Sept. 5, 1961 J. W. LIGHT 2,998,791

CONTROL APPARATUS FOR WATER CRAFT

Filed Nov. 24, 1958

FIG-1

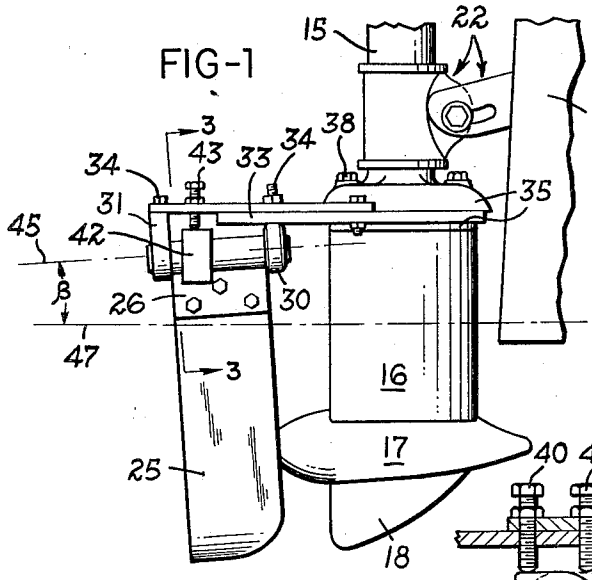


FIG-2

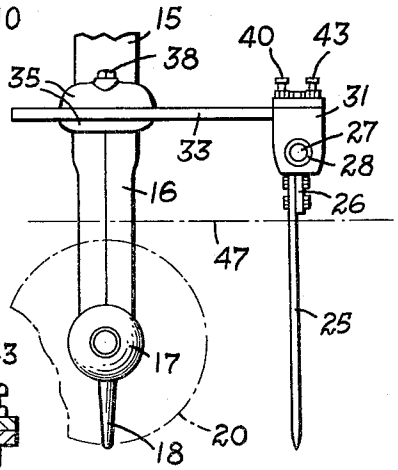


FIG-3

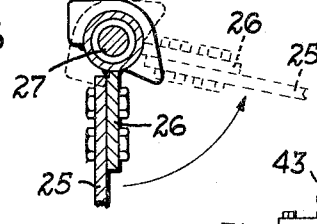


FIG-4

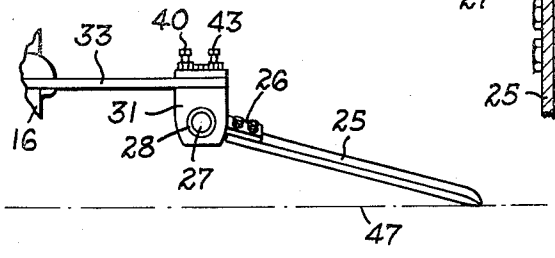


FIG-5

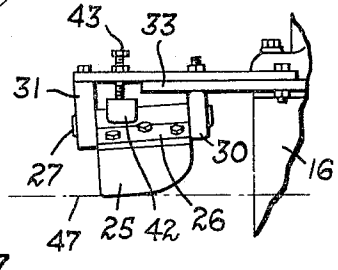


FIG-6

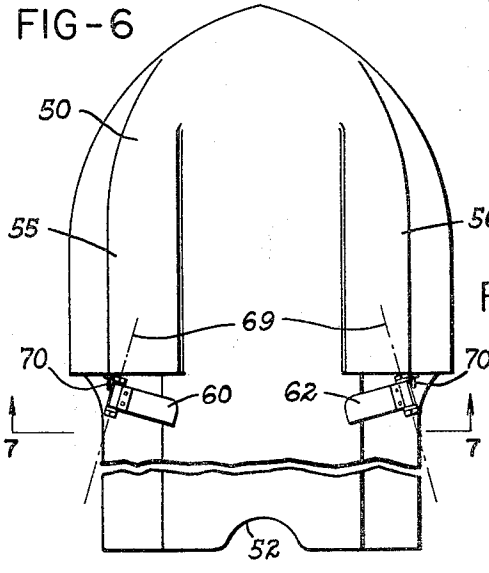


FIG-7

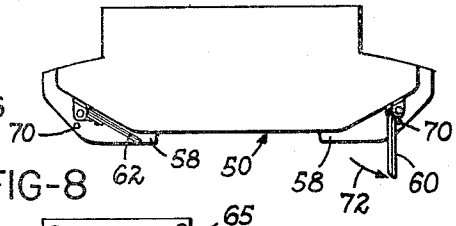
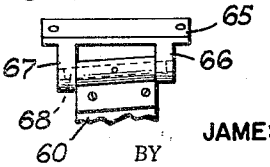


FIG-8



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CONTROL APPARATUS FOR WATER CRAFT

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This invention relates to apparatus for reducing the appendage drag of high speed water craft while at the same time improving the control thereof.

As will be seen from the following description, the present invention is directed primarily to use with high speed water craft such as racing hydroplanes. The hull of such a craft is substantially airborne when operating at high speeds, with only a minor portion of the hull surface, if any, planing over the water. In water craft of this type it is generally desirable to have little or no keel or other control appendages in the water so as to reduce drag in straight running. However, the limit to which the appendage area can be reduced must be consonant with proper control, since too little appendage area may result in a craft which is difficult to control, especially through turns.

The drag of a planing surface at or above its critical speed, or speed necessary to maintain the planing attitude, is generally speaking, not related to its velocity but to the weight of the craft. Therefore, above planing velocity the horsepower required for a given velocity tends to increase proportionately to the weight of the craft. The control appendages, however, remain substantially submerged and the appendage drag increases as the square of the velocity. The horsepower required to overcome the appendage drag increase as the cube of the velocity.

The same theories apply generally, with certain allowances, to water craft of different sizes, displacement, and power, and accordingly it is to be understood that the present invention is not limited to use with racing hydroplanes or the like, since the present control apparatus may be useful in other types of water craft which tend to plane at higher speeds.

Therefore, the primary object of this invention is to provide improved control apparatus for powered water craft which will reduce appendage drag in straight running but will provide adequate control appendage while maneuvering, as in negotiating turns.

Another object of the invention is to provide control apparatus for powered water craft including a hinged plate-like member supported to plane with most of its surface above the water surface during straight forward running of the craft, and to move into a depending position relative to the craft during turns to provide additional area effective for resisting lateral skidding movement of the craft.

A further object of this invention is to provide such apparatus which is completely automatic in its operation and thus requires no attention from the driver of the craft.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and the appended claims.

In the drawings—

FIG. 1 is a side elevational view of the control apparatus provided by the invention;

FIG. 2 is an elevational view looking from the rear or left hand side of the apparatus shown in FIG. 1;

FIG. 3 is a section taken along line 3—3 in FIG. 1, showing in dotted lines the planing position of the control plate;

FIG. 4 is a view similar to FIG. 2 showing the control plate and its planing position;

FIG. 5 is a view similar to FIG. 1 with the plate in its planing position;

FIG. 6 is a bottom view of a three-point suspension type hull incorporating the present invention;

FIG. 7 is a diagrammatic sectional view taken along the line 7—7 of FIG. 6; and

FIG. 8 is a detail view of the mounting for the control plates in FIGS. 6 and 7.

The apparatus shown in FIGS. 1–5 has been illustrated for use in controlling the craft during left turns only. This has been done both for purposes of simplification of the drawings and also to indicate how the invention may be applied to racing hydroplanes which normally are run at high speed about a closed course requiring only left turns. It will be obvious, however, that the apparatus shown in these figures may be duplicated for the purpose of resisting skidding during turns to the right.

Accordingly, referring to the drawings, particularly to FIGS. 1 and 2, the water craft includts a hull 10 which may be of any suitable shape, and which in most high speed craft includes a relatively flat bottom without a keel, so that the hull will plane on the water surface at high speed with a minimum of resistance to forward movement. For purposes of explanation, the hull 10 will be described as driven by a suitable outboard motor (not shown) including a generally vertically extending drive shaft housing 15 which has secured to its lower end a streamlined lower housing member 16 including a suitable streamlined housing 17 for the propeller shaft and associated gears and bearings (not shown), and a small protective skeg or keel-like member 18 depending from its bottom. The propeller, indicated schematically at 20, is mounted on the propeller shaft in the usual manner. All of this mechanism is supported in a well known manner upon a suitable swivel mounting, parts of which are indicated at 22, to rotate about a generally vertical axis at the stern, providing a steering control member for the craft, and in this case, also providing driving power.

The apparatus provided by this invention includes a plate-like member 25 which is secured at one of its ends to a hinge member 26 supported on a shaft 27, and opposite ends of this shaft are journaled in bearings 28 which are housed within suitable supporting blocks 30, at the forward end, and 31 at the rear. These blocks are secured to the underside of a supporting plate 33 as by suitable bolts 34, and the plate 33 is in turn secured between the connected flanges 35, at the lower end of shaft housing 15, and the upper end of housing member 16, these members being joined by suitable bolts 38.

The member 25 can swing on shaft 27 between an upper or planing position (FIGS. 4 and 5) and a depending control position shown in FIGS. 1 and 2. A stop is provided for establishing this depending position, and is shown as an adjustable bolt 40 extending through plate 33, and having its lower end adapted to contact one side of an abutment member 42 which is fixed to hinge member 26 as shown in FIG. 3. The planing position, shown in dotted lines in FIG. 3, is defined by adjustable stop bolt 43 which can contact the other side of abutment member 42, preventing bouncing of the plate member when planing. Obviously, other suitable stop arrangements can be used if desired.

One of the purposes of the invention is to have certain control appendages raised to a position substantially out of the water during straight forward movement. As one example of a construction which will accomplish this purpose, the drawings show the hinge axis 45 defined by the bearings 28 as inclined with respect to the mounting plate 33, by reason of the greater length of the rear bearing block 31 with respect to forward block 30, and the location of mounting plate 33 as above the "working water line" 47. It will be understood, that the "working water line" is not the water line of the craft at rest, but rather it is the water line of the craft when running at relatively

high speed, when the hull is in its planing attitude. At such time, the majority of the undersurface of the hull will be airborne or above the water surface, with the craft planing on only a very small portion of the hull surface, or even for short periods of time, in the case of some high speed craft, with the hull entirely airborne and only the lower portion of the lower housing being submerged. However, then the hinge axis 45 of plate member 25 extends downwardly and rearwardly with respect to the "working" water line 47, and the hinged mounting of member 25 is substantially above the water surface when the craft is planing. The inclination of the hinge axis, as indicated by the angle β, may vary with different designs. When using the present invention on a racing outboard hydroplane, the apparatus was found to operate suitably with this angle in the order of approximately 3°.

It will be apparent that when the craft is planing at high speed, the member 25, being so mounted, will also plane, due to its downward and rearward inclination. Thus this member will automatically position itself with its outer rear corner approximately at the water surface and will offer substantially no resistance to the forward movement of the craft, thereby reducing its appendage drag to little or no value. As the craft is guided into a turn, in the illustrated example a left turn, by swiveling the lower housing 16 in well known manner, it may tend to dip or heel to the outside under the effect of centrifugal force, and the stern will commence to skid in a lateral direction, since at planing speeds there is very little displacement and thus substantially no effective side area to react with the water and resist such skidding movement. The only effectively submerged parts at this time are the skeg 18 and associated parts below the working water line.

With the present invention, however, as the craft is maneuvered into a turn and starts to skid outwardly, the upper surface of member 25 is thrust under water and reacts to cause the member to swing downwardly into the position shown in FIGS. 1 and 2 where the abutment member 42 engages stop bolt 40. So long as the craft tends to skid sideways the plate member 25 will remain in this position and tend to resist lateral skidding of the stern, and hold the craft on course. The result, then, is to increase the effective area of the control surfaces in negotiating turns.

FIGS. 6–8 illustrate the application of the present invention to another type of hull which is generally referred to as a "three point" hull, used on some types of high speed water craft. Such a hull may include a relatively flat bottom 50 at the stern of which there may be a cut-away portion 52 adapted to receive an outboard motor (not shown). In the case of an inboard craft the propeller would be located in this general area. A pair of pontoon members 55 and 56 depend from the side undersurface of hull 50, being faired into the prow of the hull and providing steps 58 rearwardly of the prow. When such a craft is planing, the surfaces of pontoons 55 and 56, as well as the stern of the hull, may be in contact with the water, and for this reason the hull is referred to as a "three point" suspension.

In applying the present invention to such a craft, right and left control plates 60 and 62 are hinged to the hull at a position just rearward of the steps 58. A suitable hinge mounting is shown in FIG. 8, wherein the bracket 65 may include a forward bearing member 66 and a longer rearward bearing member 67 between which the control plates are suspended on a hinge pin 68. The mounting brackets are mounted adjacent the sides of the hull in a position such that when the craft is in its planing attitude the bracket members and hinge mountings are located adjacent or above the "working water line," and thus offer no appendage drag.

It will be noted that the hinge axes 69 of these plates extend at a slight angle forwardly and inwardly such that they would converge adjacent or beyond the prow of the hull. This "toe-in" arrangement, which is exaggerated for purposes of illustration in FIG. 6, provides for a reaction component with the water tending to cause the plate to raise unless a sufficient side force, as in a turn, is exerted against the plates to move them to their depending control position. This arrangement is preferable since it substantially avoids the possibility of both plates being dependent for a time during rapid turning maneuvers or the like, assuring that during any substantial straight forward movement of the hull the plates will be urged to their raised position.

The length of control plates 60 and 62 is such that they extend just beyond the lower surface of pontoons 55 and 56, and thus the rearward corners of the plates engage the water surface, in substantially the same manner as above described, and the control plates are caused to plane over the water surface when the craft is moving straight forward without dragging through the water when the craft is in its normal planing position. In this position the undersurface of the hull in the area of the chine acts as an upper stop or limit for the control plates, as illustrated in FIG. 7 with reference to the left control plate 62, and thus substantially the entire surface of the control plate is above the water surface, reducing the appendage drag to a negligible value, since the plate is in effect planing.

Suitable stops are provided to define the depending positions of the control plates when they are operating during turning maneuvers. One example of such stops is shown in FIGS. 6 and 7 as pins 70 projecting rearwardly from the back surface of the pontoons 55 and 56 to engage the plates and define the depending or controlling position thereof, as illustrated with reference to the right hand plate 60 in FIG. 7.

Thus, referring to FIG. 7, when the craft is maneuvered through a turn, in the illustrated example a turn to the right, the side motion or skidding of the hull results in a force against control plate 60, as indicated by arrow 72, which causes that plate to swing into its vertical or control position and to remain in that position so long as such side force during turns to the right, but when the craft again proceeds in a straight forward direction the plate 60 will swing to its upper or planing position, reducing its drag to that of a planing surface rather than an appendage. It will be obvious that the control plate 62 operates in a similar fashion during turns to the left.

Of course, different types of mountings or constructions may be employed for causing the control plates to swing to their raised or planing position during straight forward movement. For example, the downwardly and rearwardly inclined hinge axis may be used as illustrated, with or without "toe-in" of the hinge axis, or the outer trailing or leading edge of the control plates might be curved appropriately while employing a non-inclined straight forward directed hinge axis. Likewise, many variations of stop apparatus may be used to define the upper and lower limits of the control plates.

Therefore, while the forms of apparatus herein described constitutes preferred embodiments of the invention, it is to be understood that the invention is not to be limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In combination with a relatively high speed water craft adapted to assume a planing attitude in traveling over the water surface, a control appendage member automatically retractable to a non-submerged position during straight forward running of the craft and automatically movable to a depending essentially submerged control position during maneuvers, said control member including a control plate, hinged mounting means attached to one end of said plate, means securing said mounting means to said craft, said control plate extending from said mounting means in freely swinging relation thereto and being supported to react with the water sur-

face and rise to a planing position during straight forward movement of said craft reducing the drag of said plate to that of a planing member, said control plate being operable during turning maneuvers of said craft to react with the water in response to sideward motion of said craft to swing to a position depending from said mounting means into the water providing an increase in submerged control appendage area resisting such sideward motion during such maneuvers, and means limiting the movement of said plate in its depending position to form an effective appendage from said craft providing resistance to lateral skidding thereof.

2. In combination with a relatively high speed water craft adapted to assume a planing attitude in traveling over the water surface, a control appendage member automatically retractable to a non-submerged position during straight forward running of the craft and automatically movable to a depending essentially submerged control position during maneuvers, said control member including an essentially flat control plate, hinged mounting means attached to one end of said plate, means securing said mounting means to said craft, said control plate extending from said mounting means in freely swinging relation thereto and being supported to react with the water surface and rise to a planing position essentially above the water surface during straight forward movement of said craft reducing the drag of said plate to that of a planing member, said control plate being responsive to turning maneuvers of said craft to attain a position depending from said mounting means into the water providing an increase in submerged control appendage area during such maneuvers, and stop means defining said depending control position of said plate to form an effective appendage from said craft resisting skidding motion thereof during turning maneuvers.

3. In combination with a relatively high speed water craft adapted to assume a planing attitude in traveling over the water surface, a control appendage member capable of assuming a non-submerged position during straight forward running of the craft and movable to a depending essentially submerged control position during turning maneuvers, said control member including a control plate, hinged mounting means attached to one end of said plate, means securing said mounting means to said craft at a position located adjacent and above the water line when said craft is moving in its planing attitude, means supporting said control plate for reaction with the water to move to a planing position substantially out of the water during straight forward movement of said craft to reduce the drag of said plate to that of a planing member, means providing for swinging movement of said plate to a control position depending from said mounting means into the water in response to turning maneuvers of said craft for increasing the submerged control appendage area resisting skidding of said craft during such turning maneuvers, and stop means providing a lower limit to define said control position and an upper limit to minimize bouncing of said plate in its planing position.

4. In a relatively high speed water craft having a hull adapted to assume a planing attitude in traveling over the water surface, a steering control member supported to swing about a generally vertical axis adjacent the stern of said hull for controlling directional movement of said hull, a control appendage member assuming a non-submerged position during straight forward running of the craft and movable to a depending control position during turning maneuvers, said control member including a control plate, hinged mounting means attached to one end of said plate, means securing said mounting means to said steering control member at a position located above the water line when said craft is moving in its planing attitude, means for moving said control plate to a planing position substantially out of the water during straight forward movement of said craft to reduce the drag of said plate to that of a planing member, and means providing for swinging movement of said plate to a control position depending from said mounting means into the water in response to turning maneuvers of said craft for increasing the submerged control appendage area during such turning maneuvers.

5. In a relatively high speed water craft having a hull adapted to assume a planing attitude in traveling over the water surface, a steering control member supported to swing about a generally vertical axis adjacent the stern of said hull for controlling directional movement of said hull, a control appendage member assuming a non-submerged position during straight forward running of the craft and movable to a depending control position during turning maneuvers, said control member including a control plate, hinged mounting means attached to one end of said plate, means securing said mounting means to said steering control member at a position located above the water line when said craft is moving in its planing attitude, means supporting said control plate to react with the water and to move to a planing position substantially out of the water during straight forward movement of said craft to reduce the drag of said plate to that of a planing member, means providing for swinging movement of said plate to a control position depending from said mounting means into the water in response to turning maneuvers of said craft for increasing the submerged control appendage area during such turning maneuvers, and stop means providing a lower limit to define said control position and an upper limit to minimize bouncing of said plate in its planing position.

6. In combination with a relatively high speed water craft having a hull with depending pontoons at opposite sides of the forward section thereof and adapted to assume a planing attitude traveling over the water surface, control appendage members retractable from the water during straight forward running of the craft and movable to depending essentially submerged control positions during turning maneuvers, said control members each including a control plate, hinged mounting means attached to one end of each said plate, means securing said mounting means to opposite sides of said hull and at a position located adjacent the water line when said craft is moving in its planing attitude, means for moving said control plates to a planing position substantially out of the water during straight forward movement of said craft to reduce the drag of said plates to that of planing members, and means providing for swinging movement of said plates to control positions depending from said mounting means into the water in response to turning maneuvers of said craft for increasing the submerged control appendage area during such turning maneuvers, said control members being selectively movable into said control positions thereof such that during a turn in a given direction one of said control members will move to its control position and during a turn in the opposite direction the other control member will move to its control position.

7. In combination with a relatively high speed water craft having a hull with depending pontoons at opposite sides of the forward section thereof and adapted to assume a planing attitude traveling over the water surface, control appendage members retractable from the water during straight forward running of the craft and movable to depending essentially submerged control positions during turning maneuvers, said control members each including a control plate, hinged mounting means attached to one end of each said plate, means securing said mounting means to said hull aft of each of said pontoons and at a position located above the water line when said craft is moving in its planing attitude, means for moving said control plates to a planing position substantially out of the water during straight forward movement of said craft to reduce the drag of said plates to that of planing members, means providing for swinging movement of

said plates to control positions depending from said mounting means into the water in response to turning maneuvers of said craft for increasing the submerged control appendage area during such turning maneuvers, said control members being selectively movable into said control positions thereof such that during a turn in a given direction one of said control members will move to its control position and during a turn in the opposite direction the other control member will move to its control position, and stop means providing lower limits for each said control plate to define the control position thereof and upper limits for each said plate to minimize bouncing of the respective said plate in its planing position.

8. In combination with a relatively high speed water craft having a hull which tends to plane over the water surface and to deviate in a lateral direction with respect to the longitudinal axis of the craft under the influence of centrifugal force when said craft is guided to negotiate turns, a plate-like control member, hinge means attached to said member adjacent one edge thereof defining a hinge axis about which said member can rotate, means mounting said hinge means on said craft located above the water line when said hull is in its planing attitude and with said hinge axis located in a plane sloping rearwardly and downwardly, and stop means for said control member limiting movement thereof between an upper planing position extending laterally of said craft essentially above the water surface and a lower control position extending substantially vertically downwardly from said hinge axis to form an effective appendage from said hull resisting skidding motion thereof during turning maneuvers of said craft.

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