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3,517,632

BOAT SUSPENSION SYSTEM

Filed July 15, 1968

3 Sheets-Sheet 1

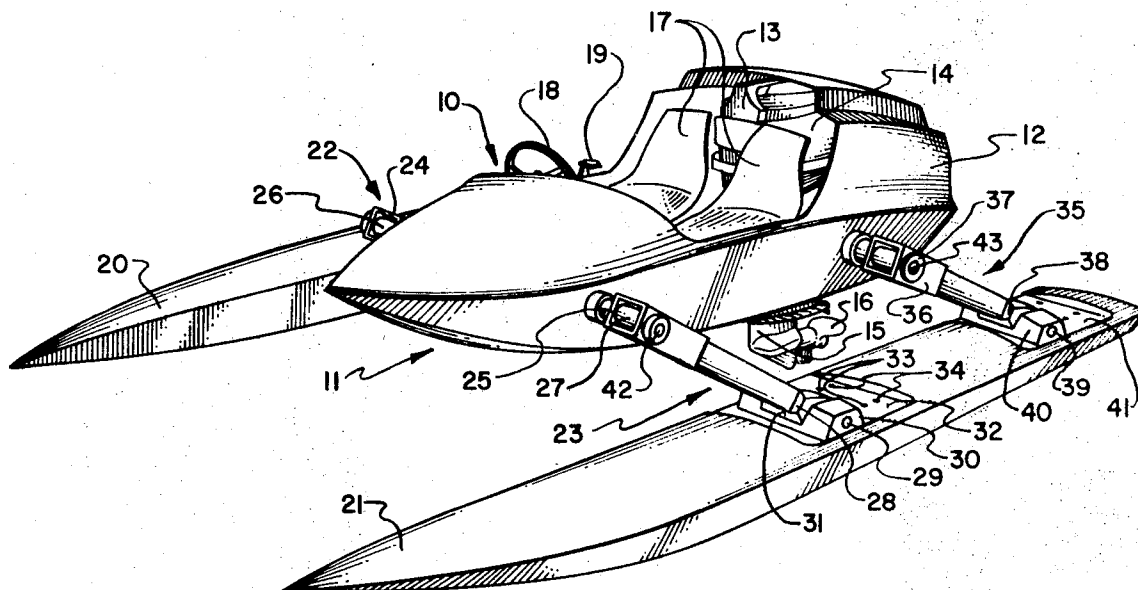


FIG. 1

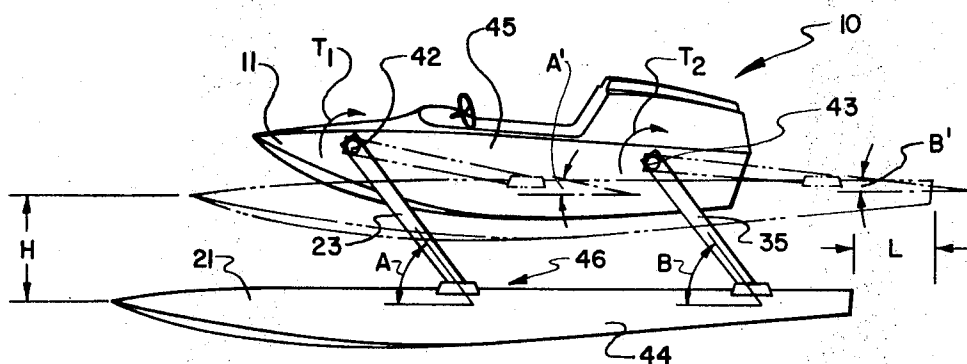


FIG. 2

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3 Sheets-Sheet 2

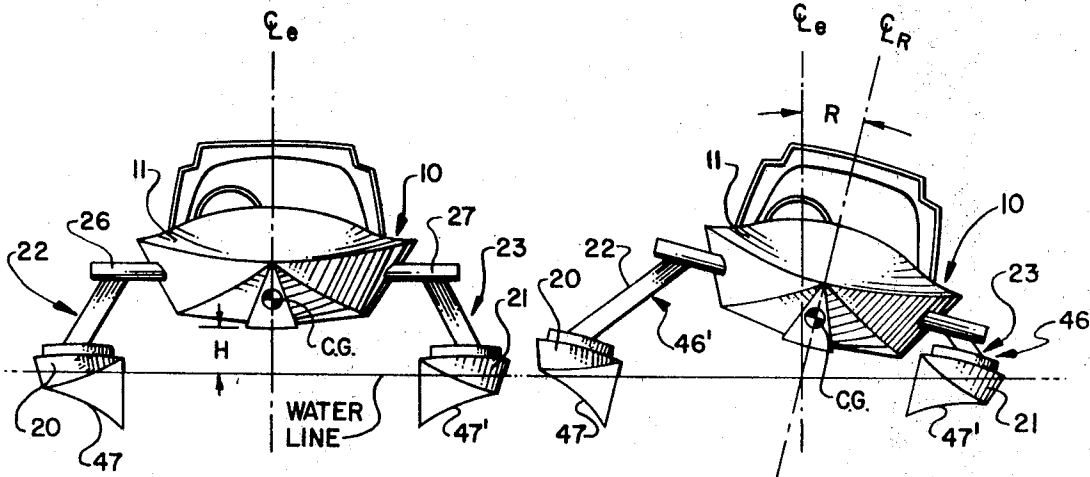


FIG. 3

FIG. 4

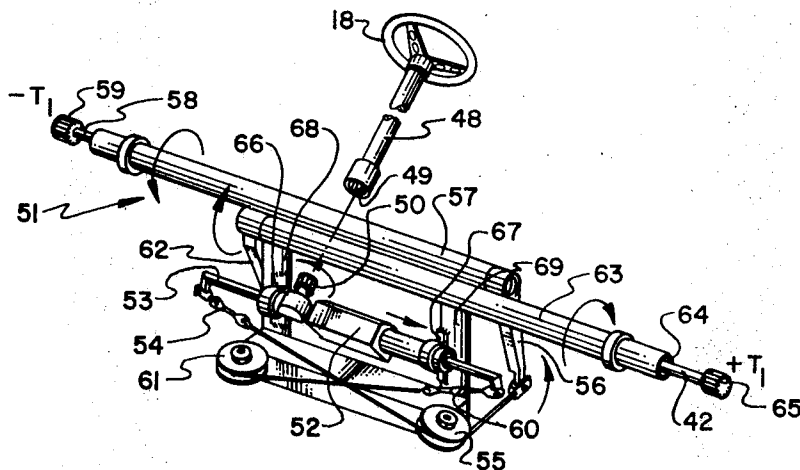


FIG. 5

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3 Sheets-Sheet 3

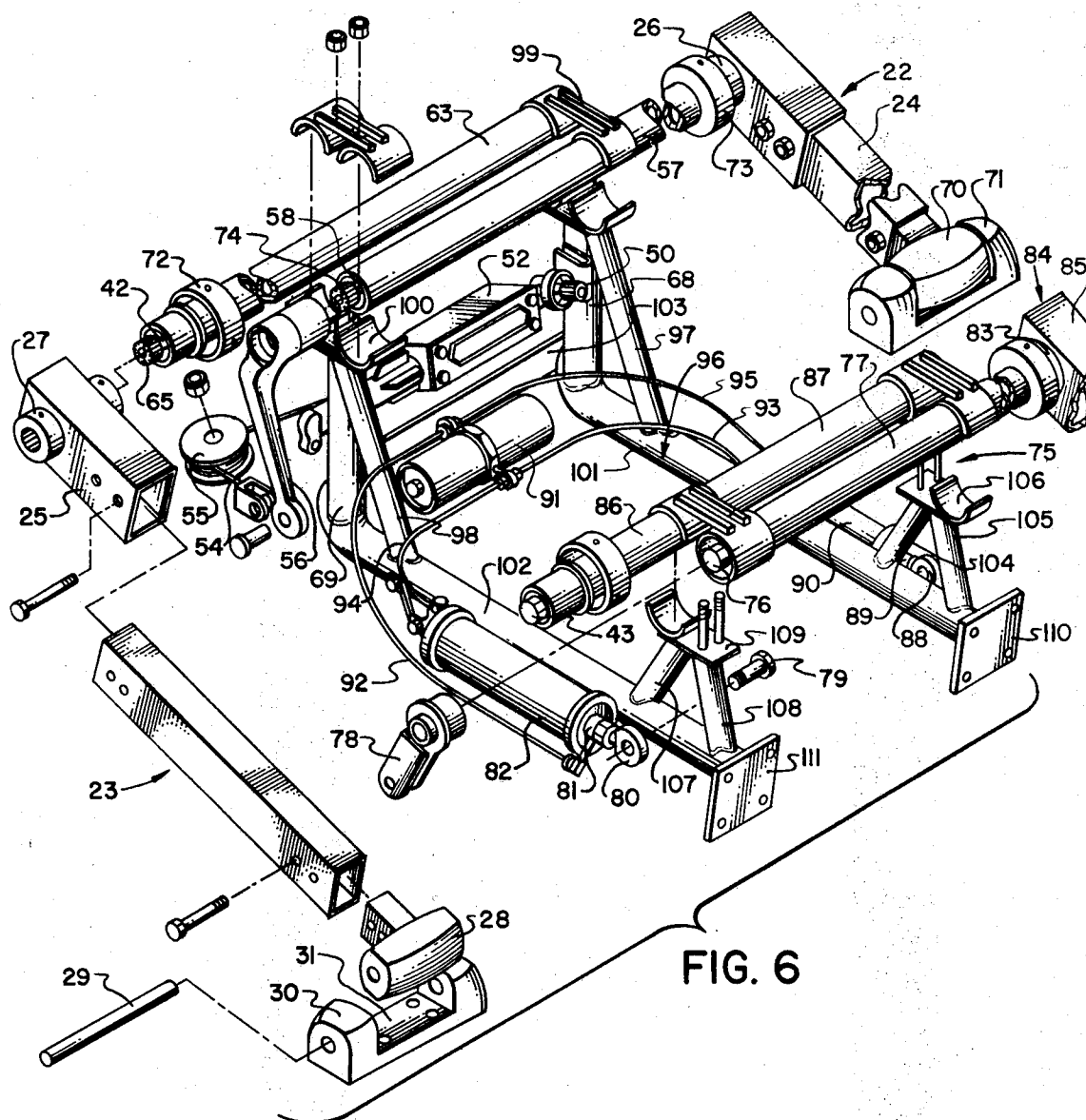


FIG. 6

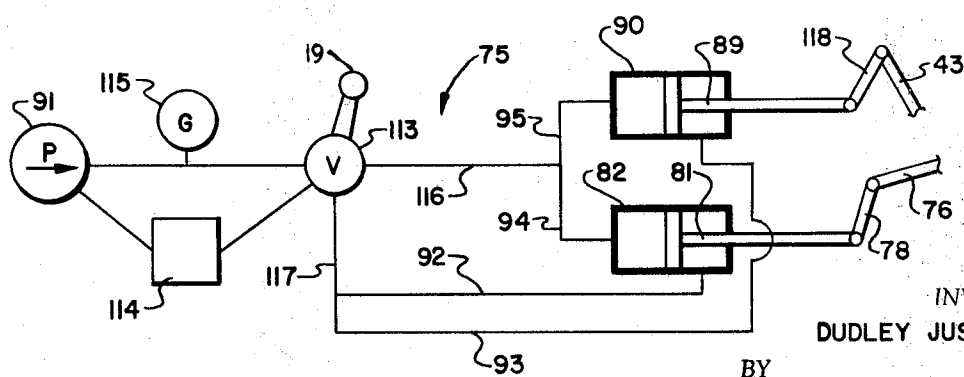


FIG. 7

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BOAT SUSPENSION SYSTEM
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U.S. Cl. 114-61

10 Claims

ABSTRACT OF THE DISCLOSURE

A suspension system for a speed boat hull has a pair of elongated laterally spaced pontoons aligned on opposing hull sides and a first pair of angularly adjustable arms that interconnect forward portions of the hull and pontoons. A second pair of angularly adjustable arms arranged in tandem with the first pair of arms interconnect rearward sections of the pontoons and the hull. When the hull is accelerated to planing speed, the rearward arms may be pivoted upwardly to raise the hull to a cruising attitude above the pontoons and water surface. With the hull in this position, one forward arm may be pivoted downwardly as the other is pivoted upwardly to tilt the hull in a direction in which the boat is sought to be turned.

This invention relates to a boat suspension system and more specifically to a suspension system for a speed boat hull capable of lifting the hull above the water and forcing the boat through turning maneuvers.

BACKGROUND OF THE INVENTION

The numerous presently operated conventional boats ordinarily suffer shortcomings from a comfort, safety, or, stability standpoint. One known approach seeking to minimize discomfort to boat occupants while increasing speed, as evidenced by U.S. Pat. 3,016,864 to Woodfield, is characterized by equipping a hull with a pair of laterally spaced stationary runners depending from opposing sides of the hull and a centrally aligned water ski or the like resiliently mounted between the runners and beneath the hull for engaging the water to generate a lifting force on the hull.

Frequently propulsion of a hull at even moderate planing speeds is sufficient to severely aggravate occupants when the hull is repetitively slapped by swells or rough spots of choppy water. The swells may be whipped up by moderate breezes or propagated by the wakes of other boats.

The well known catamaran incorporates a hull shaped to minimize discomfort and instability problems engendered under the above type of circumstances. The catamaran has two laterally spaced hulls bridged at their tops by a platform and separated by a tunnel which traps air when the catamaran is travelling at planing speed. The amount of area in contact with the water surface is considerably diminished as compared with conventional single hull crafts of similar capacity. Catamaran hulls inhibit lifting action and consequently plunge through swells and choppy waters and cushion the ride, rather than bouncing off water peaks. Another advantage of minimizing the water contact surface is that skin drag is diminished so that additional available horsepower can be used to push the boat faster. Although the catamaran dual hull arrangement makes the catamaran more stable on straight courses it has a relatively high center-of-gravity and therefore is more sensitive to excessive rolling during turning maneuvers. Inasmuch as the catamaran is relatively unstable during turning maneuvers, the catamaran design is generally not preferred when frequent turning maneuvers are anticipated.

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Another type of conventional boat known as a hydrofoil boat flies above the water surface so its path of motion is unhindered by rough water effects. A hydrofoil craft rides on foils or wings that travel beneath the water surface. Lift is provided by the dynamic force of the water acting on the foils or wings. While this arrangement generally succeeds in eliminating rough water effects, a significant amount of horsepower is required to constantly lift the hull and its load above the water surface.

As shall be fully explained, the speed boat suspension system of the present invention combines catamaran and hydrofoil boat features as well as important unique features to overcome many of the above outlined difficulties and allow a boat incorporating the suspension system to be smoothly propelled and liberated from the discomfort effects of shock and vibrations.

BRIEF SUMMARY OF THE INVENTION

Briefly stated, the present invention comprehends a suspension system for a speed boat hull arranged to raise the hull out of the water when the hull attains approximately planing speed. As the hull remains in this elevated attitude, the suspension system can be operated to effect turning of the boat by tilting the hull in a direction in which the boat is sought to be turned. A floating support structure preferably in the form of a pair of laterally spaced elongated pontoons positioned on opposing sides of the hull, is interconnected with the hull by lifting means arranged to lift the hull entirely out of the water. The lifting means may be characterized by a pair of pivot arms interconnecting opposing rearward hull portions with corresponding rearward pontoon portions. The pivot arms are coupled to a force applying means arranged to simultaneously urge the pivot arms between first inclined positions where the hull is resting on the water and second inclined positions steeper than the first inclined positions where the hull is raised out of the water and above the pontoons.

Conveniently mounted within the hull is steering means coupled to a force transmitting means which in turn is secured to a pair of rocker arms located forwardly of the pivot arms. The rocker arms interconnect forward hull and pontoon portions. Manipulation of the steering means causes the force transmitting means to simultaneously angularly adjust one rocker arm upwardly and the other downwardly to tilt the hull and shift its center-of-gravity in a direction in which the hull is sought to be turned.

One rocker arm and tandemly aligned pivot arm constitute a portion of a starboard four-bar linkage system and, similarly, the other rocker arm and tandemly aligned pivot arm constitute part of a port four-bar linkage system. The four-bar linkage systems, which are somewhat parallelogram shaped, are simultaneously expanded and collapsed by the force applying means as the hull is being lifted and lowered, respectively. However, when the hull is being turned, then the four-bar linkage system aligned with the direction in which the hull is sought to be turned is collapsed while the other linkage system, on the outside of the turn, is expanded.

In addition to being able to vertically adjust the hull and regulate turning maneuvers by selectively tilting the hull toward the turn direction, the speed boat suspension system of the present invention also serves as a shock absorber to smooth or dampen out oscillations generated by choppy or rough waters that otherwise could irritate the occupants.

BRIEF DESCRIPTION OF THE DRAWINGS

The numerous benefits and unique aspects of the present invention will be fully understood when the following detailed description is studied in conjunction with the drawings in which:

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FIG. 1 is a perspective view of a speed boat incorporating the suspension system of the present invention, showing the hull in an elevated position;

FIG. 2 is an elevational view of the boat port side, showing the hull in raised and lowered positions by the solid and phantom lines, respectively;

FIG. 3 is a front elevational view of the boat, showing its attitude when travelling in a straight path;

FIG. 4 is a view similar to that of FIG. 3, showing the hull tilted as the boat is negotiating a left turn;

FIG. 5 is a perspective view showing portions of the steering and tilting mechanism that cooperate in turning the boat;

FIG. 6 is a partially exploded fragmentary view, showing a central support frame for supporting portions of the tilting and lifting mechanisms; and,

FIG. 7 is a schematic diagram showing a hydraulic system for operating the lifting mechanism.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 a speed boat 10, somewhat resembling a trimaran, is shown having a hull 11 that includes a hood or shroud 12 at its aft portion. Hood 12 encloses an inboard-outboard motor assembly 13 that includes a conventional engine 14 from which depends a shaft casing that houses a long shaft (not shown) coupled to a propeller 16. Dual seats 17 are arranged inside hull 11, one of which accommodates the pilot or operator and is positioned adjacent a steering wheel 18 and a manually operated control handle 19 the purpose of which will be fully explained subsequently.

Hull 11 is shown raised out of the water above a starboard pontoon 20 and a port pontoon 21. The pontoons or positive floatation chambers are laterally spaced, symmetrically flank hull 11 and are longer than the bow to stern length of the hull 11. The pontoons may be fabricated from plywood and fibreglass layers and include longitudinally spaced bulkheads for rigidity.

Opposing forwardly disposed hull sections and forward sections of pontoons 20 and 21 are interconnected respectively by a pair of rocker arms 22 and 23. Rocker arms 22 and 23 are constructed from elongated hollow rectangular shafts 24 and 25 joined at their upper ends to laterally extending, internally splined bearings 26 and 27. Inasmuch as both rocker arms are structurally identical and behave similarly a description of only rocker arm 23 will suffice for a full understanding of both. Rocker arm 23 terminates at its base in an enlarged bearing block 28 formed transversely therethrough with a pivot opening. A pivot pin 29 extends through the pivot opening to couple block 28 to a yoke-shaped bracket 30 formed with a central recess 31 in which block 28 is oriented. Pivot bracket 30 is anchored to a flat mounting platform 32 formed with sets of tandemly aligned mounting holes such as sets 33 and 34. The sets of mounting holes permit pivot bracket 30 to be shifted to different locations in order to adjust rocker arm 23.

Aligned rearwardly of rocker arms 22 and 23 are pivot arms, only one pivot arm 35 of which is shown. The pivot arms interconnect oppositely disposed hull rearward sections with the rearward portions of corresponding underlying pontoons. Pivot arm 35 which is structurally similar to rocker arm 23 includes an elongated, hollow rectangular shaft 36 formed adjacent its top section with a transversely aligned splined bearing 37. Pivot arm 35 terminates at its base in an enlarged bearing block 38 formed with a pivot hole for permitting a pivot pin 39 to join block 38 with a pivot bracket 40. Pivot bracket 40 is anchored to a flat mounting platform 41 and may be shifted to different locations in order to adjust pivot arm 35. Splined bearings 27 and 37 receive externally splined torsion bars 42 and 43 whose important functions will be fully described.

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The phantom lines of FIG. 2 outline the positions of port pontoon 21, rocker arm 23 and pivot arm 35 as boat 10 accelerates from starting to planing speed. When hull 11 attains planing speed and begins to skim over the water surface, it is hoisted out of the water to an elevation above the pontoons. As shall be fully explained, approximately one-half of the lifting action on hull 11 is accomplished increasing the torque load T_2 on torsion bar 43 so that pivot arm 35 is urged upwardly. Pivot arm 35 is urged upwardly until the angle between its longitudinal axis and pontoon 21 is increased from angle B' to angle B.

Rocker arm 23, pivot arm 35, pontoon section 44 between the bases of rocker arm 23 and pivot arm 35, and, hull portion 45 between the tops of rocker arm 23 and pivot arm 35 constitute a four-bar linkage system 46. Because of this arrangement any motion of pivot arm 35 will influence the alignment of rocker arm 23. Therefore as the angle between pivot arm 35 and pontoon 21 is increased from angle B' to angle B the inclination between rocker arm 23 and pontoon 21 is simultaneously increased from angle A' to angle A. Since motion by rocker arm 23 and pivot arm 35 influence one another through four-bar linkage system 46, it can be seen that they cooperate in expanding or enlarging the parallelogram shaped linkage system 46 and raise hull 11. Conversely both arms also will close or collapse linkage system 46 to lower hull 11 toward the water level. As shall be explained, torque load T_2 is increased primarily to vertically adjust hull 11 to an optimum height H above the water which may be 12 to 18 inches and torque load T_1 is regulated to primarily tilt or roll hull 11 enabling boat 10 to negotiate turns. As hull 11 is raised to a maximum height H the pontoons are shifted forwardly by a length L.

FIG. 3 schematically depicts boat 10 cruising above planing speed with hull 11 erect and raised to its optimum height H above the water line. Rocker arms 22 and 23 are urged to assume identical relatively sharp slopes so that a vertical plane CL_e passing through the longitudinal axis or keel line of hull 11 will intersect the boat center-of-gravity CG. So long as hull 11 remains at this erect attitude, vertical plane CL_e will pass through the center-of-gravity and boat 10 will be prevented from turning. This assumes, of course, that the operator does not desire to use the conventional inboard-outboard motor assembly to negotiate turns in the usual manner. The bottom peripheries of pontoons 20 and 21 are shaped with concave or arced surfaces 47 and 47' respectively.

FIG. 4 shows the attitude of boat 10 when the operator is negotiating a left turn. In order to accomplish a swift, smooth left turn, the operator manipulates the steering mechanism to simultaneously urge rocker arms 22 and 23 upwardly and downwardly respectively. By increasing the distance between hull 11 and pontoon 21, hull 11 is forced to tilt or roll to the left through an angle R. Angle and vertical plane CL_e which would pass through the longitudinal center line of hull 11 in its rolled position and vertical plane CL_e which would pass through the longitudinal center line of hull 11 if it were restored to an erect position. The inward shifting of the center-of-gravity automatically forces boat 10 to experience a left turn by raising the right side and dropping the left side of hull 11. The pontoons are also forced to tilt inwardly. In addition to increasing the longitudinal bending strength of pontoon 20 concave surface 47 presents an effectively steeper angle to the water surface so that enhanced steering efficiency can be achieved.

During this turning maneuver, torque load is increased on rocker arm 22, decreased on torque arm 23 and remains unchanged on the rearwardly disposed pivot arms. In view of the previously explained interrelationship between the rocker arms and pivot arms, it can be seen that as the left turn is being negotiated the port four-bar linkage system 46 is collapsed to a shallower shape while the starboard four-bar linkage system 46' is expanded to an

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enlarged geometry. Rather than lying adjacent opposing sides of hull 11 when linkage systems 46 and 46' are fully collapsed, pontoons 20 and 21 could be received in recesses or cavities contoured in the chine zones of hull 11.

Referring now to FIG. 5, a steering shaft 48 extends downwardly from steering wheel 18 that is positioned for easy access by the operator. The base of shaft 48 is formed with a splined socket 49 shaped to tightly fit over an externally splined gear 50 which is one component of a force transmitting means 51. Splined gear 50 is interconnected with a conventional pinion component (not shown) of a rack and pinion steering box assembly 52. Steering box assembly 52 incorporates an elongated rack 53 aligned transversely of the boat longitudinal axis.

The starboard end of rack 53 is coupled to a high tension cable 54 which extends diagonally away from box assembly 52, is wrapped around an idler pulley 55 and eventually is coupled to the base of a crank 56. The top section of crank 56 is rigidly fixed to one end of a torsion bar tube 57 enclosing the major portion of a torsion bar 58. The exposed or outer end 59 of torsion bar 58 is splined for connection with the starboard rocker arm (not shown).

In a similar manner, the port end of rack 53 is coupled to a cable 60 which crosses cable 54, is trained around an idler pulley 61 and eventually is tightly connected to the base of a crank 62. The top part of crank 62 is fixed to a torsion bar tube 63 that contains torsion bar 42. Torsion bar 42 projects through a tube opening 64 and terminates in a splined end 65.

Rack and pinion steering box assembly 52 is mounted by a pair of brackets 66 and 67 to a corresponding pair of upright posts 68 and 69 that constitute part of a central support framework (not entirely shown).

The steering mechanism and force transmitting means 51 are interconnected to coact in tilting the hull and thereby automatically effect turning of the entire boat. By way of illustration a right turn may be negotiated by manipulating control handle 19 to simultaneously rotate shaft 48 and splined gear 50 in a counterclockwise direction as shown by the arrows. This action results in laterally shifting rack 53 in a port direction, as indicated by the arrow, so that tension in cable 54 is relaxed while cable 60 is pulled more taut. Crank 56 and torsion bar 58 will move in a counterclockwise direction to diminish the torque load (indicated by $-T_1$) in the starboard rocker arm. Simultaneously the increased tension in cable 60 will force crank arm 62 and torsion bar 64 to rotate clockwise thereby increasing torque load (indicated by $+T_1$) in the port rocker arm. Increased torque load in the port rocker arm raises the port side while decreased torque load in the starboard rocker arm simultaneously drops the starboard side with the result that the hull center-of-gravity is shifted inwardly, i.e., toward the right in this situation, so the desired right turn can be accomplished.

FIG. 6 shows some of the components that serve to selectively lift and tilt a boat incorporating the present invention. Rocker arm 22 terminates at its base in an enlarged bearing block 70 sized to fit within a pivot bracket 71 anchored to the starboard pontoon (not shown). A pair of thrust collars 72 and 73 are arranged to facilitate mounting torsion bars 42 and 58 to their respective rocker arms. Torsion bar 58 has a splined inner end 74 that tightly fits within a splined socket formed in crank 56. As previously mentioned, rotation of crank 56 regulates the torque load on torsion bar 58 which in turn controls the attitude or slope of rocker arm 22.

The pivot arms which are aligned in tandem with the rocker arms are simultaneously urged upwardly or downwardly by a force applying means 75. A transversely aligned torsion bar 76, enclosed by a torsion bar tube 77, is fixed to the upper end of a rearward crank 78. Crank 78 is secured by a high strength bolt 79 to an apertured fitting 80 attached to the piston rod 81 of a hydraulic cylinder 82. The opposing end of torsion bar 76 is fixed through a bearing 83 to starboard pivot arm 84 which is fabricated in part from a hollow rectangular shaft 85.

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Transversely aligned torsion bar 43 is similarly enclosed in a torsion bar tube 86 connected at one end 87 to a crank (not shown) that operates in a manner similar to crank 78. This crank is rigidly coupled to an apertured fitting 88 secured to a piston rod 89 of a hydraulic cylinder 90.

Simultaneous and identical movement of the rearward cranks is accomplished by a 12-volt electric hydraulic pump 91 located at the forward part of the hull. Extending from pump 91 are fluid conduits 92 and 93 that communicate with the rearward variable chambers of cylinders 82 and 90. Similarly, fluid conduits 94 and 95 communicate with the forward variable chambers of cylinders 82 and 90.

The hull lifting mechanism and hull tilting mechanism are supported by a central support framework 96. Forwardly disposed posts 97 and 98 cooperate with posts 68 and 69 respectively to mount front anchor clamps 99 and 100. As can be seen anchor clamp 99 is secured to adjacent portions of torsion bar tubes 57 and 63, and, clamp 100 performs a similar function at a laterally displaced location. A pair of elongated laterally spaced stringers 101 and 102 merge together at their forward positions to form a crossbar 103 that contributes rigidity to framework 96. The rearward section of stringer 101 mounts a pair of struts 104 and 105 that converge at their tops to support a rearward anchor clamp 106 which in turn supports portions of torsion bar tubes 77 and 86. Similarly stringer 102 mounts a pair of struts 107 and 108 that support a clamp 109 for mounting other portions of torsion tubes 77 and 86. The rearward tips of stringers 101 and 102 terminate in transom mounting plates 110 and 111.

FIG. 7 shows how force transmitting means 75 operates to increase and decrease torque loads on the pivot arms. Manually operated control 19 for regulating the lifting force on the hull, is connected to a selector valve 113. Selector valve 113 communicates with pump 91 through one line including a working fluid reservoir 114 and second line that includes a conventional pressure gauge 115. Control 19 is used to adjust valve 113 so that fluid is either pumped through branch line 116 to lift the hull or branch line 117 to lower the hull. Pressurized fluid flowed through line 116 is routed through conduits 94 and 95 to force piston rods 81 and 89 to their extended positions. Rearward cranks 78 and 118 transmit increased torque load to torsion bars 76 and 43 to thereby increase the slopes of the pivot arms. In order to lower the hull pressurized fluid is pumped through line 117 and conduits 92 and 93. This serves to retract piston rods 81 and 89 causing relaxed torque load on torsion bars 76 and 43.

OPERATION

Keeping the above construction in mind it can be understood how many of the disadvantages that accompany support or suspension systems for conventional hulls are overcome or substantially eliminated by the present invention.

Initially the operator and an occupant enter boat 10 with hull 11 partially immersed in the water and pontoons 20 and 21 retracted closely against opposing underside portions of hull 11. Inboard-outboard motor assembly 13 is operated to propel the boat and at this juncture the angular alignment of propeller 16 may be varied in the usual manner to drive boat 10 through turning movements. When hull 11 is accelerated to approximately planing speed, the operator grasps conveniently located control handle 19 to simultaneously transmit increased torque load to rearwardly disposed parallel torsion bars 43 and 76. Simultaneous twisting of torsion bars 43 and 76 serves to transmit torque load to pivot arms 35 and 84 which are urged from shallow inclined positions adjacent hull 11 to sharply sloped inclined positions. During this torque transmission action the port and starboard four-bar linkage systems 46 and 46' are simultaneously

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transformed from collapsed shapes to expanded shapes and during the transition between shapes, serve to gradually raise hull 11 from a crouched position to a level entirely out of the water overlying the pontoons.

At approximately planing speed the combined buoyancy of pontoons 20 and 21 is sufficient to support the entire weight of boat 10 without allowing the pontoons to submerge and offer excessive drag.

The pontoons act as dual outriggers to adequately stabilize boat 10 during straight path movement and simply slash through swells and choppy waters that otherwise, if the hull were still partially submerged, would jounce hull 11 and greatly irritate the occupants. The relatively slight pitching and heaving or oscillating experienced by the pontoons is absorbed by the four-bar linkage systems 46 and 46' which jointly act as a shock absorber to relieve the hull of similar oscillatory movements.

When the operator desires to negotiate a left turn, for example, he merely manipulates the steering wheel to simultaneously increase torque load to torsion bar 58 and relax torque load on torsion bar 42. This torque transmission action automatically results in urging rocker arm 23, referring to FIGS. 3 and 4, to a shallower inclination and rocker arm 22 to a more sharply sloped angle. The concomitant collapse of port four-bar linkage system 46 and expansion of starboard four-bar linkage system 46' forces hull 11 and pontoons 20 and 21 to tilt or rotate inwardly towards the left. The resulting dynamic forces when boat 10 is in this attitude force boat 10 to swerve to the left until the boat is restored to an erect position by the operator at which time it will experience straight line motion until altered once again. Turning maneuvers to the right would be accomplished in a reverse manner by uplifting the port side and dropping the starboard side.

Assuming that hull 11 is suspended in its in-flight position and the operator wants to discontinue all boat maneuvering, then he merely decelerates the boat to approximately planing speed at which juncture hull 11 is dropped back to partial submergence in the water. The operator then steers boat 10 by manipulating motor assembly 13 to a suitable dock or stopping location where he shuts off engine 14.

From the foregoing it will be evident that the present invention has provided a versatile boat suspension system in which all of the various advantages are fully realized.

What is claimed is:

1. A boat suspension system comprising:

- (a) a hull;
- (b) support structure constructed to float on water;
- (c) a pair of pivot arms positioned on opposing sides of the hull that interconnect the hull and support structure; and
- (d) force applying means coupled to the pivot arms for urging the pivot arms between first inclined positions where the hull is resting on the water and second inclined positions steeper than the first inclined positions where the hull is raised entirely out of the water,

wherein, the force applying means includes a pair of torsion bars, one end of each torsion bar being fixed to an associated pivot arm, and, actuating means coupled to the other ends of the torsion bars and arranged to apply torque to the torsion bars and adjust the pivot arms to selected inclinations between said first and second inclined positions.

2. The structure according to claim 1, wherein:

the torsion bars are aligned transversely of the hull longitudinal axis,
the torsion bar ends fixed to associated pivot arms are formed with splines, and,
the forward portions of the pivot arms define splined bearings for receiving the splined torsion bar ends.

3. A boat suspension system comprising:

- (a) a hull;

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(b) a pair of laterally spaced pontoons constructed to float on water, each pontoon being longer than the hull length;

(c) lifting means interconnecting the hull and rearward portion of the pontoons, the lifting means being arranged to lift the hull entirely out of the water;

(d) steering means; and,

(e) tilting means interconnecting the hull and forward portions of the pontoons, the tilting means being responsively coupled to the steering means so that manipulation of the steering means can force the tilting means to laterally tilt the hull and thereby accomplish turning.

4. The structure according to claim 3, wherein the tilting means includes:

a pair of rocker arms positioned on opposing sides of the hull; and,

force transmitting means coupled to the rocker arms for simultaneously angularly adjusting one pivot arm upwardly and the other downwardly to shift the hull center-of-gravity in a direction in which the hull is sought to be turned.

5. The structure according to claim 4, wherein the steering means includes:

a manually operable steering device; and

a steering shaft connected to the steering device, and the force transmitting means includes:

a pair of torsion bars, one end of each torsion bar being fixed to an associated rocker arm; and,

a steering linkage interconnecting the torsion bars and steering shaft and arranged so that operation of the steering device automatically torques the torsion bars in opposing directions to angularly adjust the rocker arms.

6. The structure according to claim 5, wherein the steering linkage includes:

a pinion connected to the base of the steering shaft;

a rack interengaged with the pinion;

a pair of cranks secured to the ends of corresponding torsion bars; and,

a pair of cables, one cable of which interconnects a corresponding crank and the rack while the other cable interconnects the other crank and the rack, the cables being connected to the rack at longitudinally spaced locations along the rack,

whereby rotation of the steering shaft in one direction results in simultaneously increasing tension in one cable and diminishing tension in the other cable to increase and decrease torque load in corresponding torsion bars, and, conversely, rotation of the steering shaft in the reverse direction results in diminishing tension in said one cable and increasing tension in said other cable to diminish and increase torque load in their corresponding torsion bars.

7. A speed boat suspension system for raising a boat hull from the water when the hull attains approximately planing speed and selectively turning the hull when maintained in its elevated position, the system comprising:

(a) a hull;

(b) a pair of laterally spaced elongated pontoons arranged on opposing sides of the hull;

(c) a first four-bar linkage system for coupling one pontoon to the hull port side;

(d) a second four-bar linkage system for coupling the other pontoon with the hull starboard side; and,

(e) force applying means coupled to both four-bar linkage systems for simultaneously expanding them to lift the hull from the water and and collapsing them to descend the hull onto the water.

8. The structure according to claim 7 including:

force transmitting means coupled to both four-bar linkage systems; and,

steering means operatively connected to the force transmitting means for forcing the force transmitting means to simultaneously collapse one four-bar link-

age system while expanding the other four-bar linkage system to thereby tilt the hull in a direction toward which the hull is sought to be turned.

9. The structure according to claim 8 wherein;
the four-bar linkage systems each incorporate rocker arms connected to forward sections of the pontoons and tandemly aligned pivot arms connected to rearward sections of the pontoons,
the force applying means incorporates torsion bars connected to top portions of the pivot arms, and
the force transmitting means incorporates torsion bars connected to top portions of the rocker arms,
whereby the hull is lifted from the water and lowered onto the water by simultaneously increasing and decreasing torque load in the pivot arms, respectively, and, the hull is turned by decreasing torque load in the rocker arm on the hull side corresponding to the direction in which the hull is sought to be turned and increasing torque load in the other rocker arm.

10. A speed boat suspension system for raising a boat hull from the water when the hull attains approximately planing speed and selectively turning the hull when maintained in its elevated position, the system comprising:

- (a) a hull;
(b) a pair of laterally spaced elongated pontoons positioned on opposing sides of the hull;
(c) a pair of pivot arms interconnecting opposite hull portions with the pontoons;
(d) force applying means coupled to the pivot arms for simultaneously urging the pivot arms between first inclined positions where the hull is resting on water and second inclined positions steeper than the first inclined positions where the hull is raised out of the water and above the pontoons;

- (e) steering means;
(f) rocker arms positioned forwardly of the pivot arms on opposing sides of the hull;
(g) force transmitting means coupled to the rocker arms for simultaneously angularly adjusting one rocker arm upwardly and the other downwardly to tilt the hull and shift its center-of-gravity in a direction in which the hull is sought to be turned;
(h) a port four-bar linkage system constituted by the pivot arm, rocker arm, hull port portion between the top sections of said rocker arm and pivot arm, and, pontoon section between the bottom portions of said rocker arm; and,
(i) a starboard four-bar linkage system constituted by the pivot arm, rocker arm, hull starboard portion between the top sections of said rocker arm and pivot arm, and, pontoon section between the bottom portions of said rocker arm and pivot arm,
whereby both four-bar linkage systems are substantially identically shaped when the hull is being lifted, lowered or moved in a straight path, and, when the hull is being turned the linkage systems are relatively expanded and collapsed.

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