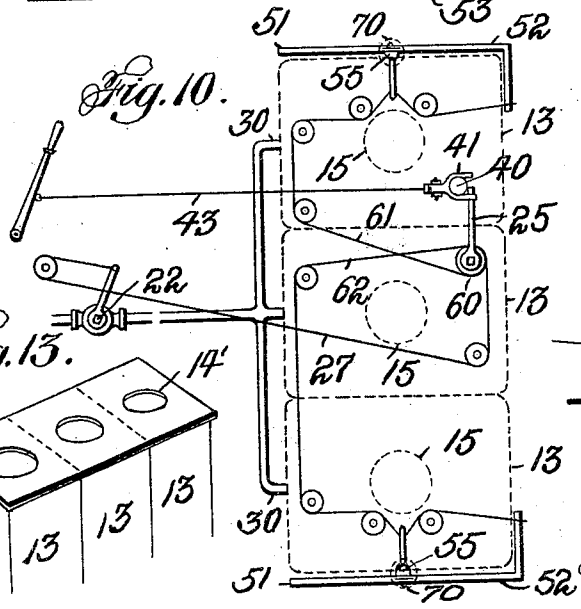


Fig. 11.

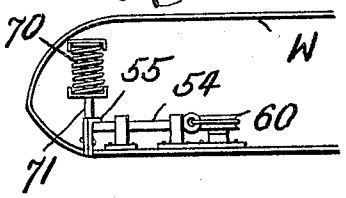


Fig. 12.

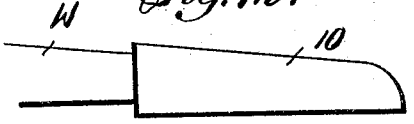


Fig. 13.

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1,871,476

UNITED STATES PATENT OFFICE

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MARINE AIRCRAFT

Application filed November 20, 1929. Serial No. 408,459.

This invention relates to marine aircraft which are characterized by wings and a floating portion, such as a housing or cabin for the pilot and for passengers or freight. In the case of all such craft it is desirable that the water-borne part be as small and narrow and as completely stream-lined as possible. This, however, results in a definite instability when the craft is floating on water. In the case of a monoplane type of aircraft, it is perfectly evident that when such a machine stands on the ground and a side gust comes and lifts one of the wings, the other wing will be correspondingly depressed or tilted until it touches the ground, whereupon no further motion will take place and it now stands in position to oppose very high velocity, lateral gusts, and wind pressures under the windward wing without upsetting or turning over and thus the plane will suffer no damage therefrom. In the case of flying boats, however, it is entirely different. If a wind should lift one of the wings, the smallness and narrowness, as well as the streamline formation of the housing, makes it easy for the wind to tilt the craft. When the lee wing in the course of its depression or tilting touches the water it encounters only the normal buoyancy of the rather narrow tip and hence meets no substantial resistance. It has been found on numerous repetitions of this sort of accident that the wing, and even a large winged float, will keep on dipping deeper and deeper into the water, since the windward wing, as it tilts upwardly, offers a more direct surface to the wind which, therefore, becomes increasingly effective. As a result, the entire plane turns like a windmill until it lies on its back, suffering very serious damage directly and indirectly and injurying also passengers and cargo.

The principal object of the present invention is to overcome this serious difficulty and still retain the ideal ship-shape of the flying boat and also to eliminate wing float appendage. It may here be stated that in order to overcome the difficulties hereinbefore mentioned, double pontoons arranged side by side but at considerable distances apart have been employed. This construction has been found to offer a great deal more head resistance, thus lowering the flying efficiency of the structure as a whole, but even of greater importance is the fact that it did not overcome the difficulty because planes equipped with such double pontoon structures have also been overturned when caught by sudden side gusts, owing to the fact that such planes can be maneuvered on the water only very slowly. To keep the flying efficiency high and at the same time to safe-guard against the class of accident described, I provide novel means for yielding a dependable extra buoyancy near the tip of the wing without in any way interfering with practically perfect flight efficiency when in the air. I disclose in the following specification two forms for accomplishing this result, the first being in the form of a perfect winged form enlargement of perfect stream line form but of a thicker wing structure which may also be wider both fore and aft to secure proper buoyancy and proper location of the center of buoyancy. This form is completely moisture proof and water tight. In a second form of the invention, I provide concealed inflatable floats adapted to be inflated upon engagement of the tip of a wing with the water. These floats are normally concealed within cavities in the wing structure so as not to interfere in the slightest with the head resistance or high efficiency of the plane in flight.

Further objects and advantages of my invention will become apparent in the following detailed description thereof.

In the accompanying drawings,

Fig. 1 is a front view of an amphibian plane illustrating diagrammatically the necessity for my invention.

Fig. 2 is an assembly view of the releasing mechanism for controlling the supply of gas under pressure for inflating the floats.

Fig. 3 is a vertical section through the water soluble element for controlling the float inflating mechanism.

Fig. 4 is a detailed view of the mechanism shown in Fig. 3 for enabling the water soluble member to be operated by hand so that

the inflation mechanism may be placed under the control of a pilot.

Fig. 5 is an end view of a wing tip, showing one of the floats extruded together with means for limiting the side expansion of said float.

Fig. 6 is a vertical section through a wing, showing the floats packed within the streamlines of said wing structure.

Fig. 7 is a view similar to Fig. 6 but showing the floats in extruded position.

Fig. 8 is a vertical section through another portion of the wing and showing the mechanism for controlling the supply of inflating gas.

Fig. 9 is an enlarged detail of the means for controlling the release element of the mechanism for limiting the side expansion of the floats.

Fig. 10 is a plan view, largely diagrammatic, showing the means for controlling automatically and by hand the supply of gas under pressure for inflating the floats.

Fig. 11 is a front elevation of the spring mechanism for rendering effective the means for limiting the side expansion of the float.

Fig. 12 is a view illustrating the modified form of my invention wherein an enlarged wing tip structure is employed rather than the floats disclosed in Figs. 6 and 7.

Fig. 13 is a perspective of a modified form of my invention.

The reason for this invention is shown in Fig. 1, which discloses an amphibian monoplane having wings W and a very narrow, relatively unstable, housing or cabin H. If a wind gust, as indicated by the arrow, should catch under one wing, the plane would readily be tilted from the full line position 1 to the dotted line position 2, where a portion of the wing tip on the lee side would tip into the water. The only resistance it would meet would be the slight buoyancy of the relatively narrow wing tip which would offer little resistance. As the windward wing reaches the position 2 it offers a more direct face to the wind which then becomes increasingly effective to tilt the plane to the positions 3 and 4 and finally completely overturns the craft.

Referring now first to Fig. 12, this illustrates the simplest form of my invention and comprises a water-tight enlarged wing section 10 at the extreme end of wing W, which is not only thicker than the wing at that point but may also be wider and longer to secure proper buoyancy and location of the center of buoyancy. Such a water-tight enlarged wing section will yield a buoyancy of between one and three tons, as required, while its air-foil form corresponds to the form of the rest of the wing structure W and gives a very low head resistance. This construction is very simple and entirely adequate for the purpose of overcoming the difficulties mentioned hereinbefore, and its only objection may be from the point of view of symmetry and odd appearance. It is for this reason that an alternative form is provided to fulfill the same function by means normally hidden in the wing structure except at the time when its special function is desired.

This means may take the form of extremely light and strong gas-tight envelopes or floats 13 which are closely folded and packed away inside of suitable cavities 13′ within the wing structure. I may store each of these floats within its respective cavity 13′ through an opening or aperture 14 in the bottom of the wing. The floats may be attached to the rim of the respective opening 14 so that when the floats are extruded they will be connected to the wing around the periphery of said apertures or openings 14. When packed within the wing, as shown in Fig. 6, each opening 14 may be closed by means of a plate 15 firmly held in position by a friction joint so that when the bags are inflated, the plates 15 will be blown off and the bags extruded through apertures 14. The plates 15 are preferably fixed to the bags themselves at one side thereof so that when the bags are inflated the plates will remain attached thereto as shown in Fig. 7. Anchor straps 18 may be provided for limiting the expansibility of the bags and for assisting to maintain the same in attachment to the peripheries of apertures 14.

In an alternative form shown in Fig. 13, the folded floats may be carried upon a single plate forming the bottom of the wing structure, the said plate being provided with the apertures 14 as before so that after the floats have been in use a new plate 14 with a new set of folded floats may easily be attached to the wing structure after the other plate has been removed.

With the floats packed in position in the wing structure, it will be seen that no increase in head resistance results therefrom and the efficiency of the plane is in no sense diminished. It is now necessary to provide means for inflating the floats quickly with a gas under pressure as soon as the necessity therefor arises, that is to say, as soon as one wing tip or the other engages and is submerged beneath the surface of the water. For this purpose I may provide a tank 20 filled with gas under suitable pressure to inflate the gas bags with the necessary rapidity to extrude the same through apertures 14. The supply of gas may be controlled by a valve 22 which is designed to be operated automatically when a wing tip dips beneath the water, or by hand at the will of an operator. The means for accomplishing this automatically may take the form of a spring-wound shaft 23 to which is attached a spring 24 normally tending to rotate the same in such direction as to move an arm 25 in a given di-

rection, such as for instance, that indicated by the arrow 26. The movement of said arm 25 in the direction of arrow 26 would wind a cable 27 upon a pulley 28 to operate the valve 22 and supply gas through the channels 39 to the respective floats. The movement of arm 25 in the said effective direction is normally retarded by means such as a block 32 which is readily soluble in water and normally of a hard crystalline structure contained within a tube 33 having a cut-away portion 34 through which arm 25 would be able to operate were it not for the intervention of the hard, crystalline, water-soluble block. The said block, as shown in Fig. 8, is located at the extreme wing tip and has an open lower end which may be covered by a filter 36 which permits the water to pass therein and upwardly into engagement with the block 32 to dissolve the same as soon as the tip dips beneath the surface of the water. Upon dissolution of the water-soluble block, arm 25 is free to rotate under the influence of spring 24 to open the valve 22 and supply the floats with gas under pressure as heretofore described. As soon as the block 32 is dissolved, the valve 37 within tube 33, normally held open by engagement with the block 32, is closed by a spring 38 so that no water can enter within the wing structure.

A means is also provided whereby the pilot may release the block 32 at will. For this purpose, said block is shown as provided with an overhanging top 40 around which engages a fork 41 forming one arm of a bell crank 42, the other arm of which has connected thereto means such as a cable 43 under the control of the pilot in the cabin or housing. When drawing upon cable 43, the pilot will mechanically release the block 32 to cause arm 25 to open valve 22 and hence extrude the floats.

I may provide means for limiting the sidewise movement of the floats and also provide means for rendering said limiting means effective only when the floats are inflated, so that normally such limiting means also lies flush within the wing structure so as to offer no head resistance thereto. Such limiting means is disclosed in Figs. 5, 7, 9, 10 and 11 at 50. Each of said limiting means 50, as disclosed in Fig. 9, comprises a toggle joint, the two parts 51 and 52 of which are pivoted at 53 and said joint being adapted to bend downwardly when in effective position. The said downward bending movement at joint 53 is normally prevented by means of a pin 54 engaging beneath a ledge 55 carried by one of the members of the toggle. When arm 25 is set free to rotate by the dissolution or withdrawal of the soluble block, a pulley 60 (see Figs. 8 and 10) rotates therewith to draw upon cables 61 and 62 which extend over suitable pulleys to the outer end 65 of pin 54. This withdraws pin 54 and leaves the toggle 51, 52, 53 comprising the limiting member 50 free to bend downwardly to form the limiting means as shown in Figs. 5 and 7. In order to effect this downward movement of the toggle as soon as pin 54 is withdrawn from beneath ledge 55, I may provide a spring 70 normally under compression and pressing upon a rod 71 which normally engages immediately above joint 53. The spring 70 and rod 71 are, however, ineffective to bend the joint downwardly as long as pin 54 is in position beneath ledge 55. When, however, the pin is withdrawn, the spring pressing upon rod 71 forces the joint 53 downwardly to flex the toggle members 51 and 52. The cables 61, 62 not only engage pin 54, but continue to the outer end of one member of each of the toggles, in this case as shown in Fig. 9, to an arm 75 at the outer end of toggle member 52. As the cables 61 and 62 are wound up, pulley 60 first withdraws pin 54 and then, after spring 70 and rod 71 have bent joint 53 downwardly, said cable pulls arm 75 inwardly in a slot 76 (see Fig. 5) to effect the said downward movement of the joint and the flexing of the toggle member.

In accordance with the provisions of the patent statutes, I have herein described the principle and operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. Also, while it is designed to use the various features and elements in the combination and relations described, some of these may be altered and others omitted without interfering with the more general results outlined, and the invention extends to such use.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In a marine aircraft, a laterally extending wing, a device for materially augmenting the buoyancy of said wing at or near said tip, so organized as to preserve a contour best suited for flight, said device being normally ineffective, and means responsive to the engagement of said wing with the water whereby said device may be rendered effective.

2. In a marine aircraft, a laterally extending wing, in inflatable device for materially augmenting the buoyancy of said wing, said wing having a cavity in which said device is carried when ineffective so as to preserve the wing contour best suited for flight, and means responsive to engagement of said wing with the water for extruding said device from said cavity and inflating the same.

3. In a marine aircraft, a laterally extending wing, a plurality of inflatable devices for materially augmenting the buoyancy of said

wing, said wing having a plurality of cavities in which said devices are carried when ineffective so as to preserve the wing contour best suited for flight, and means responsive to engagement of said wing with the water for extruding said devices from said cavities and inflating the same.

4. In a marine aircraft, a collapsible gas bag so disposed on said craft in collapsed condition as to preserve the minimum flight resistance of the craft, a source of fluid pressure, a connection between said source and said bag, and means responsive to engagement of said wing with the water for controlling said connection.

5. In a marine aircraft, a collapsible gas bag so disposed on said craft in collapsed condition as to preserve the minimum flight resistance of the craft, a source of fluid pressure, a connection between said source and said bag, means responsive to engagement of said wing with the water for controlling said connection, and hand-operated means for alternatively controlling said connection.

6. In a marine aircraft, a collapsible gas bag so disposed on said craft in collapsed condition as to preserve the minimum flight resistance of the craft, a source of fluid pressure, a connection between said source and said bag, and automatic means for controlling said connection in response to engagement of a predetermined part of said craft with the water, said automatic means including a servo motor for operating said connection and a water soluble element in said part and normally rendering said servo motor ineffective but adapted to dissolve on engagement with the water to permit operation of said servo motor.

7. In a marine aircraft, a collapsible gas bag so disposed on said craft in collapsed condition as to preserve the minimum flight resistance of the craft, a source of fluid pressure, a connection between said source and said bag, automatic means for controlling said connection in response to engagement of a predetermined part of said craft with the water, said automatic means including a servo motor for operating said connection and a water soluble element in said part and normally rendering said servo motor ineffective but adapted to dissolve on engagement with the water to permit operation of said servo motor, and hand-operated means whereby said water soluble element may be withdrawn.

8. In a marine aircraft, a collapsible gas bag so disposed on said craft in collapsed condition as to preserve the minimum flight resistance of the craft, a source of fluid pressure, a controllable connection between said source and said bag, means for limiting the lateral expansibility of the said inflated bag, and means for operating said connection to inflate said bag and simultaneously render said limiting means effective.

9. In a marine aircraft, a wing, a collapsible gas bag so disposed on said craft in collapsed condition as to preserve the minimum flight resistance of the craft, a source of fluid pressure, a connection between said source and said bag, and means responsive to engagement of said wing with the water for controlling said connection, said means including a servo motor for operating said connection and means whereby said servo motor operates said limiting means.

10. In a marine aircraft, a collapsible gas bag so disposed on said craft in collapsed condition as to preserve the minimum flight resistance of the craft, a source of fluid pressure, a connection between said source and said bag, and automatic means for controlling said connection in response to engagement of a predetermined part of said craft with the water, said automatic means including a tube having an open end adapted to engage the water and permit the same to pass therein, a water soluble element carried by said tube, a spring-pressed valve normally held open by said element against the action of said spring to permit the water to engage said element and dissolve the same, said valve being adapted to close to prevent further passage of water into said tube when said element dissolves, and a servo motor controlled by said element for operating said connection.

In testimony whereof I have affixed my signature.

ELMER A. SPERRY.