

June 16, 1964

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3,137,262

AIR-LIFT BOAT

Filed Sept. 30, 1960

2 Sheets-Sheet 1

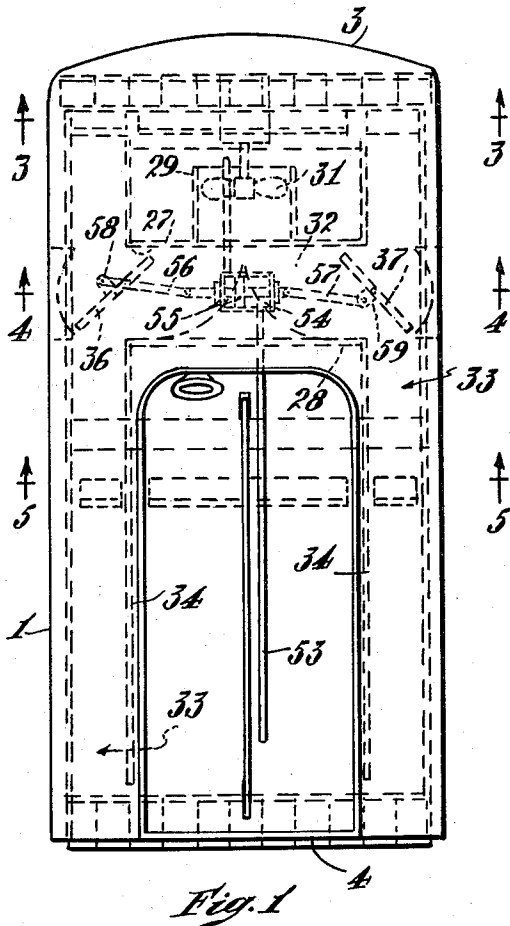


Fig. 1

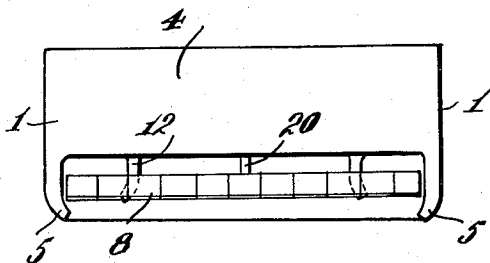


Fig. 2

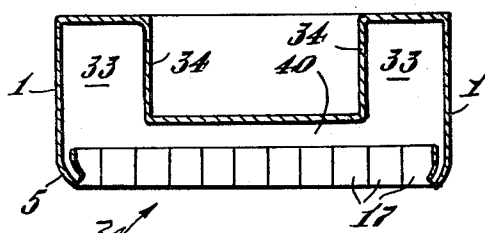


Fig. 3

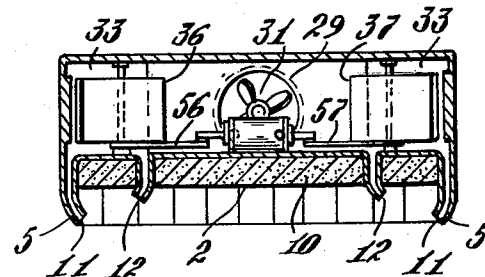


Fig. 4

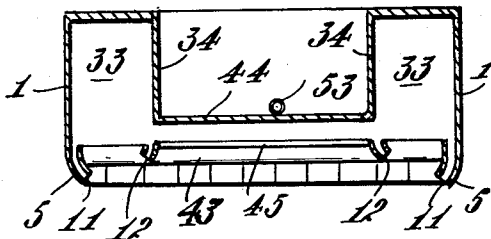


Fig. 5

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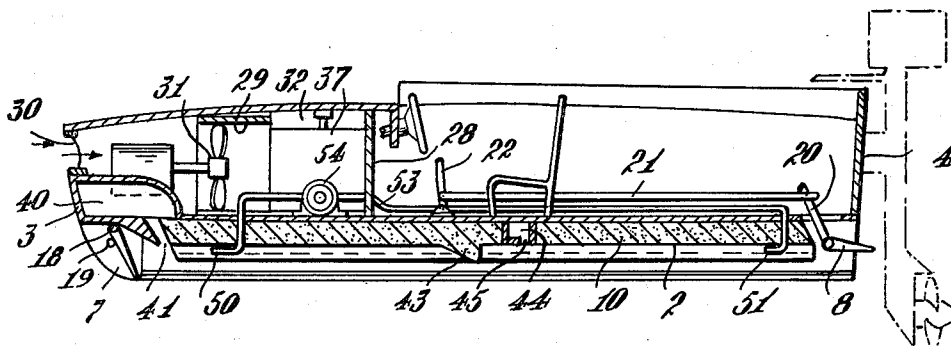


Fig. 6

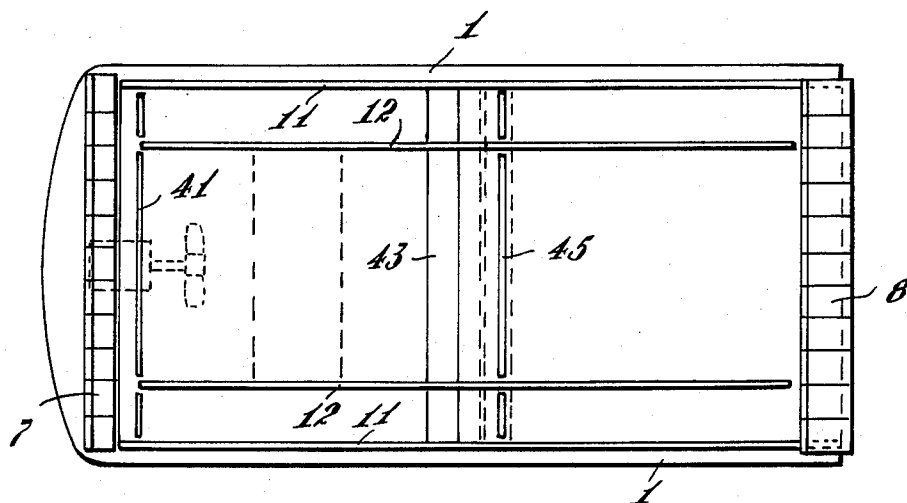


Fig. 7

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3,137,262

AIR-LIFT BOAT

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Filed Sept. 30, 1960, Ser. No. 59,560

5 Claims. (Cl. 114—67)

This invention relates to the hull construction of a boat or other vehicle and more particularly to a means for reducing the surface drag of water against a boat's hull. One attempt to eliminate this drag has been to cause the greater part of the boat's weight to be supported by air pressure in the form of an air cushion contained beneath the hull. However prior attempts at this form of construction have met with difficulty in making the boat stable and in containing the air cushion without unduly hampering the boat's normal operation. This problem with stability is that, as one portion of a boat supported on an air cushion is depressed, no more water is displaced under the depressed portion than elsewhere and thus no restoring force is produced.

Accordingly objects of the present invention are to provide a boat or other vehicle which has minimum friction with the underlying water or other medium, which is automatically stabilized against roll and pitch, which is simple and economical in construction and which is durable and reliable in use.

In one aspect the invention contemplates a hull having sides and a bottom, fins projecting downwardly along opposite sides of said hull to form an air space therebetween, means substantially bridging said fins to close the ends of said space, said bottom having an elongate slot extending lengthwise of the hull inboard of each of said fins, the mouth of each slot being disposed above the level of the lower edges of said fins and aimed laterally outward toward the corresponding fin, and means for projecting a curtain of air through each of said slots.

In the preferred embodiment the aforementioned air space is divided into sections by partition means and the vehicle comprises means responsive to the attitude of said hull for regulating the flow of air into each section relative to the flow into the other sections.

A more complete understanding of the present invention may be obtained from the following detailed description of the preferred embodiment shown in the accompanying drawings in which

FIG. 1 is a plan view of an air-lift boat according to the present invention;

FIG. 2 is a rear elevation of the boat of FIG. 1;

FIG. 3 is a section on the line 3—3 of FIG. 1;

FIG. 4 is a section on the line 4—4 of FIG. 1;

FIG. 5 is a section on the line 5—5 of FIG. 1;

FIG. 6 is a broken away side elevation of the boat of FIG. 1; and

FIG. 7 is a bottom view of the boat of FIG. 1.

Referring now to the drawings, the boat has a hull including sides 1, bottom 2, bow 3, and stern 4. In the preferred embodiment the bottom 2 comprises a thick layer of a highly buoyant substance 10 such as a closed cell plastic which renders the boat substantially unsinkable.

Fins 5 depend from each side of the hull and extend

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along its entire length thereby defining an air space beneath the hull. The ends of this air space are closed by pivoted vanes 7 and 8 which depend from the bow 3 and the stern 4 respectively. The forward vane is segmented and each segment 17 is freely pivoted at its upper edge 18 so that the vane as a whole may tend to conform itself to the surface of the water over which the boat passes. A stop 19 is provided to limit the forward travel of the segments 17 and the air pressure beneath the boat tends to keep the segments in their most forward position. The rear vane 8 is connected by the crank 20 and the rod 21 to a lever 22 within the cockpit so that its attitude may be adjusted while the boat is running.

The sides 1 of the hull and the panels 34 define ducts 33 extending along each side of the hull for its entire length. A blower 31 is open to the atmosphere through the intake 30 and is directed by the tubular duct 29 into the cross duct 32 defined by the panels 28 and 27.

This cross duct 32 connects at either end with one of the side ducts 33 and damper valves 36 and 37 at each of these intersections determine the relative amounts of air passing to the bow and stern parts of each of the side ducts.

The fins 5 may be hollow, connect with the side ducts 33 as shown in FIG. 5, and terminate in an inwardly directed outlet 11. A set of slots 12 directed laterally outward depend from the bottom of the hull at points beneath the inner wall 34 of each of the side ducts 33, the mouth of each of these slots being disposed above the level of the lower edges of the fins 5.

A bow cross-duct 40 connects the two side ducts 33 at a point just aft of the segmented bow vane 7 and vent 41 extending through the bottom 2 of the boat connects this bow cross-duct 40 with the air space beneath the hull. Approximately midway between the bow and the stern a partition 43 depends from the bottom 2 of the hull dividing the air space between two sections. A second cross-duct 44 connects the side ducts 33 just aft of this partition 43 and is also open to the air space through a vent 45. Scoops 50 and 51 depend from the bottom of the boat at points near the bow 3 and stern 4 respectively. These scoops are connected by tubing 53, each to one side of a double-acting hydraulic cylinder 54. The piston 55 of the hydraulic cylinder 54 is connected by rods 56 and 57 and cranks 58 and 59 to the damper valves 36 and 37.

When the blower 31 is started air is forced under the hull through the slots 12, the outlet 11, and the vents 41 and 45, lifting the boat and forming an air cushion in the space between the fins 5. As the outlet 11 at the sides of the boat are inwardly directed, they cause an air curtain to be formed which will tend to contain the air cushion beneath the hull even if a fin 5 is momentarily pulled completely clear of the water as by a wave striking the boat.

In order to maintain stability even though the sides 1 or outlet 11 are submerged the preferred embodiment has a set of elongate slots 12 running parallel to the sides of the boat and directed laterally outward. Normally these slots lie close to the bottom 2 of the hull so that they will remain clear of the surface of the water while the boat is running and thus reduce drag. These slots 12 provide a second air curtain which tends to maintain

zones of higher pressure along the sides between the slots 12 and the fins 5. As each narrow slot 12 is supplied with air through its own separate side duct 33, which duct is of large capacity as compared with the air needed by the slot, the amount of air passing through each slot is, at any given moment, largely unaffected by the amount of air taken by the other slot and thus the zones of higher pressure are for the most part independently supplied with air and tend to make the boat stable because the effectiveness of the air curtain is increased as the air jet nears the surface of the water. Thus as one side is depressed the zone on that side increases in pressure creating a correcting force. Conversely, the zone on the opposite side tends to spill some of its contained air into the space under the center of the boat thus aiding the righting action.

It has been found for a boat 16 feet long and 8 feet wide having side fins terminating in $\frac{1}{2}$ inch outlets directed inwardly at 39° from the vertical and opening 5 inches below the bottom and having outwardly directed $\frac{1}{4}$ inch slots depending from the bottom and running parallel to the sides at a distance of 18 inches therefrom, each of said slots and outlets communicating with a source of air under a pressure of approximately 5 inches (water gauge), that when one side of the boat is depressed 2 inches there is a pressure increase in the zone between the opposed slots of one inch (water gauge) developing a lifting force on that side of 120 lbs.

In order to obtain fore-aft stability the preferred embodiment incorporates an automatic device for controlling the relative quantity of air supplied to the bow and the stern sections of the air space. Two scoops 50 and 51 provide the sensing for this device. When the boat is under way and is on a level keel both scoops are out of the water. As the boat pitches one or the other scoop comes into contact with the surface of the water creating a hydraulic pressure which is transmitted by tubing 53 to one side of the piston 55 of a double acting hydraulic cylinder 54. If the boat is proceeding at 15 miles per hour the scoop will produce a hydraulic force of approximately 5 pounds per square inch. Higher speeds will produce correspondingly higher pressures and the area appropriate for the piston 55 may be calculated accordingly. The cylinder, acting through the rods 56 and 57 and the cranks 58 and 59 moves the damper valves 36 and 37 which regulate the quantity of air going to the part of the boat affected in such manner as to correct the pitching condition. The cranks 58 and 59 and the rods 56 and 57 are connected in a non-symmetrical fashion so that the pneumatic forces created by the movement of the damper valves on either side will be aiding. The partition 43 extending from side to side and depending from the bottom at a point approximately midships allows a pressure differential to be maintained between bow and stern and prevents such a rush of air from one end to the other as would nullify the balancing action. Although the supply of air to the slots 12 and the outlets 11 is also subject to regulation by the damper valves 36 and 37 the major sources of air for this dynamic balancing are the bow and midships cross-vents 41 and 45 respectively.

Obviously, it would also be possible to employ a very similar device to achieve lateral stability. In such a case scoops would be placed at points on opposite sides of the hull and an additional fin would be run down the middle of the hull so as to split the air cushion into two independent sections.

In the preferred embodiment the front vane 7 for containing the air cushion is segmented so that individual segments 17 may yield to the impacts of waves without causing a general escape of air pressure. These flap segments 17 are freely suspended from their upper edges with a stop 19 to limit their forward travel. The contained air pressure prevents the flaps from swinging too far to the rear. As an alternative construction the front flap may be constructed of a semi-pliable material such as

plastic. The stern vane 8 is arranged so that its attitude may be set by a lever 22 within the cockpit of the boat. This lever may then be set according to the blower capacity and the speed desired. At higher speeds the capacity of the blower is greatly increased by the ram effect of the boat moving through the air and thus the rear vane 8 may be opened entirely, so as to clear the water, further reducing the water drag.

It should be understood that this disclosure is for the purpose of illustration only and that the present invention includes all modifications and equivalents falling within the scope of the appended claims.

We claim:

1. A vehicle comprising a hull having sides and a bottom, fins projecting downwardly along opposite sides of said bottom to form an air space therebetween, each of said fins being hollow and terminating in an inwardly directed outlet, means substantially bridging said fins to close the ends of said space, said bottom having an outwardly directed elongate slot extending lengthwise of the hull inboard of each of said fins, the mouth of each said elongate slot being disposed above the level of the lower edges of said fins, and means projecting a curtain of air through each of said slots and through each of said outlets.
2. A vehicle comprising a hull having sides and a bottom, fins projecting downwardly along each side of said bottom to form an air space therebetween, said fins being hollow and terminating in inwardly directed outlets, said bottom having an outwardly directed elongate slot extending lengthwise of the hull inboard of each of said fins, the mouth of each said outwardly directed slot being disposed above the level of the lower edges of said fins, means for projecting a curtain of air through each of said outlets and slots, means substantially bridging said fins to close the ends of said space, partition means substantially bridging said fins for dividing said space into a bow section and a stern section, and means responsive to the attitude of the hull for regulating the flow of air to each section relative to the other section.
3. A vehicle comprising a hull having a bottom, means projecting downwardly from the bottom around its periphery to form an air space, a partition dividing said air space into sections, means for forcing air under pressure into each of said sections, forwardly directed scoops projecting below said bottom in each of said sections, and means responsive to the flow of water through said scoops for controlling the supply of air to each section relative to the other section thereby to maintain the hull on an even keel.
4. A vehicle comprising a hull having sides and a bottom, fins projecting downwardly along opposite sides of said bottom to form an air space therebetween, means substantially bridging said fins to close the ends of said space, said bottom having an elongate slot extending lengthwise of the hull inboard of each of said fins, and means for projecting a curtain of air through each of said slots, said slots being arranged with the mouth of each slot being disposed above the level of the lower edges of said fins and adjacent the plane in which a supporting surface will lie and being oriented so that the curtain of air projected therethrough sweeps laterally outwardly over the supporting surface thereby to create a pressure gradient within the air space and maintain independent zones of higher pressure between each slot and the corresponding fin.
5. A vehicle comprising a hull including sides and a bottom, means for maintaining an air cushion beneath said hull, and air jet means on said bottom for directing laterally sweeping air jets relative to the plane in which a supporting surface will lie in such a manner as to create pressure gradients within said air cushion, said air jet means arranged so as to define substantially independent zones of higher air pressure beneath various sections of

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said hull, the pressure within each of said zones depending upon the proximity of the corresponding portions of said air jet means to the supporting surface.

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