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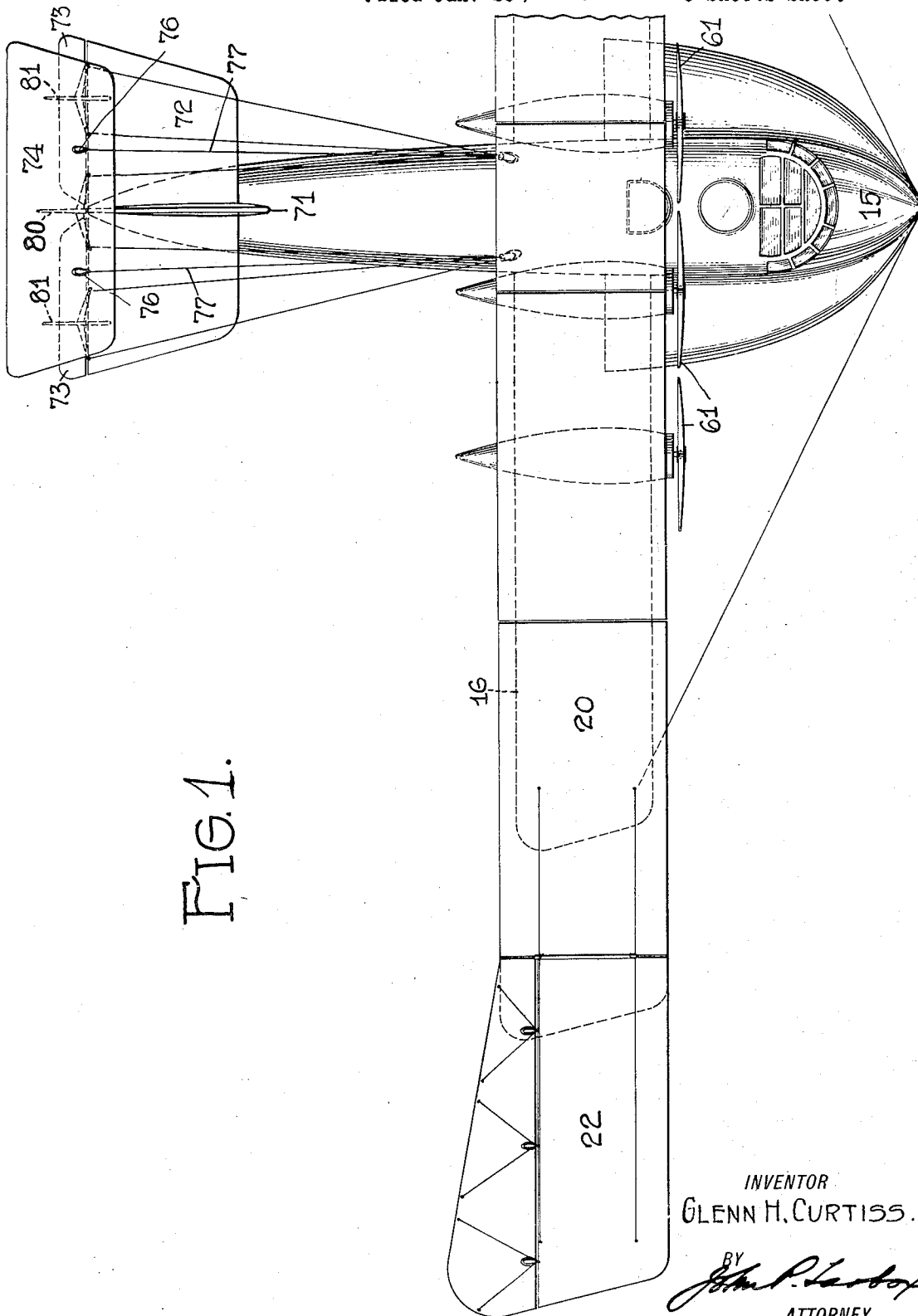
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G. H. CURTISS

TRIPLANE FLYING BOAT

Filed Jan. 13, 1916

3 Sheets-Sheet 1



INVENTOR
GLENN H. CURTISS.

BY
John P. Harbo
ATTORNEY

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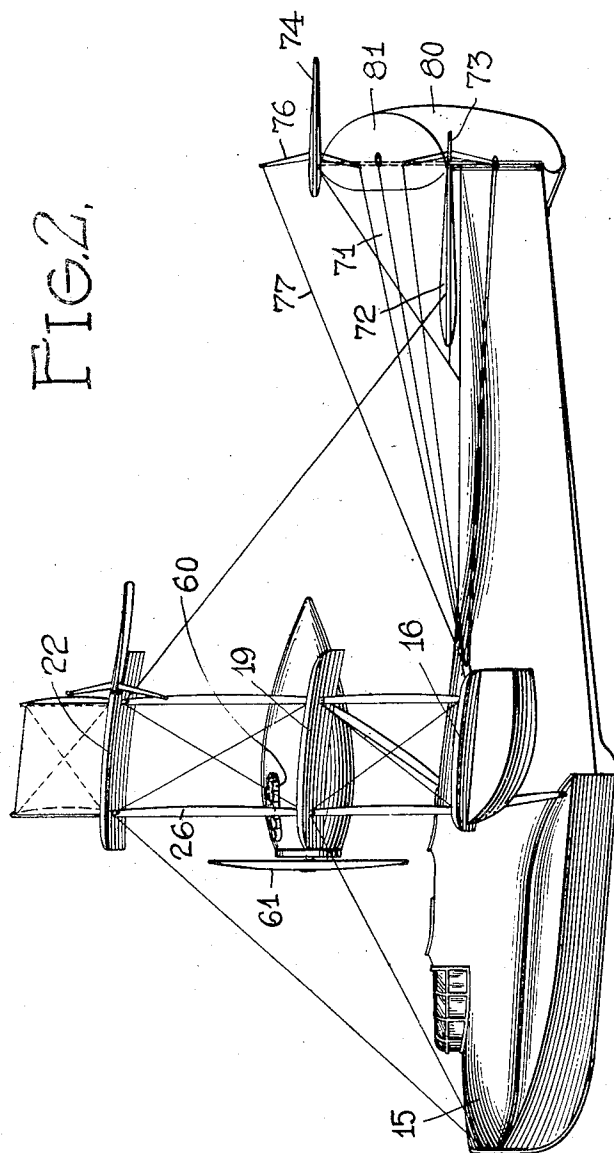
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3 Sheets-Sheet 2



INVENTOR
GLENN H. CURTISS

BY
John P. Tarbo
ATTORNEY

Aug. 28, 1923.

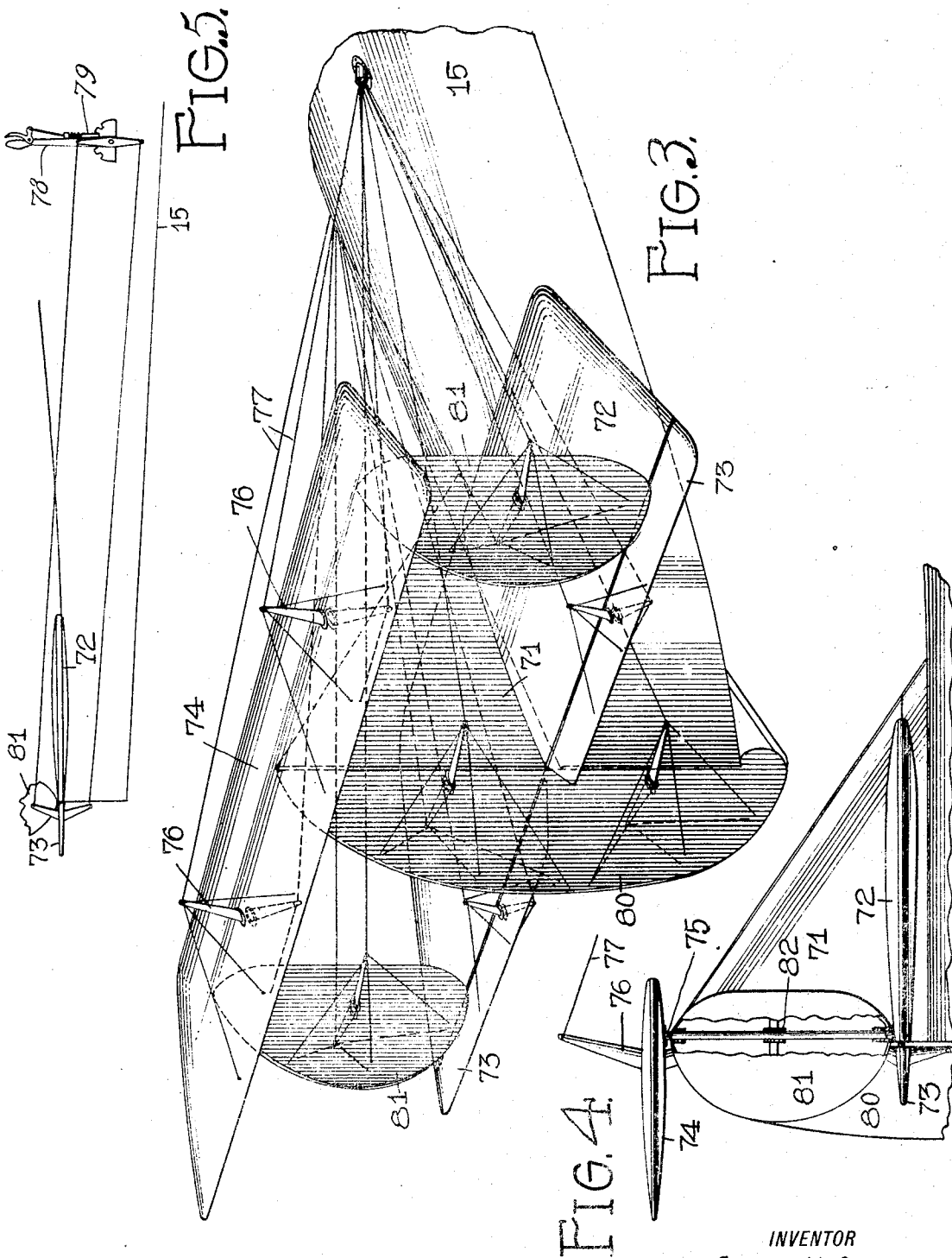
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G. H. CURTISS

TRIPLANE FLYING BOAT

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3 Sheets-Sheet 3



INVENTOR
GLENN H. CURTISS.

BY
John P. Carbox
ATTORNEY

UNITED STATES PATENT OFFICE.

GLENN H. CURTISS, OF BUFFALO, NEW YORK, ASSIGNOR, BY MESNE ASSIGNMENTS, TO CURTISS AEROPLANE AND MOTOR CORPORATION, OF BUFFALO, NEW YORK, A CORPORATION OF NEW YORK.

TRIPLANE FLYING BOAT.

Application filed January 13, 1916. Serial No. 71,942.

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 Triplane Flying Boats, of which the following is a specification.

With the use of a flying machine of unusual size and weight as for instance flying boats like that herein illustrated, I have found it desirable to depart from the usual practise as regards the design and construction of the supporting and control surfaces therefor. This also applies, as will hereinafter appear, to high speed machines regardless of size and weight. In particular, it has been my aim to provide in an airplane a pair of co-acting control surfaces having a related function, i. e., related in that the action of one surface is directly supplemental to that of the other together with means under the control of the pilot for freely moving one or both of the control surfaces during flight, the control surfaces under all operating conditions being movable about axes fixed relatively to the machine. In the preferred embodiment of the invention the related control surfaces above referred to are respectively balanced and unbalanced, the balanced control surface being oscillatable about an axis located intermediately its leading and trailing edges and the unbalanced control surface oscillatable about an axis located at or near its leading edge. Such an arrangement may be depended upon to render feasible the operation of the control surfaces of a boat of the huge size I contemplate. The invention moreover is characterized by an improved arrangement of the control surfaces relatively to each other and to the fixed stabilizing surfaces usually provided at the tail end of the machine. The novelty exhibited by this arrangement, and in fact the novelty exhibited by the invention, although described in detail hereinafter, is specifically pointed out in the claims. It is to be understood therefore that in determining the scope of the invention reference should be made not to the specification but more particularly to the claims.

In the matter of size, the modern tendency has been to increase flying machine dimensions in direct proportion to the advances made in aeronautical power plants. Machines capable of transporting through the air loads of several tons are required if aerial navigation is to develop commercially, and also are demanded by the exigencies of aerial warfare. While the flying boat, from its essentially much sturdier body construction, is better fitted than the land-alighting aeroplane for the transportation through the air of loads hitherto considered impossibly heavy, it will be readily understood that my present invention in triplanes comprehends the use of aeroplane bodies of whatever type is thought advantageous.

With the use of a boat hull of an unusual size and weight, it is necessary to depart from the usual practice as regards the design and construction of the supporting and control surfaces therefor. In particular, it has been my aim to arrange a power plant installation in intimate conjunction with one of the triplane surfaces, which installation includes the employment of a plurality of separate engine units upon each side of the longitudinal axis of the boat hull, at least four distinct engines being employed for the propulsion of the boat. As regards to control surfaces, which in a boat of this character assume such proportions as to render them unwieldy in the extreme and practically impossible of manual operation if previous arrangements are followed, I have devised a balanced arrangement of elevators and rudders, as well as a multiple combination which may be depended upon to render feasible the operation of a boat of the huge size I contemplate.

The two correlated subject matters of the power plant installation and control surface arrangements are those with which my present invention is primarily concerned, each of these broad headings including a number of grouped details of importance as illustrated in the accompanying drawings, described in the following specification, and then more particularly pointed out in the claims which are appended hereto and form a part of the application.

Of the drawings wherein like reference characters designate like or corresponding parts:

Fig. 1 is a plan view of the triplane flying boat comprehended by the invention;

Fig. 2 is a side elevation of the boat;

Fig. 3 is a view in perspective of the empennage of the machine;

Fig. 4 is a side elevation of the empennage, parts being broken away, and

Fig. 5 is a diagrammatic detail of the means employed to fixedly set one of the control surfaces of the machine.

The invention, while directed more particularly to the empennage of an airplane is not to be considered thus limited as the arrangement of the control surfaces of the empennage may be followed out in the organization of the balancing surfaces of the machine.

In the embodiment of the invention selected for illustration the boat hull is designated in its entirety by the numeral 15 and is constructed along the lines of the regulation flying boat of the standard Curtiss type, although so modified and individually designed as is required by its extraordinary size and weight carrying capacity. The supporting surfaces are arranged in a vertically superposed tier and are designated respectively 16, 19 and 22. Between the supporting surfaces a multi-unit power plant is arranged, the motors of which are designated as 60 and the propellers as 61.

Upon the extreme tail of the boat there is supported the vertical stabilizer 71 which is intersected at its base by the horizontal stabilizer 72. Hingedly connected to the first mentioned stabilizer is the lateral steering rudder 80, while similarly mounted upon the horizontal stabilizer are the longitudinal steering rudders or elevators 73. So far this construction is of the ordinary character but the large size of the boat with its attendant increase in the extent of the control surfaces has rendered necessary the employment of additional rudders and elevators in supplementation to those just described. The problem of mounting these added surfaces is one which requires departures from all previous methods in order to permit of the large surfaces being manually operated, which would be impossible if the old practice were adhered to.

Considering first the elevator surfaces, those denoted by the numeral 73 are supplemented by the large single elevator surface 74 which is given a double camber and placed at a slight negative angle of incidence in order that in normal horizontal flight no positive lift will be exerted by this surface, which will then supplement the action of the horizontal stabilizer 72, also

constructed with a similar double camber. An added reason for cambering both the tops and bottoms of these surfaces is that their large extent demands interior ribbing in order to produce a structure of the required strength, while, too, a fore and aft streamline is attained for each of these surfaces, as is desirable in cutting down head resistance, while their coacting efficiency is heightened by the rearwardly directed stagger to be observed. To mount elevator 74, a shaft 75 extends transversely across its under surface slightly in the rear of the center of pressure thereof, which so balances the elevator that it can readily be moved either upwardly or downwardly with but slight effort. When the elevator surface is thus balanced, oscillation thereof upon its shaft is readily accomplished through the medium of the usual streamline brace arms 76, which are stayed directly to the surface and connected by means 77 of a flexible nature with some operating element mounted in any customary manner within the hull 15. The oscillation of elevator 74 is seen thus to be of a balanced, as contrasted with unbalanced operation of elevators 73.

Ordinarily the smaller elevators 73 are utilized mainly to trim the boat, being acted upon, when deflected from their normally neutral position, by the air rush to either lift or depress the tail of the hull in order to correct the flying attitude of the craft. A lever 78 accompanied by any suitable locking means 79 has been provided as shown in the diagrammatic view of Fig. 5, in order that a correct setting of these elevators 73 may be maintained as long as desired. It is the large single elevator 74 which is relied upon for the longitudinal steering of the machine, in the most part.

In addition to the main central rudder 80 there are employed additional and smaller rudder surfaces 81 laterally spaced from the central rudder and mounted in the balanced manner noted in the case of the elevator 74, by means of a vertical shaft 82 extending through each surface also slightly in the rear of the center of pressure. The large rudder 80 has its lower portion curled and bracketed under the stern of the hull 15 to serve as a water rudder when the boat is operating in that medium, while the utilization of three separate rudders, which are all simultaneously operated by flexible wire controls, of the customary character, permits each surface to act upon undisturbed air; the efficiency of this multiple surface control being considerably greater than that of a single large surface equalling its combined area.

Through the rearrangement and co-ordination of the control surfaces in the manner

stated an obstacle which previously acted as a strict limitation upon the size of flying machines has been overcome. It is now possible for me to do away with the motor operated control which was formerly considered the only solution of the problem of employing over sized controlling surfaces. Furthermore, by providing a pair of co-acting control surfaces in which the action of one surface is supplemental to that of the other it is possible to operate one of the surfaces for high speed control and both surfaces for low speed control, it being a recognized fact that a larger control surface area is required for low speed control due to the fact that the reaction of air upon the surface area is less in consequence of the reduced speed. It is further possible as a result of the improved arrangement of the control surfaces to trim the flying attitude of the craft while it is in flight by merely setting the smaller surfaces 73 in a certain definite position; this being accomplished without in any way affecting the operativeness of the major controlling surface. It should be noted also that all of the control surfaces are provided with fixed pivot axes and that the operation of each surface is entirely independent of the operation of the other.

While in the foregoing, however, there has thus been illustrated in the drawings and described in the specification such combination and arrangement of elements as constitute one preferred embodiment of this invention, it is desired to emphasize the fact that such departures from the particular embodiment disclosed may be made in later adaptations of this invention as shall be recognized as within the scope of the appended claims.

What is claimed is:

1. In the empennage of a flying machine, a vertical rudder movable for steering the craft either to the right or left, an elevator mounted above the vertical rudder for steering the craft either up or down, and auxiliary elevators mounted at opposite sides of the vertical rudder and below said first mentioned elevator to supplement the steering function thereof.

2. In the empennage of a flying machine, superposed elevators for steering the craft either up or down, a vertical rudder mounted below the upper elevator and extended beyond and below the lower elevator, and auxiliary vertical rudders mounted on opposite sides of said first mentioned vertical rudder, said auxiliary rudders being mounted between the superposed elevators and with the first mentioned vertical rudder being movable to steer the craft either to the right or left.

3. In the empennage of a flying machine, a vertical rudder movable for steering the craft either to the right or left, auxiliary

vertical rudders mounted one on either side of the first mentioned vertical rudder to supplement the steering function thereof, an elevator mounted above the total number of vertical rudders, and auxiliary elevators mounted below said first mentioned elevator, one on either side of said first mentioned vertical rudder, the total number of elevators being movable to steer the craft either up or down.

4. In the empennage of a flying machine, a vertical rudder movable for steering the craft either to the right or left, a relatively large balanced elevator mounted above the vertical rudder for steering the craft either up or down, and auxiliary unbalanced elevators mounted at opposite sides of the vertical rudder and below said balanced elevator to supplement the steering function thereof.

5. In the empennage of a flying machine, superposed elevators for steering the craft either up or down, said elevators being respectively balanced and unbalanced, laterally spaced vertical rudders mounted between the superposed elevators for steering the craft either to the right or left, the pivot axes of the vertical rudders being so related to the pivoted axes of the superposed elevators that said axes intersect.

6. In the empennage of a flying machine, superposed elevators for steering the craft either up or down, the upper elevator being continuous and unbroken from tip to tip whereas the lower elevator is divided intermediately of its ends, a vertical rudder mounted below the upper elevator within the space between the sections constituting the divided lower elevator, and auxiliary rudders mounted between the superposed elevators at opposite sides of the first mentioned vertical rudder, the rudders collectively being movable to steer the machine either to the right or left.

7. In the empennage of a flying machine, a vertical stabilizing surface, a vertical rudder mounted in rearward continuation of said vertical stabilizing surface, said vertical rudder being freely movable for steering the craft to the right or left, superposed elevators for steering the craft either up or down, said superposed elevators being mounted in planes respectively above the horizontal plane of the upper end of the vertical rudder and in a horizontal plane intermediately of the ends thereof, said lower elevator being intermediately divided to provide duplicate elevator sections, the respective sections being mounted on opposite sides of said vertical rudder.

8. The combination in the empennage of a flying machine, of a fixed horizontal stabilizing surface, a directional control surface normally parallel thereto and vertically spaced above it, a second directional control

surface mounted between the stabilizing surface and the directional control surface first mentioned, and a third directional control surface mounted in direct rearward continuation of the horizontal stabilizing surface.

9. The combination in the empennage of a flying machine, of a stabilizing surface, an unbalanced movable control surface mounted to the rear of the stabilizing surface in direct continuation of it, a movable balanced control surface spaced above the stabilizing surface, and fixed and movable control surfaces arranged between the stabilizing surface and the movable surface above it, the movable control surfaces last mentioned being likewise respectively balanced and unbalanced.

10. In the empennage of a flying boat, elevators operable to control the flying attitude of said boat, a single rudder operable in both air and water to control said boat and an additional rudder and elevator intermediately balanced for ease of operation to supplement the control of said boat.

11. In the empennage of a flying machine, stabilizing surfaces arranged in intersecting planes, unbalanced control surfaces having hinged connection with said stabilizing surfaces, and separate balanced control surfaces arranged respectively in planes parallel with said stabilizing surfaces.

In testimony whereof I affix my signature.

GLENN H. CURTISS.