April 19, 1966 C. F. ALEXANDER, JR 3,246,915

OUTBOARD PROPULSION UNITS FOR BOATS

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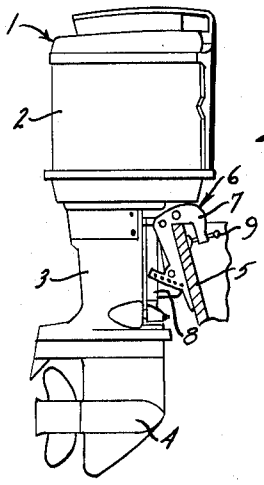


Fig. 1

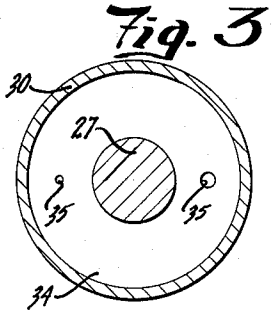


Fig. 3

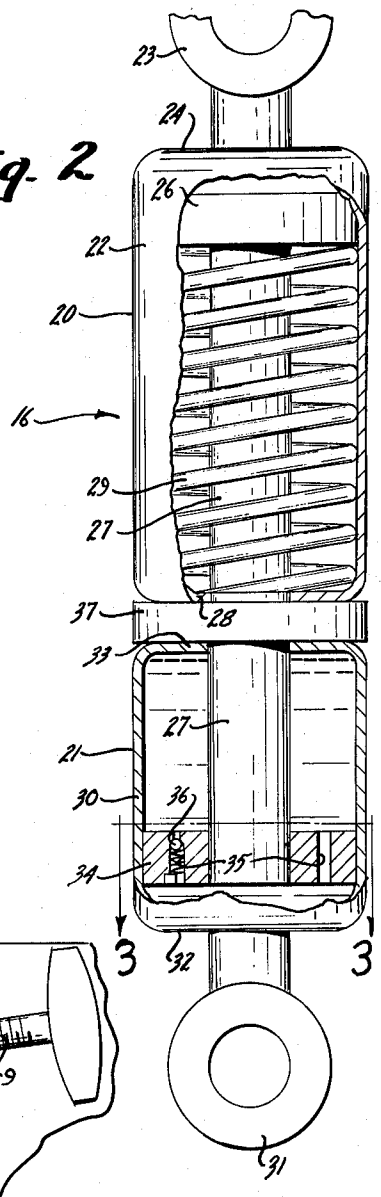


Fig. 2

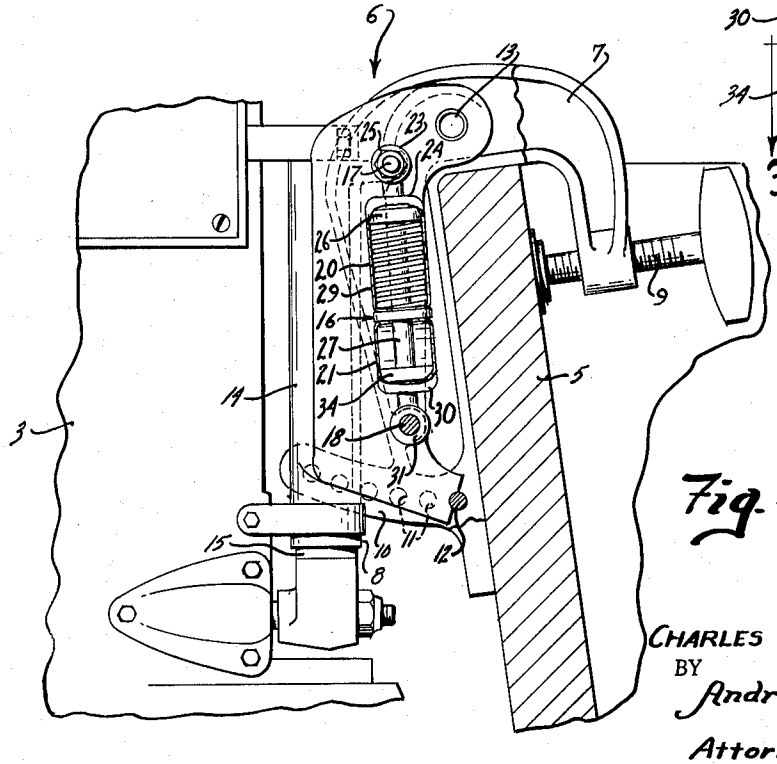


Fig. 4

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OUTBOARD PROPULSION UNITS FOR BOATS

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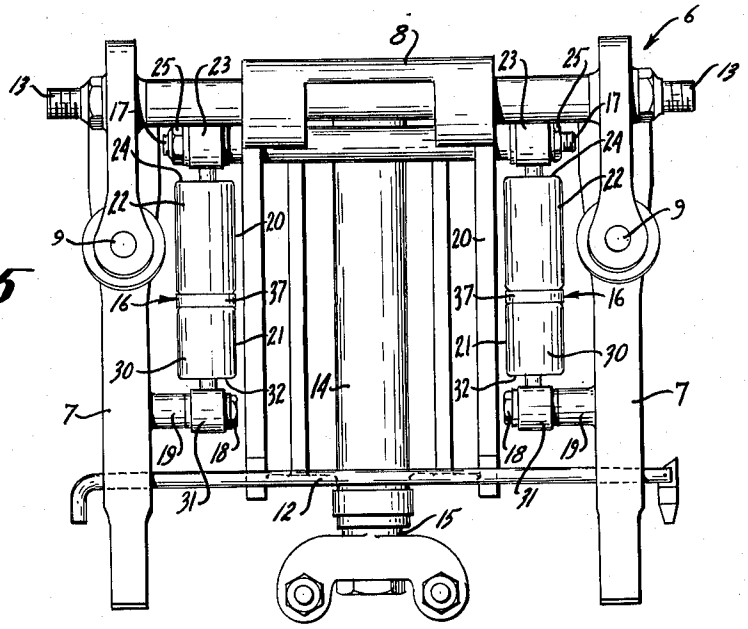


Fig. 5

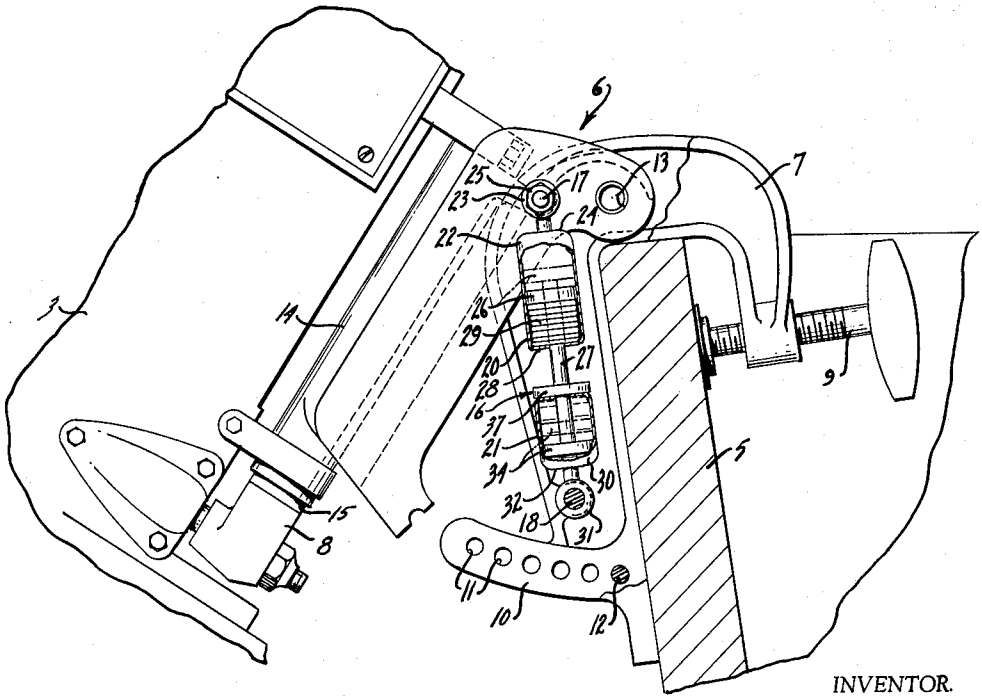


Fig. 6

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OUTBOARD PROPULSION UNITS FOR BOATS

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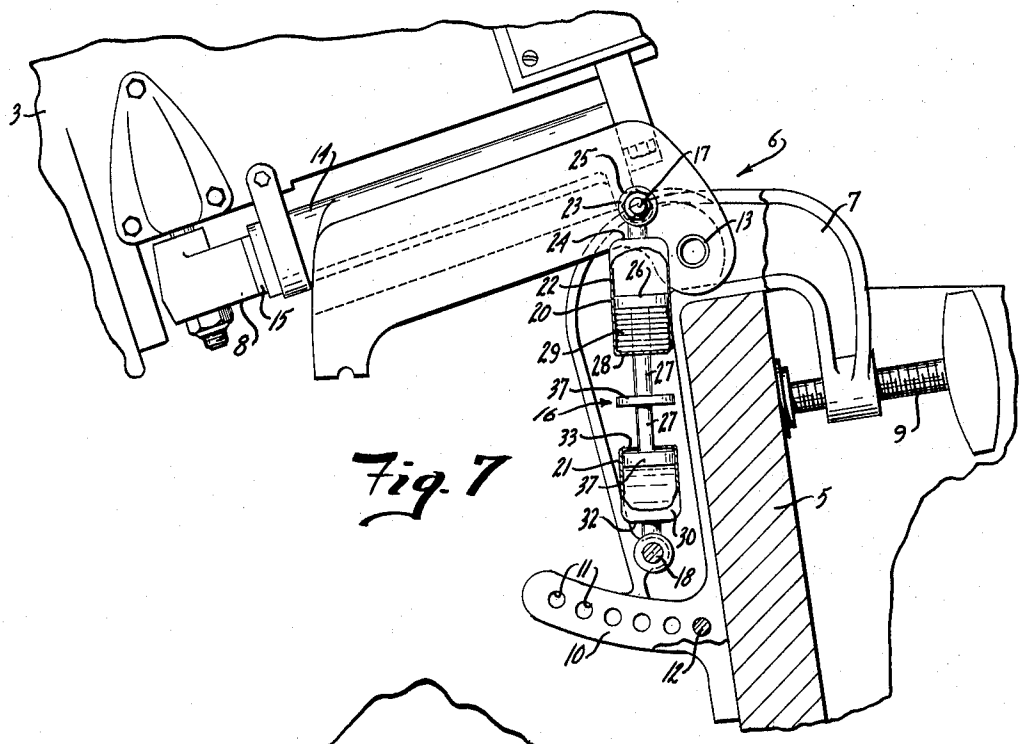


Fig. 7

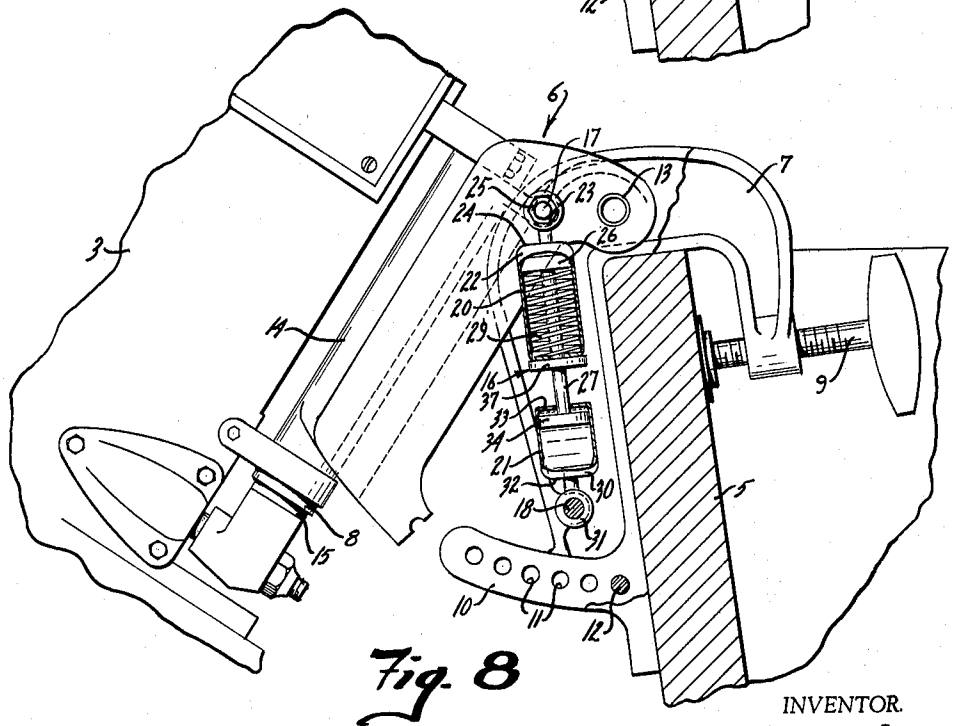


Fig. 8

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OUTBOARD PROPULSION UNITS FOR BOATS

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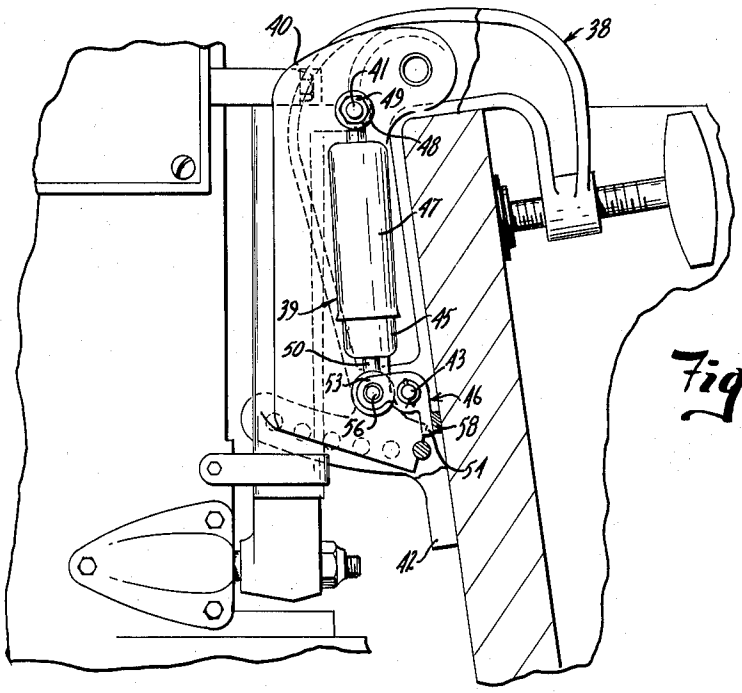


Fig. 9

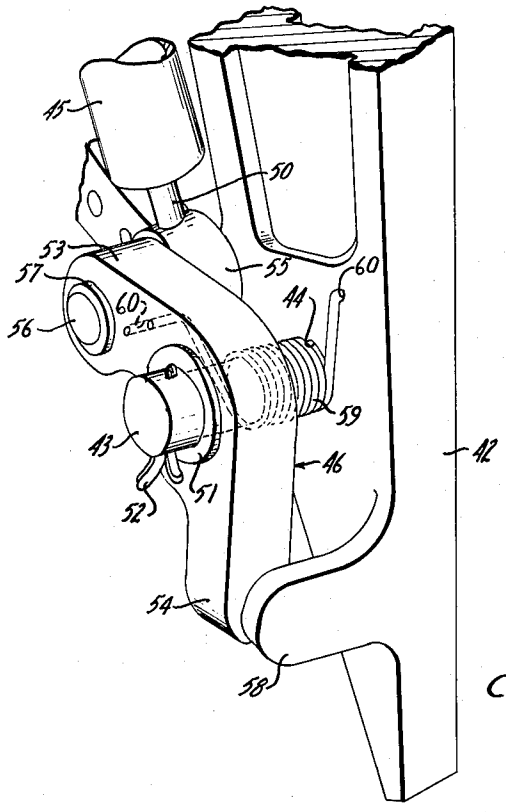


Fig. 10

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United States Patent Office 3,246,915
Patented Apr. 19, 1966

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OUTBOARD PROPULSION UNITS FOR BOATS

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Filed Aug. 6, 1963, Ser. No. 300,349
5 Claims. (Cl. 248—4)

This invention relates generally to outboard propulsion units supported for tilting movement on a horizontal transverse axis and more particularly relates to units provided with shock absorbing means for damping and otherwise controlling tilting movement of the unit.

Primarily to provide a measure of protection from floating and submerged obstructions in the water, outboard propulsion units of boats are ordinarily supported to tilt or pivot freely on a horizontal axis and from a normal running position with the lower end of the unit underwater to rearwardly and upwardly position wherein the lower end or skeg of the unit is well above the waterline. Among other things, this freedom to tilt enables the propulsion unit to swing rapidly upwardly upon encounter with an obstruction in its path to clear the same and thereby prevent or minimize damage to the lower end of the unit and to the boat transom on which the motor is mounted from impact with such obstruction.

While clearly desirable in this respect, the pivot support afforded the propulsion unit leads to other problems which have been accentuated of late due to the trend towards heavier and higher horsepower propulsion units. Namely, the propulsion unit, because of its mass may attain a very appreciable angular momentum upon striking an obstruction, particularly at high speeds, and may as a result thereof impact violently against its mountings or support structure at the top of the pivot. Then too, during returning of the unit to running position, any unexpended momentum of the unit from the impact at the top of the arc and the additive impetus gained during dropping to the water may result in a heavy impact between the propulsion unit and the bracket structure at running position. This latter impact can be further agravated by the forward thrust of the propeller upon the latter re-entering the water.

Additionally, at times the propulsion unit is caused to tilt only partly rearwardly or trail out from running position. Thus, for example, when the throttle of the unit is suddenly or abruptly closed, the forward thrust of the unit will be reduced commensurately and as a result the water drag forces the unit to swing rearwardly relatively of the boat. When the throttle is thereafter opened up, the unit will be driven forwardly into impact with the boat transom.

These noted impacts at either end of the tilt arc of the propulsion unit may lead to serious damage to the unit, its mountings and to the boat transom on which the unit is mounted, and it has been proposed therefore to incorporate shock absorbers in the mounting structure of the unit to damp the latter during tilting and thereby reduce the severity of the aforementioned impacts.

However, in order to provide the propulsion unit relief from obstructions in the water, it is extremely desirable that any such shock absorber be constructed to provide only a minimum amount of resistance to the initial portion of the upward tilting movement of the unit. Furthermore, it will be appreciated that once the lower end of the propulsion unit leaves the water, steering control over the boat on which the unit is fastened is lost. Accordingly, it is of further advantage that the shock absorber when used with an outboard propulsion unit provide a minimum of resistance to the unit during the initial portion of its return movement from a fully kicked-up position.

Reference is made to U.S. Patent No. 2,953,335 granted to E. C. Kiekhaefer and which discloses a number of different shock absorber constructions for this purpose.

The present invention is directed to an outboard propulsion unit employing a shock absorber for controlling the tilting movement of the unit in the manner recited above, and more particularly is directed to a shock absorber in which such tilt control is effected through a relatively simple and rugged combination of operating parts whereby the device may have an inexpensive manufacture and yet be operationally reliable and durable in service.

This is accomplished in the present invention by providing a self-container, two-way acting hydraulic piston-cylinder assembly connected across the transverse pivotal axis between the propulsion unit and transom mounting bracket and having a lost motion therein. The lost motion connection is adapted to hold the damper assembly inoperative during the initial tilting movement of the unit from the running and fully tilted positions to enable the unit to tilt freely and rapidly in clearing an obstruction in its path and in returning towards a steering position in the water from a fully tilted position. The damper assembly is operative following the initial tilting of the unit in either direction and damps and dissipates the angular momentum of the unit as the latter approaches the limit positions of tilting movement to enable the unit to come to a safe controlled stop thereat.

To control the unit where the latter tilts through a limited portion only of its arc as during trailing-out in the water, the lost motion connection is made single-acting with respect to upward tilting of the unit by the provision therein of a relatively light return spring member. The spring member, while of no consequence insofar as impeding the rapid tilting of the unit owing to the substantial disparity between the spring energy and that of the unit during tilting, is nonetheless operative in a limited slow tilting of the unit to actuate the lost motion connection toward the return position to thereby cause a corresponding actuation of the damper assembly. As a result of the spring action, the lost motion coupling can accommodate a portion only of the return movement of the unit and the final increment thereof is controlled by the damper assembly, thus enabling the unit to be damped as it finally swings to running position to prevent the unit from impacting heavily against its mounting structure.

The lost motion connection may be provided by a second piston cylinder assembly or a simple radius link element, for example, either of which is susceptible to an inexpensive and rugged manufacture as is the hydraulic piston cylinder assembly. There thus is provided an economical and dependable shock absorber construction which when employed in the mounting of an outboard propulsion unit greatly enhances the overall safety of operation of the unit while reducing the severity of working stresses on the unit, its mounting structure and on the boat transom as well.

In the drawings:

FIG. 1 is a side elevation of the outboard motor embodying the invention mounted to the transom of a boat;

FIG. 2 is an enlarged axial elevation of a shock absorber constructed according to the invention with parts broken away and others sectioned for clarity of illustration:

FIG. 3 is a transverse section of the shock absorber taken on the lines 3—3 of FIG. 2;

FIG. 4 is an enlarged segmental side elevational view of the motor suspension system of FIG. 1 with parts broken away and showing the unit of FIG. 1 in normal running position and the shock absorber in a fully retracted position;

FIG. 5 is a front elevational view of the motor suspension structure shown in FIG. 4 with the transom removed;

FIG. 6 is a segmental side elevation similar to FIG. 4 illustrating the unit tilted upwardly and to the position wherein the lower end of the unit is approximately just above the water line and showing the shock absorber in a corresponding partially extended condition and further illustrating in phantom lines a return position of the shock absorber in the event of the unit halting in such tilt position;

FIG. 7 is a segmental side elevation similar to FIG. 4 showing the unit in a fully kicked-up position and the shock absorber in a fully extended condition;

FIG. 8 is a segmental side elevation similar to FIG. 4 showing the unit tilted partly downwardly from the upper tilt position and to the position wherein the lower end of the motor is just below the waterline and showing the shock absorber in a corresponding partly retracted position;

FIG. 9 is a segmental side elevation of a motor unit support structure embodying an alternative form of shock absorber with the unit in normal running position; and

FIG. 10 is a perspective enlarged detail view of the lower end portion only of the shock absorber and motor support structure of FIG. 9.

Referring to the drawings and to FIGS. 1 to 8 in particular, the outboard motor 1 shown generally therein has as its essential elements an upper power head 2, an intermediate hollow drive shaft housing 3 and a lower propeller unit 4 adapted for underwater operation. The motor is pendently supported on the transom 5 of an associated boat (not shown) by a bracket structure indicated generally at 6 and which comprises a clamp bracket 7 and a swivel bracket 8.

Clamp bracket 7 of generally C-clamp design and open center construction (see FIGS. 4 and 5) fastens directly over boat transom 5 and carries a pair of clamping screws 9 engaging the inboard face of transom 5 to clamp the latter between the end of the screws and the outboard end of the bracket. The bracket 7 is formed outboard with a pair of rearwardly projecting horns 10 provided with a series of openings 11 to receive a tilt adjustment bar 12 for selectively positioning motor 1 at the desired operating position relative to the vertical.

Swivel bracket 8 fits between the sides of clamp bracket 7 and is pivotally assembled thereto by a horizontal transverse pintle 13. Further, swivel bracket 8 is formed with a vertically extending tubular portion 14 pivotally accepting a swivel pin 15 connected at the ends to drive shaft housing 3.

In accordance with the invention, the bracket structure 6 further includes one or more two-way acting shock absorber mechanisms 16 adapted to control the motor during tilting movement on the pintle 13. In the illustrated construction, two shock mechanisms 16 are employed and the swivel bracket 8 is shown having a reduced width relative to clamp bracket 7 to accommodate mechanisms 16 on either side of bracket 8 and immediately inwardly of the sides of the clamp bracket 7. The upper ends of mechanisms 16 are pivotally secured to swivel bracket 8 by a cross pin 17 located just aft of pintle 13 while the lower ends of mechanisms 16 are pivotally secured to the corresponding sides of clamp bracket 7 by the individual cross pins 18 threadedly engaging in the tapped embossments 19. The above described arrangement of mechanisms 16 in bracket structure 6 is of advantage in that it permits the upper shock absorber attachment to be brought into close proximity with pintle 13 enabling a somewhat shorter overall length of the mechanisms 16. The mechanisms may be mounted outwardly of the sides of bracket 7 if desired, however, by slight modification of the brackets 7 and 8 and the attachment means between the latter and the mechanisms.

As particularly shown in FIG. 2 of the drawings, each of the identical two-way acting mechanisms 16 is comprised essentially of a pair of axially interconnected piston cylinder assemblies 20 and 21, each of which is adapted to accommodate a preselected angular increment of movement of motor 1 in either direction of tilting movement. Assembly 20 is of single action construction and comprises a cylinder member 22 pivotally supported on one end of cross pin 17 by a mounting eye 23 welded or otherwise secured to the upper end 24 of cylinder 22. A nut 25 holds the cylinder 22 captive to pin 17. Cylinder 22, slidably mounts a piston 26 attached to one end of an operating rod 27 extending through the lower, centrally apertured end 28 of the cylinder. The one way action of assembly 20 is provided by a contractible spring 29 mounted between piston 26 and lower cylinder end 28 in concentric relation with rod 27, the spring thus acting to oppose relative sliding movement between piston 26 and cylinder 22 in the extending direction of movement of assembly 20 in turn to oppose corresponding upward tilting movement of motor 1. The flexure characteristic of spring 29 is fairly light, however, and the spring opposition to the extension of assembly 20 and to the tilt movement of the unit when tilting against assembly 20 by way of comparison with the momentum force of the tilting unit is substantially light. The other of the assemblies 20 and 21 and in this instance assembly 21 has a double acting design and includes a cylinder member 30 having a mounting eye 31 secured to its lower end 32. The eye 31 receives one of the previously referred to pins 18 to secure assembly 21 to clamp bracket 7 along the side thereof corresponding to its cooperating assembly 20. The upper end 33 of cylinder 30 is centrally apertured and rod 27 extends therethrough and is connected to a piston 34 slidably carried in cylinder 30 to thereby connect assemblies 20 and 21 together.

The double action of assembly 21 is provided through means of a suitable hydraulic fluid medium contained in cylinder 30 with suitable sealing means being provided between rod 27 and end wall 33 to seal cylinder 30 against leakage of fluid. Piston 34 is provided with a number of axially extending fluid passages 35 adapted to accommodate a restricted flow of fluid during relative sliding movement between piston 34 and cylinder 30 in either direction of movement of assembly 21 to thereby provide a heavy resistance to such movement and to corresponding upward and return tilting movement of motor 1 as the latter tilts against assembly 21. In the illustrated construction, piston 34 is shown having two diametrically located passages 35 in one of which is assembled a spring loaded ball check valve 36 adapted to open in the extending direction of movement of assembly 21 at a predetermined pressure setting. The valve 36 in passage 35 of piston 34 serves to provide a wider range of shock absorber action by assembly 21, so that the restriction resulting from the open passage 35 functions for tilting movements of lower speed, and the restriction resulting from both passages 35 functions for tilting movements of higher speed and momentum. This also provides for a more constant maximum stressing of the piston rod throughout the stroke of the piston and thereby gives a maximum energy absorption with a smaller shock absorber.

The inner adjacent ends of cylinder 22 and 30 may butt together when the shock absorber is fully retracted. However, it may be preferable to provide an intermediate buffer stop therebetween, shown as disc 37 fixed on piston rod 27 at a position which limits the movement of piston 26 toward cylinder head 24 and of piston 34 toward cylinder head 32.

The overall functioning and operation of mechanisms 16 may best be understood by reference to FIGS. 4 to 8 of the drawings illustrating the critical tilt positions of the motor in tilting from running position to a fully kicked-up position and back again. In the normal running position of motor 1, the individual assemblies 20 and 21 are in the retracted positions as shown in

FIGS. 4 and 5. In tilting to a fully kicked-up position, the motor is initially controlled by assembly **20** which extends freely so as to permit motor **1** to swing rapidly from running position with such movement continuing until assembly **20** reaches a fully extended position at which time the motor will have tilted up to the position wherein its lower end is approximately in the horizontal plane of the boat on which the motor is mounted, this position being indicated in FIG. 6. Thus, in the event of the lower portion of motor **1** encountering an obstruction in the water, motor **1** may tilt freely upwardly to clear such obstruction and thereby be relieved of collision damage therefrom. As the motor tilts progressively further upwardly from the position of FIG. 6 and to the top of the arc, it is controlled by hydraulic assembly **21** which as it extends acts to arrest and retard the motor to thereby absorb and dissipate the angular momentum thereof. By the time assembly **21** reaches a fully extended condition the angular momentum of the motor will have been appreciably dissipated enabling the motor to come to a safe, controlled halt at the upper tilt position, this position of assembly **21** and motor **1** being shown in FIG. 7. During returning to running position, motor **1** will initially drop freely back toward and to the position indicated in FIG. 8 wherein its lower end is in the horizontal plane of the boat while in the remaining increment of movement to running position, the motor will be dampened as first assembly **20** and then assembly **21** return to the retracted positions. Thus, after reaching the top of its tilt arc, the motor will return rapidly towards a steering position in the water to minimize the time period during which steering control of the motor and boat is lost. At the same time, the motor **1** is damped as it approaches the running position, thereby preventing heavy impact between bracket **7** and **8** at the running position of motor **1**.

The operation of mechanism **16** during a limited tilting movement of motor **1** as might occur at lower boat speeds or when trailing out can best be understood by reference to FIG. 6 and taking the position of the motor shown therein as the top of the tilt arc. In such a case the tilting movement may be sufficiently slow to cause the actuation of piston **34** in cylinder **30** with a substantially reduced actuation of piston **26** against spring **29** in cylinder **22**, as indicated by the phantom line positions shown in FIG. 6. As the motor returns and swings forward to running position, assembly **20** is able to accommodate a portion only of the movement owing to the aforesaid action of spring **29** with the final increment being controlled and damped by assembly **21** to enable motor **1** to come to a controlled halt at running position. The present construction thereby largely eliminates the impact heretofore objectionable when the unit returns from a trailing out condition.

A second embodiment of the invention is shown in FIGS. 9 and 10 of the drawings in connection with a bracket structure **38** which is substantially identical in construction with the previously described structure **6**. A single shock absorber mechanism **39** is pivotally mounted at the upper end to swivel bracket **40** on the end of the pivot pin **41** and is pivotally secured at the lower end to clamp bracket **42** by a pivot pin **43** threadably engaging within a tapped opening **44** provided in the side of the bracket **42** shown, it being understood that a second mechanism **39** is mounted on the opposite side of bracket structure **38**, not shown.

The shock absorber mechanism **39** in this instance is composed essentially of an extensible and retractable piston cylinder assembly **45** and a cooperating generally L-shaped radius link element **46** coupled thereto, with each of the assembly **45** and radius link **46** adapted to accommodate a preselected arcuate travel of the motor in either direction of tilting movement. Assembly **45** is similar in design to assembly **21** of the previously described embodiment of the invention being of two stage or double acting construction and including a cylinder member **47** having a mounting eye **48** welded to one end thereof. Eye **48** accepts the end of the pin **41** which is shown to support assembly **45** on swivel bracket **40** and a nut **49** is provided to hold assembly **45** captive to pin **41**. Cylinder **47** slidably mounts a piston (not shown) secured to one end of an axially extending operating rod **50** extending through the lower end of cylinder **47**. As in the case of assembly **21**, a hydraulic fluid medium, not shown, is provided in cylinder **47** to oppose extension and retraction of assembly **45** and damp corresponding upward and return tilting movement of the motor, the fluid being accommodated for displacement by suitable passages in the piston.

Radius link element **46** is single acting in design and as shown is apertured in the apical portion thereof to receive pivot pin **43** securing the linkage to clamp bracket **42**. A washer **51** and split pin **52** are assembled on pin **43** to retain link element **46** thereon. The L-forming arms **53** and **54** of link element **46** extend rearwardly and downwardly respectively from pivot pin **43**. Arm **53** is connected to a ring-like fitting **55** on the lower end of rod **50** by a pivot pin **56** which is held captive between fitting **55** and arm **53** by any suitable means such as a pair of lock washers **57** only one of which is shown. The other linkage arm, arm **54**, abuts a laterally inwardly extending stop member **58** formed integrally with clamp bracket **42**. Thus constructed and connected between operating rod **50** and clamp bracket **42**, link element **46** may pivot on pin **43** between the position wherein arm **54** abuts stop member **58** and the position wherein the arm **53** is in alignment with operating rod **50** to accommodate a preselected angular travel of the motor in both the upward and return directions of tilting movement.

The single action of link element **46** is provided by a coil spring **59** assembled coaxially of pivot pin **43** between linkage **46** and clamp bracket **42** and anchored at the ends within suitable holes **60** provided in linkage **46** and bracket **42**. The spring **59** is disposed to urge link element **46** in a counterclockwise direction on pin **43** as viewed in FIG. 9 and to the position wherein arm **54** engages stop member **58** with the motor in running position. Thus positioned, spring **59** opposes upward tilting movement of the motor but as in the earlier embodiment, the spring flexure characteristic is fairly light and the spring opposition is of no real significance in comparison with the energy of the tilting motor.

The operation and functioning of shock absorber **39** is identical with that of the earlier described construction in that in a full or substantially full sweep of the motor, linkage **46** accommodates the motor from running position to an intermediate tilt position wherein the lowered end of the motor is just above the waterline, thus enabling the motor to rapidly clear any obstruction in its path, while assembly **45** controls the further upward tilting of the motor to dissipate and absorb the momentum thereof as it approaches a position of full tilt.

Similarly, in the return direction of tilting of the motor, linkage **46** initially accommodates the motor as it tilts to a position wherein the lower end of the motor is closely adjacent the waterline, while the remaining angular travel thereof to running position is accommodated by assembly **45** to effect the benefits previously discussed. In trailing out of the motor, the linkage **46** under the return action of spring **59** will cause a partial extension of the damper assembly **45** during momentary halting of the motor in the course of returning to running position to enable the final increment of the return movement to be damped by assembly **45**.

Both embodiments of the shock absorber mechanism set forth above are particularly well suited for low cost manufacture owing to the relative simplicity of their component parts. Further, the proposed mechanisms are capable of providing trouble-free operation over extended periods of use as the parts thereof are of rugged design.

Various modes of carrying out the invention are contemplated as being within the scope of the following claims particularly pointing out and distinctly claiming the subject matter which is regarded as the invention.

I claim:

1. In an outboard propulsion unit mounting having a transom mountable bracket supporting the unit for tilting movement on a horizontal transverse axis and between a normal upright running position and a rearwardly and upwardly inoperative position, tilt control means comprising a two-way acting damper element connected between the tiltable propulsion unit and the transom bracket to accommodate a preselected portion of the angular movement of the unit in tilting between the running and inoperative tilt positions, and a spring actuated lost motion means coupled to said damper element in the connection therefor for delaying actuation of the damper element during the initial tilting movement of the unit from the running to the inoperative tilt positions to enable the unit to have relief from obstructions in its path when in running position and to return rapidly toward a steering position in the water from an inoperative tilt position, said damper element being operative following the initial movement of the unit from the running to the inoperative tilt position to damp the unit as it approaches the full tilt position in the tilt cycle of the unit and also upon the return tilt movement as the unit approaches its operative position, said lost motion means delaying actuation of said damper element upon the return stroke until the unit reenters the washer from the inoperative tilt position.

2. An outboard propulsion unit mounting comprising a clamp bracket adapted to be fixedly secured to the transom of a boat and a swivel bracket carrying the propulsion unit and pivotally secured to said clamp bracket on a horizontal transverse axis to provide for tilting movement of said unit from and between a normal upright running position with the lower end of the unit underwater and a rearwardly upwardly tilted inoperative position with the end of the unit lifted clear of the water, shock absorber means connected between said clamp bracket and said swivel bracket for controlling the unit during tilting movement, comprising a hydraulic piston-cylinder assembly of double acting design pivotally connected through one of its cooperating piston-cylinder elements to the upper end of said swivel bracket, a link pivotally secured to the lower end of said clamp bracket and having a rearwardly horizontally extending first arm portion pivotally connected to the other of the cooperating piston-cylinder elements of said piston-cylinder assembly and a downwardly extending second arm portion abutting a forwardly disposed portion of said clamp bracket with said unit in running position, and spring means connected between said link and clamp bracket and biasing said link relatively against pivoting movement in the direction corresponding to upward tilting of the unit, said spring means adapted to bias said link towards a return position and said spring means having a light flexure characteristic and only nominally opposing the initial upward tilting of the unit.

3. In mounting means for an outboard propulsion unit which is tiltable rearwardly and upwardly from an operative position upon a substantially fixed transverse pivot axis, means for controlling the tilting movement of the unit, comprising a double acting hydraulic cylinder and piston means, means connecting said hydraulic means across the axis to be actuated by the tilt movement of the unit, mechanical lost motion means in the connection for said hydraulic means for delaying actuation of said hydraulic means during initial rearward and upward tilt of said unit and in the initial return movement thereof, and spring means resisting movement of said lost motion means during initial rearward and upward tilting of the unit and assisting the initial return movement of the unit.

4. In a mounting for an outboard propulsion unit which is tiltable rearwardly and upwardly from an operating position upon a substantially fixed transverse pivot axis, means for controlling the tilting movement of the unit, comprising a combination of separate double acting hydraulic and spring yieldable means connected across the axis in series to be actuated by the tilt movement of the unit, said spring means having a light flexure characteristic whereby it yields in preference to said hydraulic means during the initial portion of the rearward and upward tilt movement of the unit and as said spring means becomes fully loaded said hydraulic means takes over to absorb the momentum of the tilting unit, and upon return tilting movement said spring means again acts in preference to said hydraulic means to aid in a fast initial return of the unit followed by a hydraulic cushioning of the return movement to the upright operative position of the unit.

5. In an outboard propulsion unit mounting comprising a transom mountable bracket pivotally mounting the unit for tilting movement on a horizontal transverse axis and between a normal upright running position and a rearwardly and upwardly tilting inoperative position, tilt control means for controlling a pre-selected portion of the angular movement of the unit, said means comprising a two-way acting hydraulic piston-cylinder assembly damper element connected between said bracket and the unit, and lost motion means for delaying actuation of the damper element during the initial tilt movement in either direction, said lost motion means comprising a pivotal link connected to one of the assembly elements of said damper element, and an actuating spring biasing said link in a direction of return movement for said lost motion means.

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