July 31, 1962 J. F. SHERRILL 3,046,928

BOAT TRIMMING STABILIZER

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FIG. 1

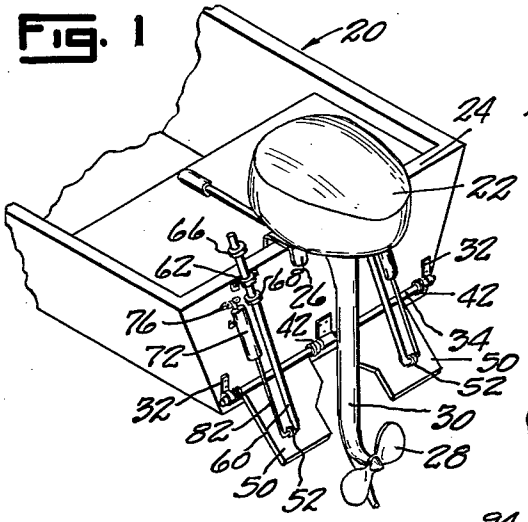


FIG. 2

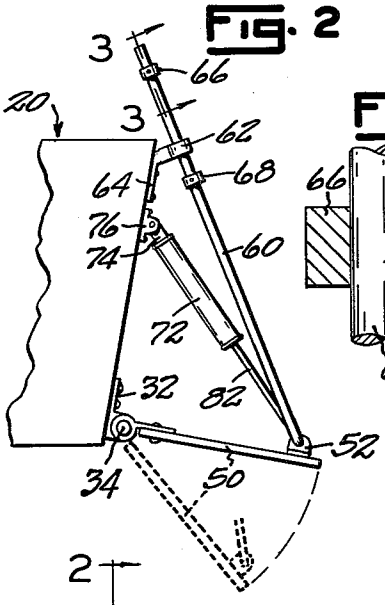


FIG. 3

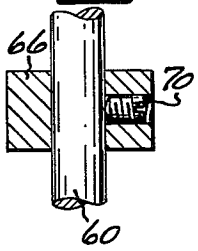


FIG. 4

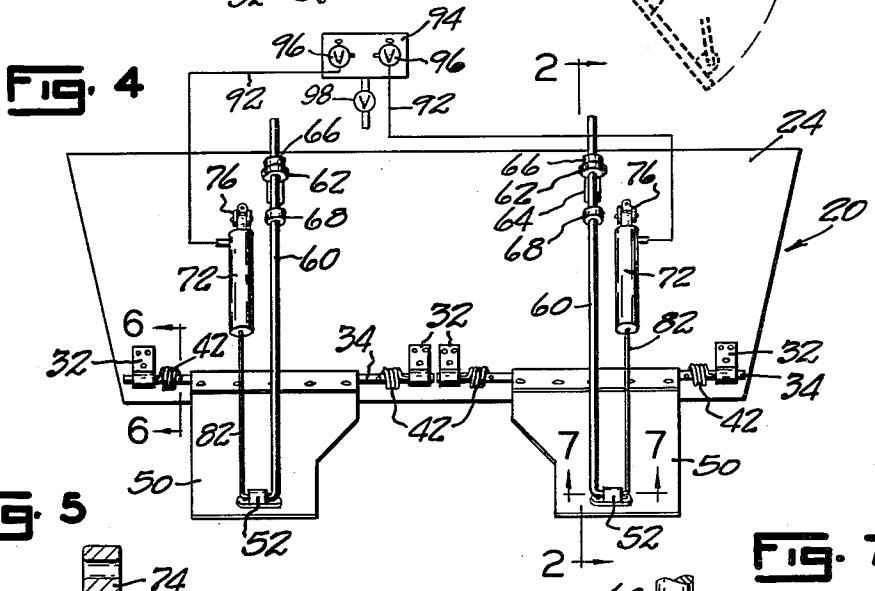


FIG. 5

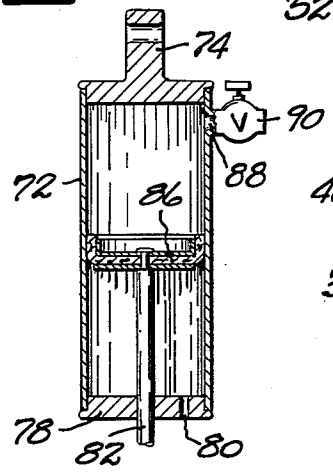


FIG. 6

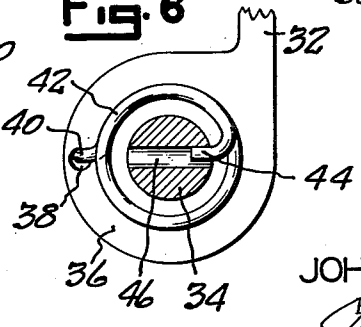
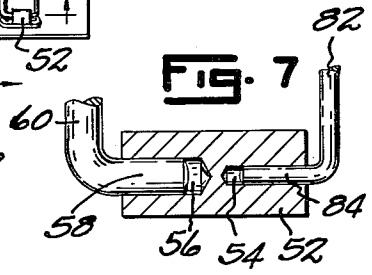


FIG. 7



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FIG. 8

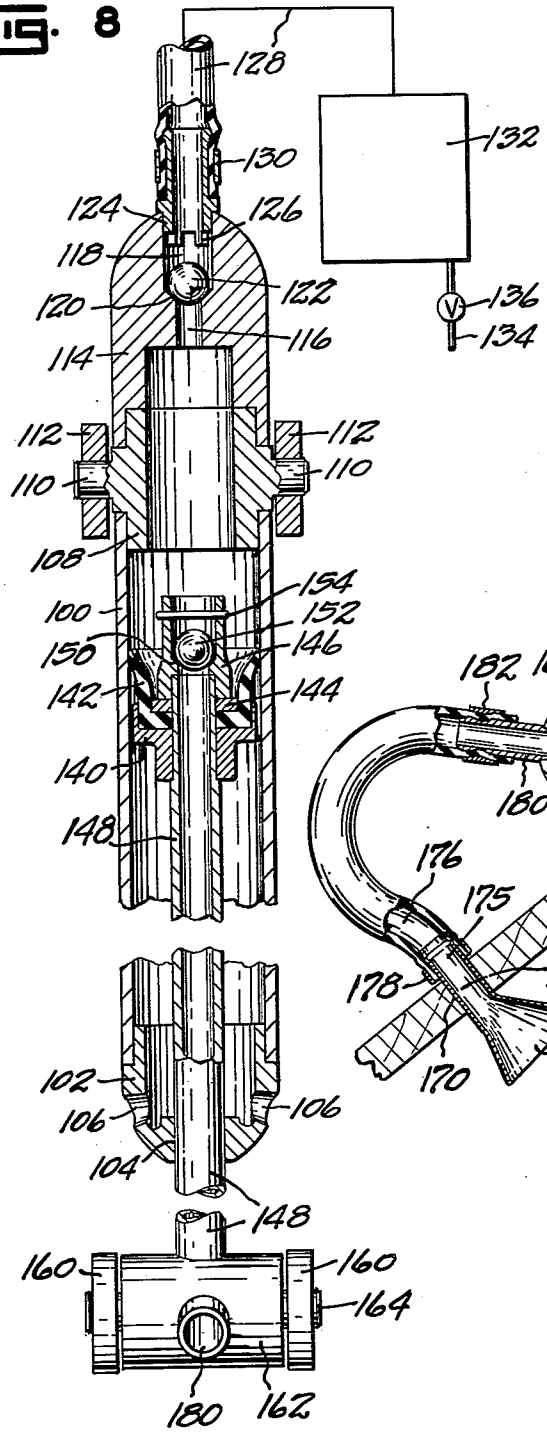


FIG. 9

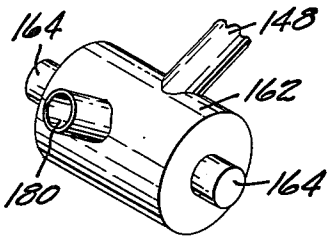
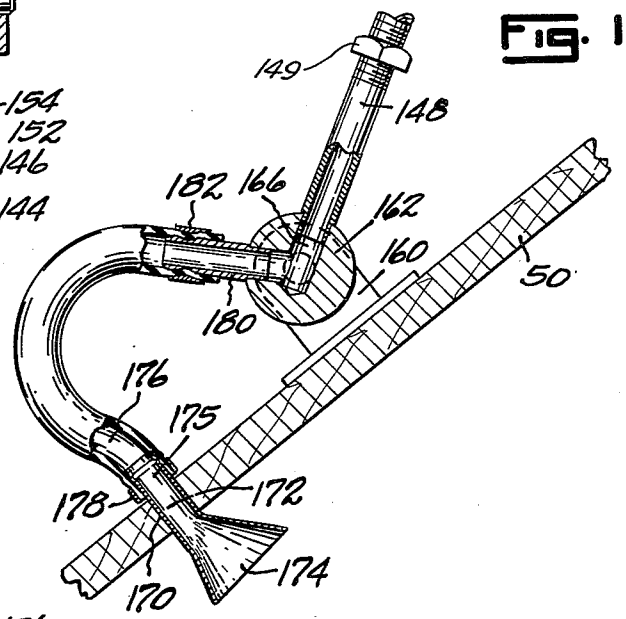


FIG. 10



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BOAT TRIMMING STABILIZER

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Filed Sept. 28, 1959, Ser. No. 842,928
17 Claims. (Cl. 114—66.5)

This invention relates to improvements in boat trimming stabilizers, and more particularly to a stabilizer adapted to be attached to or mounted upon a power operated boat having either an inboard engine or an outboard motor.

The primary object of this invention is to provide a device of this character which stops "plowing" of the boat in the water, reduces the lift or elevation of the bow of the boat as it begins to move through the water and before it reaches planing speed, and assures planing of the boat at low speed.

A further object is to provide a device of this character which increases the speed of a boat with safety, increases the mileage or travel of the boat per unit of fuel consumed, reduces plunging of the boat at high speed, and eliminates danger in making sharp turns.

A further object is to provide a device of this character which eliminates the necessity for acurate setting of the position or attitude in which an outboard motor is mounted upon a boat, and which eliminates the possibility of overloading the back of a boat by reason of the weight of an outboard motor and the seating of passengers in the rear of the boat.

A further object is to provide a device of this character serving to retard the speed of a boat while docking so as to simplify docking and increase the safety of docking.

A further object is to provide a device of this character which reduces the wake of a boat as it travels in the water so as to increase the safety of water skiers towed by a boat, which does not interfere with ski ropes attached to a boat, and which provides a boat with improved acceleration to give a smooth rapid starting lift to a skier.

A further object is to provide a device of this character which reduces the bouncing of a boat as it travels in choppy water.

A further object is to provide a device of this character which can be mounted upon a boat easily and quickly without interference with an outboard motor or with the propeller shaft and propeller of a boat having an inboard engine.

A further object is to provide a device of this character having means for automatically compensating the operation of the same in response to variations in speed and thrust of the boat and to variations in the surface condition of the water through which the boat travels, so as to provide a smooth ride at maximum speed for any given motor speed setting and water surface condition.

Other objects will be apparent from the following specification.

In the drawings:

FIG. 1 is a fragmentary perspective view illustrating a boat driven by an outboard motor and having my trimming stabilizer attached thereto;

FIG. 2 is a view of the stabilizing means in side elevation attached to the stern of the boat;

FIG. 3 is an enlarged detail sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a rear view of the device mounted upon a boat, illustrating parts of the device schematically;

FIG. 5 is an axial sectional view of a pneumatic shock strut or dashpot used in the stabilizer illustrated in FIG. 4;

FIG. 6 is an enlarged fragmentary detail sectional view taken on line 6—6 of FIG. 4;

FIG. 7 is an enlarged detail sectional view taken on line 7—7 of FIG. 4;

FIG. 8 is an enlarged detail sectional view of a hydraulic dashpot or shock strut usable with the device, illustrating associated hydraulic components schematically;

FIG. 9 is a perspective view of a swivel member to which the hydraulic member illustrated in FIG. 8 is connected; and

FIG. 10 is a fragmentary side view with parts shown in section, illustrating the manner of connecting the hydraulic unit shown in FIG. 8 to a stabilizer plate to provide a water scoop for supplying water to the hydraulic device illustrated in FIG. 8.

Referring to the drawings and particularly to FIGS. 1 to 7, inclusive, which illustrate one embodiment of the invention, the numeral **20** designates a boat of the power operated type. Thus FIG. 1 illustrates a boat powered by an outboard motor **22** secured to the transom **24** of the boat by suitable clamp means **26** and driving a propeller **28** mounted upon the lower end of a depending drive structure **30** of the character well understood in the art, but the showing of an outboard motor is not intended to be limiting.

A plurality of bearing brackets **32**, preferably consisting of two pairs, as seen in FIG. 4, are secured to the boat transom **24** adjacent the bottom thereof and in transverse axial alignment with respect to the bearing portions thereof. Brackets **32** serve to mount a pair of axially aligned transversely extending shafts **34** positioned horizontally and in substantially balanced relation relative to the longitudinal central vertical plane of the boat. The apertured bearing portion **36** of each bearing bracket **32** journaling a shaft **34** has an aperture **38** formed therein eccentrically thereof to receive one end portion **40** of a coil spring **42** encircling the shaft **34** with clearance and in turn having an opposite end portion **44** received in a cross bore **46** in the shaft. Two springs **42** preferably encircle each shaft **34**, being positioned adjacent the opposite ends of each shaft, as best illustrated in FIG. 4, and being biased to rotate shaft **34** in the same direction, namely, a clockwise direction as viewed in FIG. 2.

Each shaft **34** has fixedly mounted thereon a plate or water reactance member **50**. The plates **50** are of the same shape and area and are preferably symmetrically arranged, as illustrated in FIGS. 1 and 4, relative to the longitudinal vertical central plane of the boat. The plates **50** are spaced apart a distance sufficient to accommodate the propulsion means of the boat therebetween and, for this purpose, are preferably cut away at the free or outer ends of their inner edges so as to accommodate swinging movement of the vertically elongated driving portion **30** of an outboard motor as the same is pivoted relative to the boat about a longitudinal substantially vertical axis for the purpose of steering the boat. Also, the spacing between the plates **50** and their inner edge configuration is such as to accommodate adjustment of the attitude of the part **30** of the outboard motor relative to the transom for maximum efficiency of operation and maximum boat-propelling action.

Each plate **50** has mounted thereon, adjacent the free edge thereof and substantially centrally between its opposite sides, a pivot bracket **52** preferably having two substantially aligned sockets **54** and **56** open at opposite ends thereof, as illustrated in FIG. 7. One socket **56** preferably journals the end portion **58** of an elongated rigid strut member **60**, said end portion **58** preferably extending perpendicularly to said strut. The opposite end portion of the strut is slidable endwise in the apertured or eyelet portion **62** of a bracket **64** secured to the transom **24** of the boat adjacent the upper end thereof. A pair of spaced stops **66** and **68** are mounted upon each strut **60**, the stop **66** being mounted above the bracket eyelet **62** and the stop **68** being mounted upon the strut

below the eyelet 62. The stops 66 and 68 may be of any desired construction and may be anchored in any selected manner. Thus, as illustrated in FIG. 3, the stops may comprise members having apertures slidably fitting on a strut 60 and provided with a screw-threaded aperture transverse of said bore to receive a set screw 70 for anchoring the stop in selected position upon the strut 60, as illustrated in FIG. 3. The eyelet 62 of the bracket 64 will receive the strut 60 with sufficient clearance to accommodate swinging of the strut 60 fore and aft in a vertical plane coincident with endwise sliding of the strut. Thus reference is made to FIG. 2 which illustrates one position of the plate 50 in full lines and another position in dotted lines and from which it will be apparent that both the elevation of the strut 60 and its angle of tilt relative to the vertical vary incident to variations in the position of the plate 50. It will be apparent that the stops 66 and 68 determine the limits to which the plates 50 can swing during the operation of the device. Thus, as viewed in FIG. 2, the springs 42 will serve to swing the plate 50 downwardly and forwardly, that is, in a clockwise position, as seen in FIG. 2, to the limit determined by the setting of the stop 66 located above and engageable with the bracket 62. As the boat moves forward in the water, the plate 50 reacts with the water to swing upwardly in a counterclockwise direction (FIG. 2) against the action of the springs 42 to the limit permitted by the setting of the lower stop 68 below and engageable with the bracket 62.

A shock strut or dashpot is preferably associated with each plate or reactance member 50. In the construction illustrated in FIGS. 1 to 7, the shock strut is pneumatic and consists of a cylinder 72 having an end member mounting an apertured ear 74. A pivot bracket 76 is fixedly carried by the transom 24 adjacent the upper end thereof and preferably in laterally spaced relation to adjacent strut 60. As here illustrated, the bracket 76 is at a lower level than the bracket 62, 64, but this arrangement is illustrative and is not intended to be limiting inasmuch as the bracket 76 may be at the same elevation as the eyelet 62, or even at a higher elevation if desired. It will be understood that the ear 74 of each cylinder 72 is pivoted to a bracket 76. The opposite end 78 of cylinder 72 has an air passage 80 therein and a central aperture slidably receiving an elongated rigid piston rod or shaft 82 whose lower end is preferably bent perpendicularly at 84 and is pivoted in the socket 54. The piston rod 82 mounts a piston 86 slidable within the cylinder 72 and here illustrated as being of the type consisting of cross plates mounting a cup leather therebetween.

The cylinder 72 has a discharge passage or outlet 88 at the upper end thereof with which may be connected an adjustable control valve 90, as illustrated in FIG. 5. The control valve 90 accommodates adjustment of the reaction of the shock strut or dashpot 72, making it possible to adjust the response of the two plates or reactance members 50 individually.

In FIG. 4 is illustrated schematically a pneumatic circuit in which lines or conduits 92 extend from the outlets of the two shock struts 72, as by connection with valves 90, and extend to a closed vessel or container 94. Each line 92 may have one or more valves interposed therein between the dashpot 72 and the container 94. In the event two valves, i.e., a valve 90 and a valve 96, or two valves 96, are incorporated in each line, one valve, such as valve 90, may constitute a regulating valve, and the other, such as valve 96, may constitute a check valve retarding or preventing flow of air from the container 94 to the shock strut 72 or cylinder. In this instance the cup leather of the piston may have a sufficiently loose fit to accommodate flow of air therepast upon the down stroke of the piston incident to the rotation of the shaft 34 by the springs 42. It will be understood, however, that a check valve is not essential in a pneumatic unit and that the operation of the device may serve as means to generate a cushion of air under pressure in the upper chamber of the cylinder 72, and the pneumatic system connected thereto and including the conduits 92 and the container 94, which air cushion retards upward swinging of the plates 50. It will be understood that the container 94 may have a valved outlet 98 if desired.

After the device has been mounted upon a boat, it will first be tested by checking the setting of the stops 66 and 68 for the purpose of ascertaining the adjustment which will secure best operating results. The adjustments include variation of the spacing between the stops 66 and 68 which will control the range of pivotal movement of the plates 50 and the locations of the stops upon the struts to provide desired limit positions of the reactance members. Preferably the stops are so spaced as to limit the swinging of the plates 50 through an angle not greatly exceeding 45 degrees or any desired or preferred lesser angle. The positions of the lower stops which abut the brackets 62, 64 while the boat is under way, will be so regulated as to provide desired control of the attitude of the boat while running at high speed. The position of the upper stops 66 will preferably be set so as to control the attitude of the plates 50 desired when the boat is traveling at low speed, as when it is docking and a controlled speed-retarding position is desired.

The strength of the springs 42 will be such as to swing the plates 50 downwardly to speed-retarding position as determined by the setting of the stops 66 and their engagement with brackets 62, 64 when the thrust or forward driving force exerted on the boat is at a low value. This spring strength is low enough to permit the spring to yield and accommodate upward swinging of the plates 50 as they react with the water incident to starting thrust and normal driving thrust thereagainst. In cases where shock struts 72 are employed in conjunction with the struts 60, the strength of the springs 42 must be correlated with the action of the shock strut retarding upward swinging of the plates 50.

In theoretical operation and in operation in still water, the plates 50 will swing to their upper operative position determined by the point of engagement of the stops 68 with the brackets 62, 64 and will remain in that position as long as normal operating speed and constant thrust and water reactance are experienced thereagainst. However, under conditions where swells occur in the water due to the wake of other boats or due to waves, the reactance of the plates 50 with the water varies even though the speed of the propellers is maintained constant. In such circumstances, the springs 42 come into play as water reactance against a plate associated therewith reduces, thereby causing a partial downward swinging of the plate 50. This downward swinging of the plate automatically compensates the position of the plate to the water conditions encountered thereby. In rough water it will be apparent that the frequency of such compensating swinging movement of the plates 50 may be high, particularly at high speed boat travel. The shock struts 72 serve to cushion the forces acting upon the plates to swing them upwardly to positions in which the stops 68 engage the brackets 62 and 64. The periodic swinging of the plates 50 according to variations in water reactance thereagainst in rough water, acts to stabilize the boat in the water and to smooth its travel.

The control valves, such as the valves 90 used in connection with shock struts or dashpots, serve to regulate the action supplementing the springs 42 for controlling the rate of response and swinging of the plates 50 as water pressure thereagainst moves them upwardly. Thus in the FIG. 5 construction the valve 90 may be open to atmosphere, and the extent to which it is opened will determine the cushioning action provided by the dashpot. If the valve is cracked or open only a slight amount, a substantial resistance to upward movement of the plates 50 is provided by the dashpot supplementing

the action of springs 42, while a greater opening of the valve will reduce the cushioning action.

In the construction illustrated in FIG. 4, assuming that valves 96 are adjustable regulating valves, and that valves 90 are omitted, so line 92 is connected directly at outlet 88 of strut cylinder 72, the control valves 96 may be positioned remote from the transom, as at a control panel near the driver's seat, and provide remote control for the cushioning of the swinging of the plates 50 in response to water pressure thereagainst. Also in the construction illustrated in FIG. 4, selective operation of the regulating valves 96 may provide for change in the setting of one strut member 72 compared to the other for the purpose of facilitating a sharp turn of a boat in the water while it is traveling at high speed. In all instances the strength of the springs is correlated to the thrust developed by the propeller and to the setting of the shock strut so as to insure that the plates 50 will be shifted downwardly immediately upon release or reduction of water pressure thereagainst, while at the same time avoiding a strength of a spring so great as to act to lift or elevate the rear end of a boat as speed is increased.

The use of hydraulic shock strut means in this device is possible, and hydraulic means are illustrated in FIGS. 8, 9 and 10. The hydraulic shock strut comprises a tubular cylinder body 100. One end of the tubular member 100 is connected to an end cap 102 having a central aperture 104 therein and having additional apertures 106 opening the interior of the adjacent part of the tube 100 to atmosphere. The opposite end of the tube 100 is secured to an annular member 108 from which project aligned trunnions 110 pivotally connected to the arms 112 of a yoke or bracket carried by the transom of the boat and serving the same function as the bracket 76 in the previously described embodiment. An end cap 114 is carried by the member 108 and has a central bore 116 communicating with a larger bore 118, whereby a valve seat 120 is provided at the annular shoulder between the bores 116 and 118. A spherical valve member 122 of a diameter less than the bore 118 and larger than the bore 116 is adapted to bear against the valve seat 120 and is free to move clear of said seat in response to pressure exerted thereagainst through the passage 116. A fitting 124 is screw-threaded in the passage 118 and serves as an abutment for limiting movement of the valve element 122. If desired the inner end of the fitting 124 may be toothed or notched at 126 to permit flow of fluid past the valve element 122 when the same engages the inner end of the fitting 124. The fitting 124 projects from the end cap 114 and a conduit 128 is connected therewith in any suitable manner as by means of a clamping strap 130 pressing the same around the projecting part of the fitting 124. Conduit 128 may extend to a container or vessel 132 which may be provided with an outlet 134 having a control valve 136 interposed therein. The conduit 134 may be connected to hydraulically actuable means (not shown) upon the boat, if desired, or valve 136 may be connected to the conduit 128 and located at a control station near the driver's seat of the boat. A pressure gage (not shown) may be provided to indicate the hydraulic pressure acting on the device.

A cup-shaped piston member 140 is located within the cylinder 100 and mounts a cup leather 142 held in place therein by a pressure plate 144 pressed upon by a tubular fitting 146 screw-threaded or otherwise mounted upon one end of a tube 148 which constitutes a piston rod. The fitting 146 has a passage therethrough communicating with the bore of the tube 148 and of stepped character so as to define an annular valve seat 150 against which a spherical valve element 152 normally seats. The valve element 152 fits loosely within the large diameter part of the bore of the part 156, and its travel therein is limited in any suitable manner, as by means of a cross-pin 154 spanning the member 146 in a position spaced from the valve element 152 in the normal seated position thereof, as illustrated in FIG. 8. It will be observed that the open end of the cup leather 142 extends upwardly, that is, in the direction of the outlet passages 116 and 118. The tube 148 fits slidably within the passage 104 of the lower cap. Each plate or water reactance member 50 mounts a bifurcated bracket 160 adjacent the lower free end thereof and positioned at substantially the same location as the bracket 52 in the previously described embodiment. The bracket 160 serves to journal a swivel member 162 to which the lower end of the tubular piston rod 148 is connected. The swivel member 162 preferably comprises a cylindrical part having trunnions 164 projecting from the center thereof at its opposite ends and fitting rotatably in apertures in the bracket 160. Swivel member 162 has a bore 166 extending transversely therethrough and preferably constituting two angularly extending communicating radial portions, as best seen in FIG. 10. One end of the tubular piston rod 148 is preferably screw-threaded in one end portion of the bore 166.

The plate or water reactance member 50 has an aperture 170 extending therethrough adjacent to the bracket 160 and preferably located between the same and the free edge of the plate. In this aperture is mounted a tubular member 172 from which projects a flaring mouth part 174 at the front or downwardly positioned side of said plate. The opposite end portion 175 of the tube 172 projects from the opposite surface of the plate 50 and one end of a flexible conduit 176 is secured thereto, as by means of a clamp 178. The opposite end of the conduit 176 is mounted upon the projecting part of a tubular fitting 180 which is screw-threaded or otherwise mounted in the end of the passage 166 in the swivel member 162 opposite that to which the tubular piston 148 is connected. A clamp 182, or other suitable means, serves to connect the flexible conduit 176 to the fitting 180.

The use of a separate strut, such as strut 60, is not required in connection with the hydraulic unit, the piston serving to limit the swinging of the plates 50; or a stop (149) adjustably mounted on the piston rod as seen in FIG. 10 and engageable with the end of the cylinder limiting the piston stroke in an upward direction. The control valve 136 provides two basic operating conditions. When the valve is in "Exhaust" position, the hydraulic pistons 140 will be free-operating and impose only minor friction resistance to free swinging of the plates 50, leaving the position of the plates under the control of the springs 42. When the control valve is in "On" position i.e., fully or partly closed position, the angular position of the plates is controlled by the hydraulic units 100, 140 and the pressure-relief valve 136 acting together.

The operation of the device is as follows: Assuming that the boat starts from a standing position when the chamber 132 is empty or partly empty, the plates 60 will be in their lowered positions so as to expose the mouth or inlet 174 in the direction of travel. As the boat begins to move water enters mouth 174 and passes through conduit 176, fitting passage 166, conduit 148, fitting 146, past valve 152 and through the interior of the cylinder 100 to and through passage 116, past valve 122 and through line 128 to container 132. This continues until container 132 is filled if valve 136 is closed. Intake of water ends when a pressure balance is established between the parts of the system on opposite sides of valve 122, which pressure in the cylinder acts on the piston to resist upward pivoting of the plates 50 which has been taking place as the reaction of the water on the plates 50 overcomes the resistance of spring 42. When the pressure equilibrium is broken by reducing speed, the cylinder pressure supplements the action of the springs to swing the plates 50 downwardly and forwardly. When pressure equilibrium is overcome by speed increase or wave action, an increase in pressure occurs in the system. Of course, the valve 136 may be cracked to permit bleeding of accumulated back pressure in the container 132 if desired. The optimum setting for the pressure-relief valve 136 will

depend upon the weight distribution in the boat, the nature of the wave action encountered by the boat, and the hydrodynamic properties of the boat and of the plates **50**. Proper adjustment and manipulation of the control unit **136** results in the damping or elimination of the tendency for the boat to pitch as it encounters waves, reduction of the roll of the boat as the boat starts to make a turn, and decrease of the tendency of the stern of the boat to settle lower in the water when the boat is suddenly decelerated. The operation of the device can be described best by discussing the effect of various forces on the boat as the boat is moving and encounters wave actions.

When the boat is at rest, the torsion springs **42** preferably hold the elevators in a downward rearward inclination of from 30% to 40% to the horizontal. As the boat is accelerated, the thrust of the propeller acting below the boat's center of gravity tends to pitch the bow of the boat upward. As the boat gets under way, the water acting on the plates **50** produces lift and drag forces acting on the boat in the opposite direction to the forces produced by operation of the propeller and tending to pitch the boat upward. When a proper relation between the area of the plates **50** and the torsion of springs **42** is provided, the hydrodynamic forces exerted on the plates **50** and tending to raise the rear of the boat act to neutralize the forces produced by the propeller and tending to raise the bow of the boat with the result that the boat will retain a horizontal attitude during acceleration.

Normally, for most boats it will not be necessary to use the hydraulic cylinder-piston units **100**, **140** to assist the plates **50** in maintaining the desired boat attitude during acceleration. If the hydraulic units **100**, **140** are used, care must be exercised to prevent setting the pressure-relief valve **136** to excessively restrict flow in conduit **128**. If the setting restricts water flow in conduit **123** excessively, the plates **50** will act to over-correct the propeller forces tending to raise the bow of the boat and will result in pitching the bow downwardly into the water, i.e., may cause the boat to dive. If the particular combination of boat, plates **50** and springs **42** results in undesirable pitch up of the bow during acceleration, then the hydraulic cylinders **100**, **140** can be used to assist the plates **50** to maintain the desired boat attitude during initial acceleration.

The wave action of the water and the direction of the boat to the wave action will affect the boat ride. For travel in light choppy conditions, such as encountered in inland waters, the plates **50** acting under the influence of the springs **42** only should be effective to control the normal low amplitude pitching of the bow. However, if an undesired pitch is experienced, or, if the boat begins to "porpoise," the hydraulic units can be used for further correction of boat attitude. This attitude correction is accomplished by the action of the hydraulic cylinder piston unit **100**, **140** and control valve unit **136** to modulate the response of the plates **50** to cyclic wave action and resulting cyclic variations of water reactance thereon so as to continuously readjust the inclination of the plates **50** for the wave condition encountered. This continuous change of inclination of the plates **50** entails continuous loading and unloading of the cylinders **100** proportional to and in direct response to the wave and water reactance conditions existing and acting on the device.

When the boat is planing, the plates **50** will assume a nearly horizontal position. As the boat heads into a wave crest, however so as to momentarily free, the plates **50**, from the water, the combined action of springs **42** and the pressure built up in cylinder **100** will swing the plates downwardly and forwardly so as to close valve **122** and unseat valve **152**. When the plates again contact the water in this new position they tend to lift the stern of the boat and to increase pressure in the system so as to again open valve **122** and close valve **152** and to compensate for the forces tending to elevate the bow, thus keeping the boat level. At the same time, both the tendency for the bow to pitch upward and the lifting action of the plates **50** will increase the dynamic pressure on the plates **50** incident to repeated reaction to waves in the manner just described. When the force acting on the hydraulic cylinders becomes great enough, i.e., greater than the pressure in container **132** and conduit **128** the check valve **152** and the valve **122** above the cylinder open and the piston **140** may move upwardly in the cylinder to a small extent. If the control valve unit **136** has been set properly to relieve pressure in the system, the boat will be moving into a trough of a wave at this same time. However, the tendency of the bow of the boat to drop into the trough will be compensated for by the now upwardly deflected plates **50**, which produces less than average lift on the stern of the boat. With the lowering of the dynamic forces on the plates **50**, the springs **42** and the pressure in the cylinders **100** acting on pistons **140** tends to deflect the plates **50** downward. The check valve **122** then closes, and the check valve **152** between the scoop **174** and the cylinder opens in response to the lowered system pressure. This permits water to flow into the cylinder to act on piston **140** and establish a new pressure equilibrium in the new position of plates **50**. By the time the next wave crest is reached, the plates **50** are again in the slightly downwardly tilted position ready to react in the next wave crest.

Caution must be exercised when using the hydraulic cylinder assist in moderate and heavy wave action. If the setting of the pressure-relief valve of control **136** excessively restricts flow in conduit **128**, and if the frequency with which heavy waves are encountered is high, then the repeated wave-responsive actions of the device might force the plates **50** progressively downward until over-correction of the attitude of the boat occurs. This could result in "swamping" the boat. An emergency correction for this condition is effected by moving the control valve **136** to "Exhaust," eliminating the action of the hydraulic cylinders from control over the position of plates **50**.

In making a short radius turn, the forward thrust of the propeller is reduced and a lateral component of the thrust is introduced. Normally, the bow of the boat tends to pitch down and the lateral component of thrust exerted by the screw acting below the boat tends to roll the boat about its longitudinal axis. Under this condition, the plate **50** located on the inside of the turn will be forced deeper into the water while the other plate **50** moves out of the water. In addition, the downward inclination or tilt angle of the plates **50** will increase with decreased water speed. This results in increased lifting and drag forces on the inside plate **50** which counteracts the lateral force component of the propeller. The net effect is to reduce the roll of the boat toward the inside of the turn and to hold the stern in the water to counteract the pitch down of the bow. Holding the stern down alleviates the tendency for the propeller to "cavitate" in a turn.

In a sudden decrease in forward speed of a boat, the waves which had been produced by the boat overtake the boat as it slows, and, without the plates **50**, hydrodynamic forces permit the boat to drop down fully from its planing angle. This often results in flooding the transom. With the plates **50**, as the boat loses forward speed, the plates **50** will continue to exert lifting forces tending to raise the stern of the boat. Also, if the hydraulic cylinders are not in use, the plates **50** will drop to a greater angle downward to maintain these forces and keep the stern up. These forces lifting the stern permit the stern to ride the following wave.

While the preferred embodiments of the invention have been illustrated and described, it will be understood that changes in the construction may be made within the scope of the appended claims without departing from the spirit of the invention.

I claim:

1. In combination a power driven boat having a transom, rigid water reactance means pivoted at one end to the lower part of said transom and spring-urged downwardly and forwardly, a strut pivoted to said water reactance means, a guide mounted on the upper part of said transom and slidably engaged by said strut, spaced stops on said strut engageable with said guide, and fluid pressure responsive shock strut means pivoted to said water reactance means and to said transom to cushion rearward upward water reactive pivoting of said reactance means toward a limit position defined by engagement of a stop with said guide.

2. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means downwardly and forwardly on its pivot, means for limiting pivotal movement of said reactance means between two predetermined angular positions, and fluid pressure responsive shock strut means connecting said reactance means and transom and operative to retard water-responsive swinging of said reactance means rearwardly and upwardly on its pivot, said strut means accommodating relatively free spring-urged downward and forward movement of said reactance means.

3. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means in a downward and forward direction relative to said boat on its pivot, a rigid strut pivoted to said reactance means spaced from its pivot and slidably connected to the upper part of said transom, means associated with said strut and transom for limiting pivotal movement of said reactance means, and fluid pressure responsive shock strut means connecting said reactance means and transom and operative to retard swinging of said reactance means rearwardly and upwardly, said limit means including spaced stops adjustable lengthwise on said strut.

4. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means downwardly and forwardly on its pivot, means for limiting pivotal movement of said reactance means between predetermined angular positions, and fluid pressure responsive shock strut means connecting said reactance means and transom and operative to retard water reactive swinging of said reactance means rearwardly and upwardly on its pivot, and means for regulating the retarding action of said shock strut means, said strut means having lesser resistance to spring-urged downward and forward swinging of said reactance means.

5. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means downwardly and forwardly about its pivot, means for limiting pivotal movement of said reactance means between predetermined angular positions, and fluid pressure responsive shock strut means connecting said reactance means and transom and operative to retard water reactive swinging of said reactance means rearwardly and upwardly about its pivot, said shock strut means including a valve for regulating flow of fluid therethrough, said spring means overcoming the resistance of said strut means to downward and forward swinging of said reactance means when said boat is stationary.

6. In combination, a boat having a transom and power driven means including a propeller rearwardly of and adjacent to said transom, a pair of plates of similar shape and area, means pivoting said plates at one end thereof to the lower part of said transom on a common axis transverse of said boat and in spaced laterally balanced relation at opposite sides of said propeller, spring means normally urging each plate downwardly and forwardly about said axis, means for limiting pivotal movement of said plates between two predetermined angular positions, and a fluid pressure responsive dashpot connected to each plate spaced from said axis and to the upper part of said transom and operative to retard upward swinging of said plate and to accommodate relatively free spring-urged downward swinging of said plate.

7. In combination, a boat having a transom and power driven means including a propeller rearwardly of and adjacent to said transom, a pair of plates of similar shape and area, means pivoting said plates at one end thereof to the lower part of said transom on a common axis transverse of said boat and in spaced laterally balanced relation at opposite sides of said propeller, spring means normally urging each plate downwardly and forwardly about said axis, an extensible member connected to each plate spaced from said axis and to the upper part of said transom and including an inclined cylinder and a piston, each cylinder having at its upper part an outlet for fluid under pressure generated by upward swinging of the plate associated therewith, and a valve controlling each outlet, each cylinder being open to atmosphere at its lower part.

8. In combination, a boat having a transom and power driven means including a propeller rearwardly of and adjacent to said transom, a pair of plates of similar shape and area, means pivoting said plates at one end thereof to the lower part of said transom on a common axis transverse of said boat and in spaced laterally balanced relation at opposite sides of said propeller, spring means normally urging each plate downwardly and forwardly about its axis, an extensible member connected to the free end part of each plate and to the upper part of said transom and including a cylinder and a piston, each cylinder having at one end portion thereof an outlet for fluid under pressure generated by upward swinging of the plate associated therewith and at its opposite end portion having an opening to atmosphere, and a fluid pressure system including a chamber and conduits connecting said first named cylinder outlets to said chamber.

9. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means downwardly and forwardly on its pivot, a cylinder pivoted to the upper part of said transom, an apertured piston slidable in said cylinder, a tubular piston rod projecting from said cylinder and pivotally connected to said reactance means spaced from its pivot and communicating with said piston aperture, means carried by said plate for collecting water as said boat moves and delivering said water into said piston rod and means receiving water from said cylinder and having a selectively adjustable outlet.

10. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means downwardly and forwardly on its pivot, a cylinder pivoted to the upper part of said transom, and apertured piston slidable in said cylinder, a tubular piston rod projecting from said cylinder and pivotally connected to said reactance means spaced from its pivot and communicating with said piston aperture, means carried by said plate for collecting water as said boat moves and delivering water into said piston rod, a normally closed check valve accommodating flow of water in said piston rod when the pressure in said rod exceeds the pressure in said cylinder and regulable means for discharging water from said cylinder.

11. In combination, a power driven boat having a transom, water reactance means pivoted to the lower part of said transom on an axis transverse of said boat, spring means urging said reactance means forwardly and downwardly about said axis relative to said boat, an extensible fluid pressure responsive member connected to the upper

part of said transom and to said reactance means spaced from said axis and operative to retard rearward swinging of said reactance member about said axis, and means for limiting pivoting of said reactance means between predetermined angular positions said pressure responsive member having negligible resistance to spring-urged downward and forward swinging of said reactance means.

12. In combination, a power driven boat having a transom, water reactance means pivoted at one end thereof to the lower part of said transom on an axis transverse of said boat, spring means urging said reactance means forwardly and downwardly about its pivot axis, an hydraulic dashpot interconnecting the upper part of said transom and said reactance means spaced from its pivot and having an adjustable outlet, water inlet means carried by the reactance means at the front thereof and connected to said dashpot, and stops for limiting pivoting of said reactance means.

13. In combination, a power driven boat having a transom, water reactance means pivoted to the lower part of said transom on an axis transverse of said boat, spring means urging said reactance means forwardly and downwardly about said axis relative to said boat, an extensible fluid pressure responsive member connected to the upper part of said transom and to said reactance means spaced from said axis and operative to retard rearward swinging of said reactance member about said axis, and means for limiting pivoting of said reactance means between predetermined angular positions, said reactance means constituting two spaced plates having aligned pivot axes and being of the same shape and area, said plates being equispaced from the longitudinal center of said boat, each plate having an independent fluid pressure responsive member connected thereto said pressure responsive member having negligible resistance to downward pivoting of said reactance means by said spring means.

14. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means downwardly and forwardly on its pivot, a shock strut unit pivoted to said transom and to said reactance means spaced from the pivot connection of said reactance means to said transom, fluid collecting means communicating with said strut member and having selectively operable outlet means, a water scoop carried by said reactance member at the lower front face thereof, and a conduit communicating with said scoop, said shock strut unit including a cylinder, an apertured piston slidable in said cylinder and a tubular piston rod communicating with said piston aperture and projecting from said cylinder, said piston rod communicating with said conduit.

15. In combination, a power driven boat having a transom, rigid water reactance means pivoted at one end thereof to the lower part of said transom, spring means normally urging said reactance means downwardly and forwardly about its pivot, a shock strut unit pivoted to the upper part of said transom and to the free end of said reactance member, said shock strut unit including a cylinder, an apertured piston slidable in said cylinder, and a tubular piston rod shiftable in said cylinder and communicating with said piston aperture, means carried by said reactance means and open at the lower forward portion thereof for delivering water into said piston rod and cylinder, a water receiver connected to said cylinder and having a manually adjustable outlet valve, and a check valve preventing return flow of water from said receiver to said cylinder.

16. In combination, a power driven boat having a transom, water reactance means pivoted at one end thereof to the lower part of said transom on an axis transverse of said boat, spring means urging said reactance means forwardly and downwardly about its pivot axis, an hydraulic dashpot interconnecting the upper part of said transom and said reactance means spaced from its pivot and limiting pivotal movement of said reactance means relative to said boat, and water inlet means carried by said reactance means at the front thereof and connected to said dashpot.

17. In combination, a power driven boat having a transom, water reactance means pivoted at one end thereof to the lower part of said transom on an axis transverse of said boat, spring means urging said reactance means forwardly and downwardly about its pivot axis, strut means extensible and retractable between predetermined limits and connecting said transom and reactance member spaced from the pivot axis of said reactance member, said strut means being fluid pressure responsive to retard retraction thereof in response to water reactance swinging of said reactance means rearwardly and upwardly on its pivot, said strut means being freely extensible, and means for regulating the retarding action of said strut means.

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