Sept. 5, 1950 I. TROENG 2,521,268

BOAT

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Fig. 1.

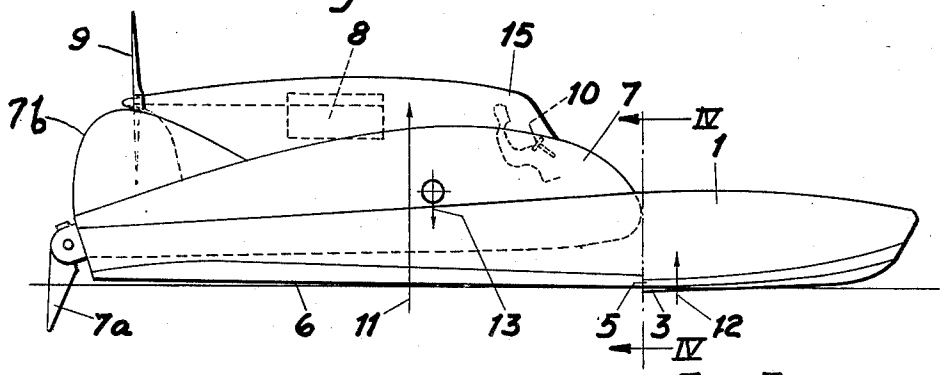


Fig. 3.

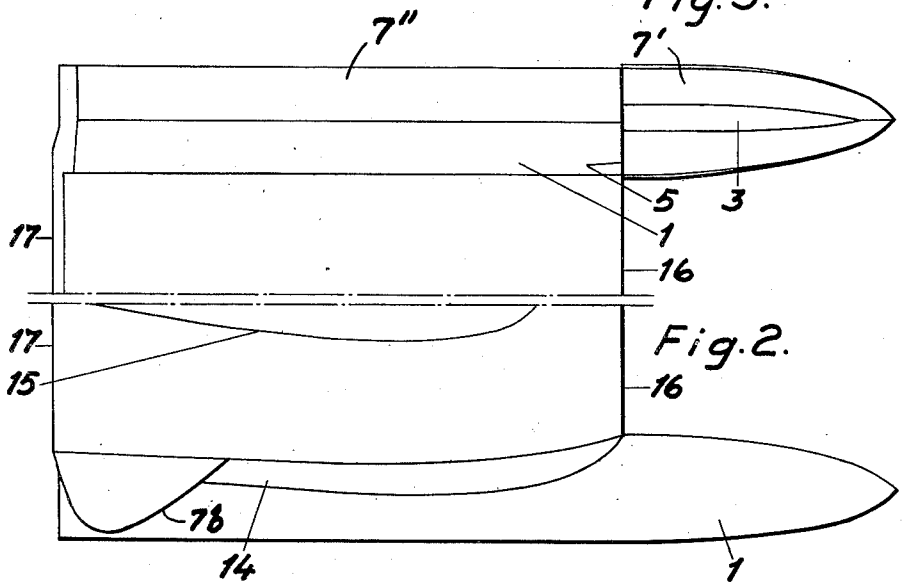


Fig. 2.

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Fig. 4.

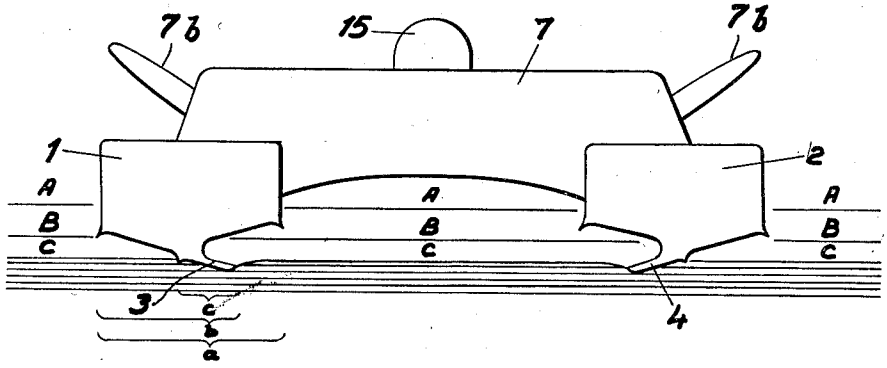
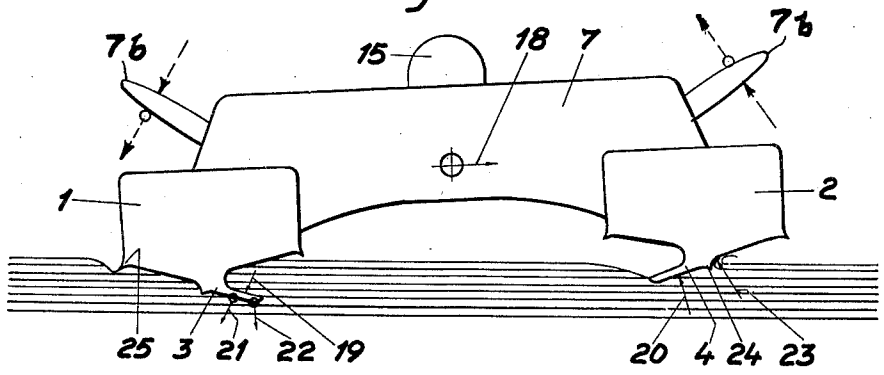


Fig. 5.



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BOAT

Ivan Troëng, Alvsjo, Sweden

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6 Claims. (Cl. 114—66.5)

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The problem of building a fast boat which at the same time is economical is not only a problem of resistance. The particular difficulties connected with high speed, in the form of wave shocks, damage caused by floating bodies and the centrifugal force in the taking of turns must also be mastered if a boat with low resistance at high speed shall be of any practical use.

Many earlier inventors have realized the importance of aero wing-like members as being superior, from the viewpoint of resistance, to the bottom surfaces generally used in planing boats. As a rule, the wing has been situated in the water which, however, has involved considerable drawbacks. The boat becomes deepgoing and is subjected to enormous stresses at heavy sea when the profiles are passing now in the air now in the water. Moreover it is easily liable to get damaged by floating bodies. The object of the present invention is to completely eliminate these drawbacks.

The boat according to the invention consists of at least two (possibly three) pontoons and one or more wing-like intermediate members located above the water surface and connecting the said pontoons. The said intermediate member is adapted to substantially carry the boat when the boat is moving. The invention is substantially characterized by the fact that the pontoons or outer pontoons are provided with inwardly and downwardly directed, longitudinal, fins which, when turns are to be taken, are adapted to press down the pontoon located nearer to the turn centre and to press upwardly the pontoon which is located more remote from the said centre.

The underside of the intermediate member is preferably formed as one or more transverse arches so that particularly the rear portion becomes strong and capable of being used as bottom surface at low speed. The proximity to the water is of very great importance for obtaining good aerodynamic values. This is obtained in that, when the boat is lying still, the rear portion of the intermediate member trails in the water so that, when moving, it comes nearer to the water surface than it would otherwise do.

The pontoons can be made of a shape similar to those of a seaplane, the step being, however, provided much farther forward. Between the said pontoons there are provided one or more wing-like members having the profile and aerodynamic qualities of an airplane wing which may contain compartments, motors or load spaces. It may often be advantageous to use relatively thick profiles—about 20% of the chord—and to

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cut off the rear edge which might have a resistance diminishing effect. If now the centre of gravity lies at or just before the centre of pressure of this wing member (or these wing members) only a small part of the weight—a few hundredths—will at high speed rest on the water by the far advanced steps, while the main part of the weight of the boat is carried by the air forces acting on the wing-like member (or members). Thus, a total gliding ratio of 1:25 can be obtained without difficulty, which means that a boat shaped in this way has only about a third of the resistance of an about 40-knot plane-boat, although it also can obtain this gliding ratio at a speed up to a multifold value, if desired.

Due to the fact that the weight resting on the water has thus been reduced to a minimum, the gliding ratio of the bottom surfaces will be of secondary importance, and therefore one is free to a very great extent to shape said bottom surfaces in accordance with the demands of seaworthiness and stability in contradistinction to the bottoms of a common plane-boat, in which everything must submit to the demand of a speed-producing shape. With increasing air lift the water forces on the pontoon bottoms decrease, which results in a reduction of stresses.

As a matter of fact, the air forces in a boat according to the invention afford a possibility of obtaining a laterally stabilizing effect in the taking of turns. However, except at very high speed, this effect as well as the lateral pressure of the air in general in the taking of turns is so low that, as a rule, the boat should be steered by means of members in the water. The stability in the longitudinal direction is obtained automatically by the boat raising the stern more and more at higher speed so that the angle of incidence of the wing member is reduced from about 5° to 2° or 3° or less. If a boat is constructed with the centre of gravity in the aerodynamic centre of pressure, this boat can begin to fly completely at high speed. In spite thereof it is stable in the longitudinal direction because, due to its vicinity to the water surface, the pressure centre wanders in a direction opposite to that of a wing in the free air. An angle increase will cause a movement of the pressure centre backwards and an angle decrease a forward movement of the said centre so that balance is obtained. Due to leakage of pressure air from the lower to the upper side an increase of the size of the opening between the pontoon and the water surface results in a reduction of the lifting force. Thus the boat is prevented from rising higher than

to the position at which the lifting force and the total weight balance each other.

In order that the water resistance shall be as little as possible, the water line breadth should not be broader than necessary at the speed in question. At higher speed the breadth at the step should be reduced in proportion to the increase of the speed. This is obtained by longitudinal steps on the pontoon bottoms, particularly before the aforementioned, transverse step.

A lateral stabilization in a boat moving normally on the water is obtained by the above-mentioned inwardly and downwardly directed bottom pins on the pontoons, which preferably incline more downwardly at the front end than at the rear end and which in taking turns function in such a way that in the turn the inner pontoon is pressed down and offers a considerable resistance along the turning radius, while the outer pontoon is pressed upwardly and together with the inner pontoon compensates the tilting moment of the centrifugal force. This device is combined with a rudder (possibly also fins) in the water and/or in the air. A rudder in the water as well as fins can be adapted to be raised in order to reduce the draught of the boat and to form a protection against large floating bodies. In order to protect the front fins against large floating bodies, the said front fins may be yieldingly mounted outside the hull of the boat. Preferably, the centre of gravity of the boat is situated at a short distance before or in the pressure centre of the air on the intermediate wing member and at a larger distance behind the pressure centre of the water on the said fins. If the centre of gravity lies before the air pressure centre, the first-mentioned distance is made preferably equal to 10%, at the most, of the last-mentioned distance. A suitable value of the ratio between the said distances is thus in many cases about 1:20.

In certain cases it might be desirable to provide stabilizing means in the air. The said means preferably consist of fins on the rear side edges of the intermediate member. The fins should be directed obliquely upwardly and outwardly. Sometimes they are also of importance for protecting persons on-board the boat from being hurt by the air propeller, particularly if two propellers are used. Such fins may be provided simultaneously with or instead of the above-mentioned planes moving in the water.

Boats according to the present invention should preferably be driven by means in the air, i. e. air propellers or jet engines. Water propellers or other driving device in the water can only be used in exceptional cases. Air propellers are preferably arranged as pushing propellers in casings at the back on the upper side of the wing members. In small boats there is preferably used a motor in the front portion of the boat, which motor, by a shaft extending to the rear portion of the boat and by a belt extending to the propeller casing, drives the propeller shaft at a suitable speed—usually considerably lower than that of the motor. In large boats there is preferably provided an extension shaft between an aero engine which should be placed in or before the pressure centre, and the propeller which is placed above the rear portion of the wing.

Particularly in large ocean boats according to the invention it might be advantageous to completely or partially fill the airplane wing-profiled intermediate member with a gas that is lighter than air, e. g. helium or hydrogen, in order to obtain an increased carrying capacity. The said gas may be contained in balloons within the intermediate member. For the same purpose Autogiro wings driven by the air stream may be arranged on the boat.

The seaworthiness of a boat according to the invention will be influenced advantageously by the following factors:

(1) The slight pressure of the pontoons on the water.

(2) The shape of the pontoon with a narrow carrying surface which can easily cut through the water, and relatively high longitudinal steps to the broader surfaces carrying the forepart of the boat at starting and at low speed.

(3) The automatic adjustment of the boat to a certain trim angle for each speed and its capacity of maintaining this angle relatively unchanged in spite of the waves.

The invention is illustrated in the accompanying drawings by way of an example.

Fig. 1 shows a side view of the boat. Figs. 2 and 3 show the right boat half, viewed from above, and from below respectively. Figs. 4 and 5 show the boat in profile approximately on the line IX—IV of Fig. 1, on a straight course, and turning to starboard, respectively.

1 is the right pontoon and 2 the left pontoon. 3 and 4 are inwardly and outwardly extending planes diving into the water at high speed, which planes will be described more particularly below and which terminate rearwardly at the step 5. 6 is the air space between the rear portion of the pontoons and the water surface. 7 is the airplane wing-like portion connecting the pontoons and containing engine room, cabins, and so on. 7′ and 7″ show the form of the bottom of the pontoons at the fore and the rear ends thereof, respectively. 7*a* is the rudder and 7*b* the fins, if such are used. 8 is the motor and 9 the propeller. The hand wheel 10 and the person operating the same are indicated in the front of the boat. In Fig. 1 the arrows 11 and 12 show the air pressure centre, and the water pressure centre respectively, at high speed, while the arrow 13 shows the centre of gravity of the boat. The surface 14 in Fig. 2 is the side surface of the wing and the line 15 shows the wheel cabin. The line 16 is the front edge of the wing and the line 17 the rear edge thereof.

In Fig. 4 the reference letter A shows the water line and *a* shows the floating line breadth at rest or at low speed, B shows the water line and *b* the floating line breadth at middle speed, and C shows the water line and *c* the floating line breadth at high speed. The inclined planes 3, 4 shown in Figs. 4 and 5 incline inwardly and downwardly so that their upwardly directed normal inclines inwardly and backwardly. They may either constitute a stationary, rigid portion of the pontoons or preferably consist of flexible strips, e. g. of spring steel or sheet iron, fixed to the said pontoons at about the longitudinal center line of the bottom thereof and extending inwardly and downwardly forming a low angle with the horizontal. In the example illustrated, these inwardly and downwardly inclined planes are disposed approximately at an angle of 20° to the horizontal and while this angle may be varied to some extent, it must be less than 45° in order to achieve the desired upward thrust when the boat is advancing through the water. Due to the fact that their normals incline in the said manner the effect shown in Fig. 4 is obtained, viz. that their upper side is maintained dry at straight course and a high speed, which to a great extent

contributes to reducing the friction relatively to the water, while the inward inclination of the normals causes the effect shown in Fig. 5 viz. that when the boat through the centrifugal force (the arrow 18) when turning tends to skid on the water, the inner pontoon 1 is pressed down into the water and the outer pontoon 2 is pressed upwardly. The arrows 19, 20 show the pressure of the water against the upper side of the plane 3, and against the lower side of the plane 4 respectively, while the arrows 21, 22 show the underpressure on the underside of the plane 3. The arrow 23 represents the impulsive force of the water against the edge 24 of the pontoon, the said force reducing the movement of the boat in the lateral direction. Due to the edge 25 the water does not contact the side of the inner pontoon 1 whereby the friction and thus also the reduction of the speed when turning are diminished. The fins 7b contribute to the stability when turning.

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

1. A boat comprising a pair of pontoons in spaced relation and an intermediate connecting wing member having the profile of an airplane wing extending across and rigidly connected to the pontoons, said wing member being adapted substantially to sustain the weight of the boat when the latter is traveling forward at high speed, the connections between the wing member and the pontoons being such that no lateral air passages are provided between the under surface of the wing and the pontoons, a longitudinally extending inwardly and downwardly inclined fin secured to the under surface of each of said pontoons, the planes of said fins forming a low angle with the horizontal whereby said fins sustain a portion of the weight of the boat and give lateral stability when the boat is traveling forward and upon the taking of turns exert a downward force on the pontoon closer to the center of turning and a lifting force on the other pontoon.

2. A boat as claimed in claim 1, in which the centre of gravity of the boat is located at a short distance forwardly of the pressure centre of the air on the intermediate wing member and at a greater distance behind the pressure centre of the water on the said fins.

3. A boat as claimed in claim 1 in which the centre of gravity of the boat is located at a short distance forwardly of the pressure centre of the air on the intermediate member and at a greater distance behind the pressure centre of the water on the said fins the ratio between the said two distances is not greater than 1:10.

4. A boat as claimed in claim 1, in which the centre of gravity of the boat is located approximately in the vertical line through the pressure centre of the air on the intermediate member but behind the pressure centre of the water on the said fins.

5. A boat as claimed in claim 1, in which each of the fins is inclined so that its normal is directed inwardly and backwardly.

6. A boat as claimed in claim 1, in which the fins are provided under the forward portion only of the pontoons, the said forward portion of the pontoons terminating rearwardly in a transverse step located forward of the centre of gravity of the boat whereby at high speed no portion of the boat rearwardly of the step will contact the water.

IVAN TROËNG.

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