# United States Patent [19]

**Frisbee**

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## [54] BOAT STEERING STABILIZER


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[52] **U.S. Cl.**..... **114/235 WS,** 114/162, 114/163, 115/6.1

[51] **Int. Cl.**..... **B63b 21/56**

[58] **Field of Search**..... 9/310 R, 310 A; 114/144 R, 114/162, 163, 164, 235 R, 235 WS, 236, 237; 115/6, 6.1, 7



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[57] **ABSTRACT**

A steering stablizer for a boat towing in a load is disclosed herein in which the stabilizer includes an auxiliary rudder rotatably mounted on the transom by a torque device offset from the longitudinal center line of the boat. A control linkage is carried on the torque device and is coupled to the load via a tow line. The control linkage is responsive to transverse movement of the load to rotate the torque device and the auxiliary rudder in the direction of the load movement so that the heading of the boat is unaffected by the load-induced side forces at the stern of the boat.


**13 Claims, 7 Drawing Figures**

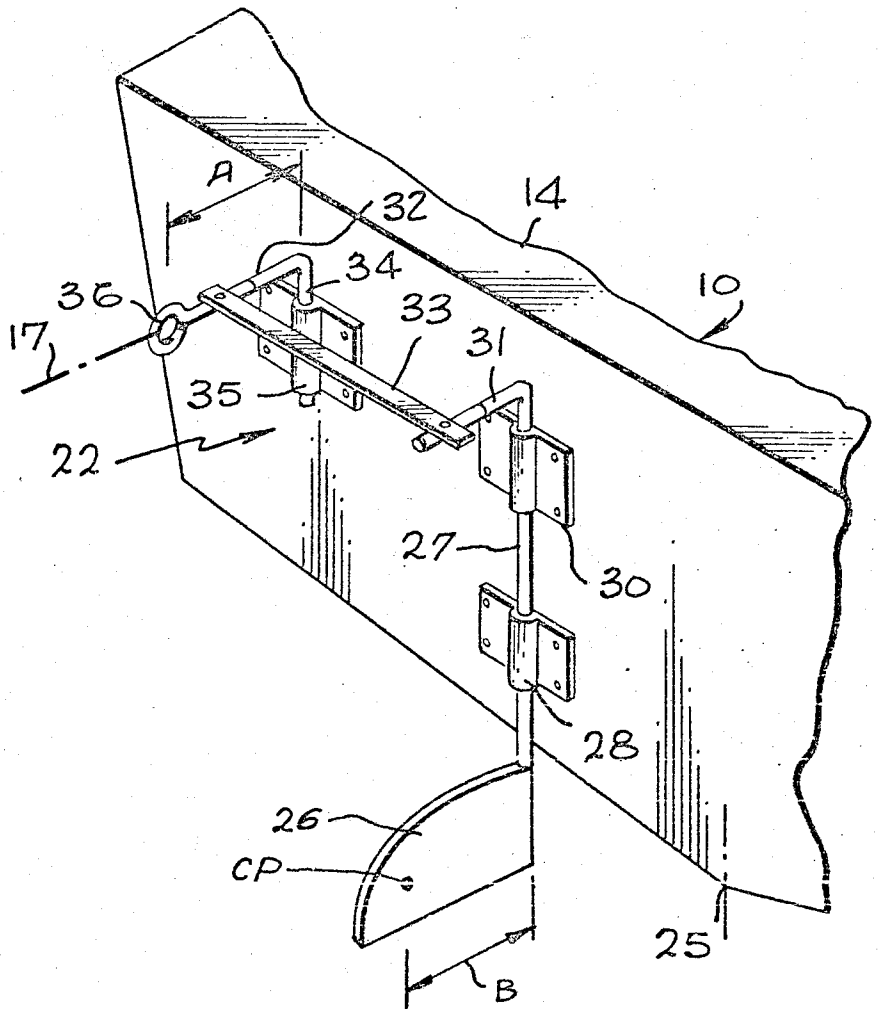


Fig. 1

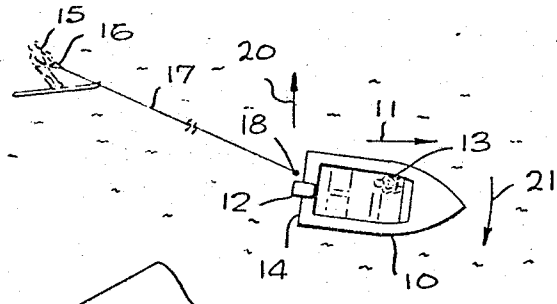
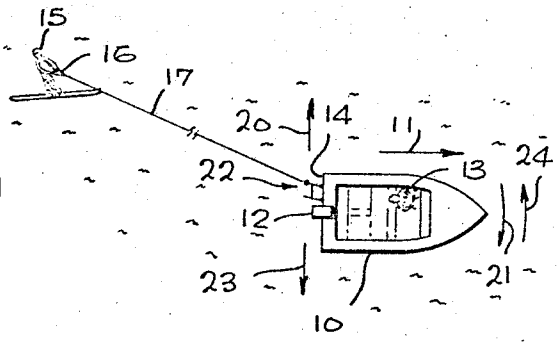



Fig. 2



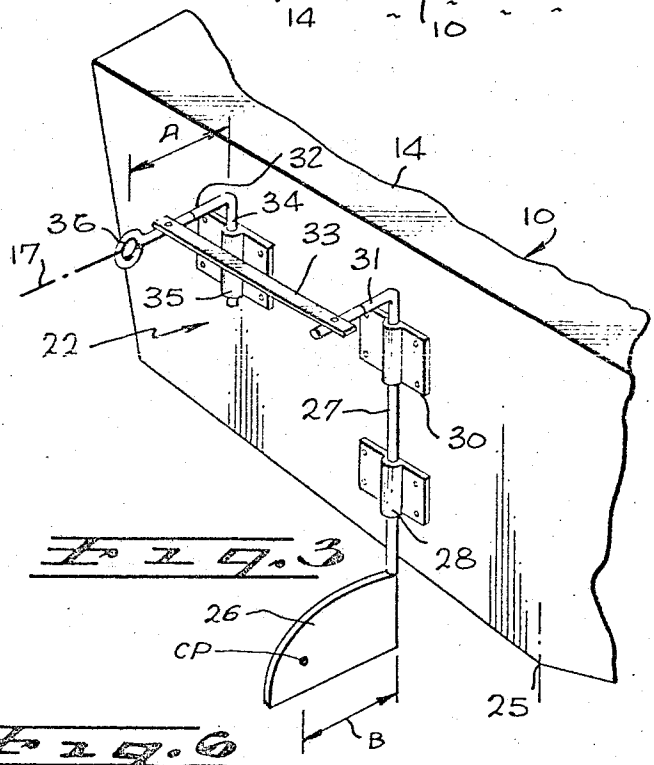




Fig. 3

Fig. 4

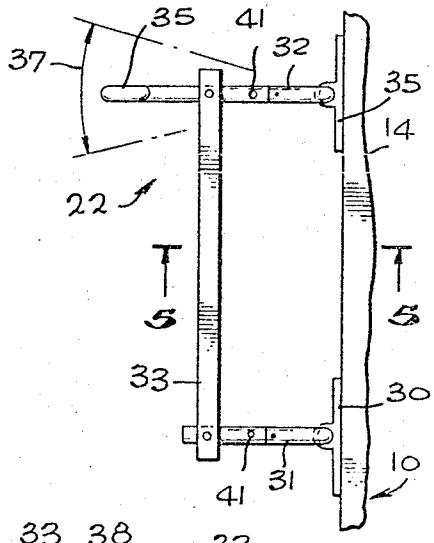
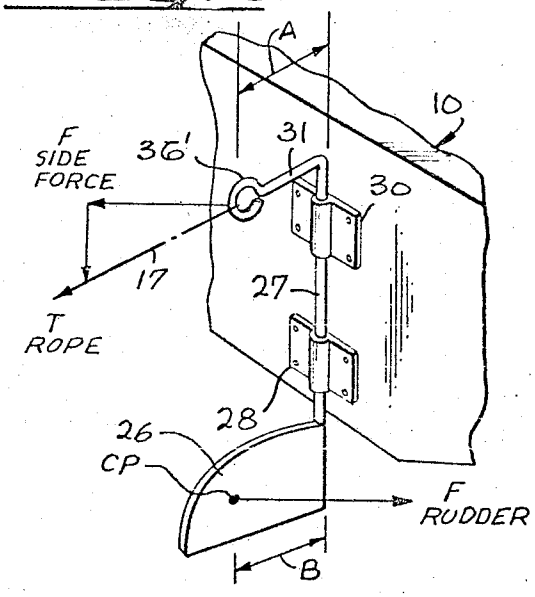



Fig. 6



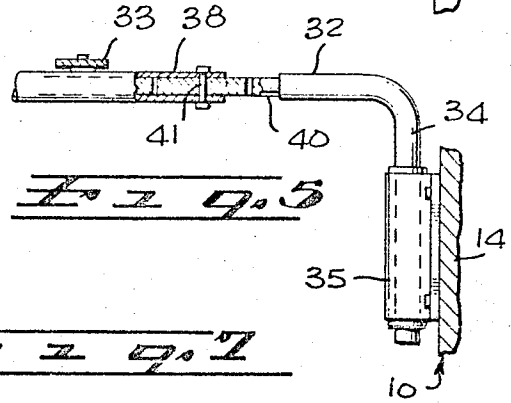
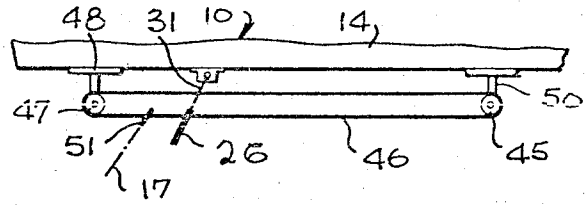




Fig. 5

Fig. 7



# BOAT STEERING STABILIZER

## BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to automatic stabilizing means for a boat and, more particularly, to an automatic means responsive to lateral movement of a towed load to maintain the heading and course of the boat.

2. Description of the Prior Art

In the boating field, it is well known that the steering of a boat is accomplished by moving the boat's stern to either the right or left of its longitudinal center line. Means for providing this movement may take the form of the discharge force of an engine via the propeller or by means of a controllable rudder or a combination of both. However, when the boat is towing a load, side load forces are induced to the stern of the towing boat due to lateral shifts or displacement of the towed load. These side forces cause the boat to turn or pivot approximately one-third aft of its bow so that the intended heading or course of the boat is altered significantly. This altered heading must then be corrected by the operator of the boat through his conventional steering means so that the boat is directed back onto the intended heading.

Obviously, not only is the steering of the boat greatly restricted but the overall maneuverability of the boat is adversely affected and substantial skill of the boat operator is required to steer and compensate for the shifting lateral side load forces. This problem is particularly acute when the boat is employed for towing one or more waterskiers, since the skier is constantly moving across the stern of the boat in a substantial arc from the point of two rope connection at the transom of the boat. For example, as a waterskier moves laterally to either side, he produces a side load and turning moment on the boat that tends to pull the stern of the boat towards the side where the skier is located and, as the stern moves in this direction, the boat is turned in the opposite direction. To keep on course, the operator is required to maintain a constant vigil and must continually correct for the side pull and turning tendency by means of the steering wheel being controllably connected to the boat motor.

In the past, attempts have been made to overcome the adverse steering effects of a towed load and such attempts are disclosed in U.S. letters Pat. Nos. 394,174; 398,631 and 1,968,577. However, these prior devices relate to remote controlled means for steering a towed boat rather than for enhancing the control of the steering of the towing boat. These prior devices are also extremely complex and are directed more towards situations in which a towed boat is following almost in a direct line with the towing boat as opposed to a widely swinging load such as a waterskier.

Therefore, a long standing need has existed to provide an automatic means for overcoming the adverse effects of said load force generation induced at the stern of a towing boat due to an extremely wide lateral displacement of a towed load.

## SUMMARY OF THE INVENTION

Accordingly, the problems and difficulties encountered with lateral swinging loads towed from a vessel or boat are obviated by the present invention which provides an automatic stabilizing means that counteracts induced side forces at the stern of the towing vessel.



The stabilizing means includes a rotatable auxiliary rudder carried on the transom of the towing vessel offset from the longitudinal center line of the vessel by means of a turning or torque-sensitive device. Control linkage is operably coupled between a tow line connected to the towed load and the turning device so as to be responsive to lateral shifts of the towed load for rotating the rudder in the direction of the induced side force load at the stern of the towing vessel.

Therefore, it is among the primary objects of the present invention to provide a novel automatic stabilized steering control for a towing vessel responsive to induced side forces at its stern to counteract the resultant side swing and turning tendency from its intended course.

Another object of the present invention is to provide a novel automatic stabilizing means for maintaining a boat heading and course regardless of widely swinging lateral loads induced by a laterally moving towed load.

Another object of the present invention is to provide an auxiliary rudder mechanism offset from the standard steering device of the boat operable in response to swinging side load forces generated by a laterally moving towed load to maintain the course and heading of the boat.

Another object of the present invention is to provide a novel automatic stabilizing means for preventing a waterskier or skiers from continuing pulling the tow boat off its course as the skiers maneuver from side-to-side behind the towing boat.

Yet another object of the present invention is to provide a novel towing stabilizer carried on the stern of the towing boat for automatically counteracting the side swing and turning tendency of the boat which a waterskier produces without the attendent need of corrective steering by the operator of the tow boat.

## BRIEF DESCRIPTION OF THE DRAWINGS

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of a conventional water ski tow boat towing a waterskier therebehind;

FIG. 2 is a diagrammatic view similar to the view shown in FIG. 1 of a tow boat incorporating the present invention for towing a skier through the water;

FIG. 3 is an enlarged perspective view of one form of an automatic stabilizing means of the present invention as employed on the tow boat shown in FIG. 2;

FIG. 4 is a top plan view of the automatic stabilizing means shown in FIG. 3;

FIG. 5 is a side elevational view, partly in section, of an adjustable link employed in the stabilization means shown in FIG. 4 as taken in the direction of arrows 5—5 thereof;

FIG. 6 is a perspective view of another embodiment of an automatic stabilizing means incorporating the present invention; and

FIG. 7 is a top plan view of still another version of the automatic stabilizing means of the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, a conventional water ski tow boat is indicated by numeral 10 and is illustrated as heading on a course in the direction of arrow 11. Boat 10 is powered and steered by a conventional motor 12 via a steering wheel under the control of the operator of the boat 13. As is the usual practice, motor 12 is located on a transom 14 constituting the stern of the boat and is substantially located along the longitudinal center line of the boat. Boat 10 is employed as a tow boat for towing a waterskier 15 therebehind. The skier grasps a handle 16 which is connected to one end of a tow rope 17 while the opposite end of the tow rope is secured to transom 14 by a fixed fastener attachment means 18. Attachment means 18 is of a stationary design and generally takes the form of an apertured fitting or the like. As the waterskier 15 is towed behind the boat 10, the skier maneuvers laterally along a wide arc behind the boat. During such maneuvering, the skier produces a side pull or load at the stern of the boat in the direction of arrow 20 which induces a turning moment on the boat tending to pull the stern of the boat towards the side where the skier is located. Also, this induced side force tends to turn the bow of the boat in the opposite direction from the arrow 20 whereby the heading of the boat turns in the direction of arrow 21. The turning moment of the boat in the direction of arrow 21 changes the heading and course of the boat from its intended course 11. To keep the boat on course, the operator must continuously correct for the side pull in the direction 20 and the turning tendency in the direction of arrow 21 by means of the steering wheel and the normal steering control such as the motor 12. If more than one waterskier is being towed, the problem is compounded and at times, corrective steering by the operator is extremely difficult, if not impossible.

In contract to the above-described conventional situation, FIG. 2 illustrates the same boat 10 incorporating the automatic stabilizing means of the present invention. The automatic stabilizing means is indicated in the general direction of arrow 22 where it is mounted on the transom 14 of boat 10. The end of ski rope or line 17 is attached to the automatic stabilizing means and the force developed by the automatic stabilizing means tends to swing the stern of boat 10 to the side opposite the skier as indicated by arrow 23 and to turn the boat back on its intended course 11 as indicated by the arrow 24. In this manner, the stabilizing means of the present invention automatically counteracts the side swing and turning tendency which the skier 15 produces without the need of corrective steering by the operator of the boat. Side force 20 induced by the lateral load of the skier is compensated for by the side force 23 in response to the automatic stabilizing means. The turning moment 21 of the boat induced by the lateral load of the skier is counteracted by the automatic stabilizing means when it induces the opposite turning moment 24.

Referring now in detail to FIG. 3, the stabilizing means of the present invention is illustrated in the general direction of arrow 22 and is operably carried on transom 14 of boat 10 substantially offset from the longitudinal center line of the boat as is indicated by numeral 25. For purposes of clarity, motor 12 is not illustrated as mounted on the stern of the boat; however, it is to be understood that any conventional motor or rudder combination may be employed for normal steering of the boat. The automatic stabilizing means 22 comprises an auxiliary rudder 26 submerged in the water preferably below the waterline of the boat. The auxiliary rudder is carried on the end of an auxiliary rudder turning or torque rod 27 that is rotatably carried on the transom by means of a pair of torque rod bearing supports 28 and 30. The end of rod 27 from its carrying rudder 26, is provided with a control crank 31 which projects outwardly from the transom 14 substantially in vertical alignment with the rudder 26. A ski rope attachment arm 32 is arranged in parallel relationship with the control crank 31 by means of an interconnecting link 33. The opposite ends of link 33 are pivotally attached to the arm 32 and control crank 31, respectively, by pins or the like. Attachment arm 32 includes a rod 34 rotatably carried on a bearing support 35 fixedly secured to the transom in fixed spaced relationship with respect to the rod bearing support 30. The opposite end of arm 32 from its end connected to the rod 34 is formed with an attachment means 36, such as a closed eye, for detachably securing the end of tow rope 17 therewith.

It is to be noted that a significant relationship is established by having the attachment arm 32 equal in length to the distance from the pivot axis to the center of pressure of the auxiliary rudder 26. More specifically, dimension A in connection with attachment arm 32 should be equal to the dimension indicated by dimension B associated with auxiliary rudder 26. If the tow rope attachment point 36 is the same distance from the rudder pivot axis as the rudder center of pressure indicated by character B, the side force and rudder force will exactly equal each other.

In FIGS. 3 and 6, a diagram of the forces and important dimensions of the ski-boat stabilizer are shown:

In the diagram, the following symbols and notation are used:

F(side-force) = Skier's Side-Force component
F(rudder) = Rudder Force
T(rope) = Tow-rope Tension or Pull-Force
c.p.(rud.) = rudder center-of-pressure
A = distance from rope attach point to pivot-point (rudder shaft axis) (or, length of tow-rope attach arm)

B = distance from rudder center-of-pressure to rudder shaft axis, or pivot point

It can be seen that for any condition the Side Force moment on the crank and the Rudder moment will be equal and opposite as stated by the following relationship:

1. F(side-force) X A = F(rudder) X B

From this relationship, it is also clear that if dimension A is set equal to dimension B, the rudder force, F(rudder) will equal the skier's side-force component, F(side-force).

This is the situation pictured in FIGS. 3 and 6. In this situation the skier's side-force, or side pull, on the stern of the boat is exactly counterbalanced by the force being produced by the rudder in the opposite direction, and the boat does not turn.

If, however, dimension A does not equal dimension B, it is clear from relationship (1), above, that the rudder-force F(rudder) will be either greater or less than the skier's side-force, F(side-force), and since these

forces tending to move the stern of the boat one direction or the other are not balanced, the boat will turn opposite the direction of the larger force.

For example, if A were longer than B, the skier would have leverage to turn the rudder to an angle that would produce a rudder force greater than the skier's side-force (thus turning the boat towards him). If A were shorter than B, the skier's leverage would not turn the rudder far enough to balance his side-force (the boat would turn away from him).

From the above description, it is clear that the significance of maintaining A and B equal is that the side-force produced by the rudder, F(rudder), will balance the skier's side-force F(side-force). Thus the rudder stabilizes the boat against the skier but does not steer it.

Referring now to FIG. 4, it can be seen that as the attachment arm 32 is rotated in its bearing 35 responsive to lateral movement of the towed load as indicated by the arc 37, control link 31 will follow via the interconnecting link 33 so that the auxiliary rudder 26 will also be rotated in its bearing supports 28 and 30.

Although the length of control crank 31 and the length of attachment arm 32 may be of a fixed dimension, it is to be understood these links may vary in order to accommodate more efficient load handling capabilities and efficiencies in response time. For example, the attachment arm and control crank may be composed of telescoping members, such as is illustrated in FIG. 5, so that they may be varied in length, as desired. In this instance, attachment arm 32 is illustrated as having a tube portion 38 and a rod portion 40 that are in slidable telescoping relationship. The tube portion and rod portion are provided with apertures that when in registry, will readily receive a detachable fastener such as a spring pin 41. However, it is essential that the substantial length of the two members be of equal length so that the link 33, attachment arm, control crank and the transom of the boat form a parallelogram in plan view when the boat is towing under load.

Referring now to FIG. 6, another embodiment of the present invention is illustrated which represents a simplified version of the boat towing stabilizer wherein the tow rope 17 is attached directly to the control crank 31 by provision of attachment means 36' carried thereon. It is understood that the torque device 27, auxiliary rudder 26 and the bearing supports 28 and 30 are identical to the construction shown in FIG. 3. As described previously, the distance A which is the length of the control crank is equal to the distance B of the rudder so that the side force and rudder force will be exactly equal with respect to each other.

Other embodiments and versions of the invention are contemplated such as is shown in FIG. 7 wherein an endless cable 46 is trained around the periphery of a pulley 45 and a pulley 47. Both pulleys are rotatably mounted on the transom 14 by suitable bearing supports 48 and 50, respectively. It is to be noted that the ski rope 17 is detachably connected to the outside side of the cable loop by an attachment connector 51. Also, torque device 27 may be rotated by coupling the control crank 31 to the outside side of the cable loop by any suitable means. Therefore, as the ski rope moves from side to side, cable 46 will move accordingly and effect rotation of the torque device 27 and the downwardly depending auxiliary rudder attached thereto.

In view of the foregoing, it can be seen that the automatic towing stabilizer of the present invention provides a means for counteracting the side swing and turning tendencies encountered by a towing boat when the skier swings along a wide arc from side-to-side behind the boat. The towing stabilizer means as shown in FIG. 3, as an example, includes an auxiliary rudder installed on the transom of the tow boat below the waterline and is rotated by the rod 27. The rod 27 is rotatably carried by bearing supports on the boat transom and is provided with a control crank 31 at its upper end to which the tow rope is attached directly as shown in FIG. 6, or to which one end of the link 33 may be attached by means of a pivot pin. The outboard end of the link 33 is attached by means of a pivot pin to the attachment arm 32 and the tow rope is attached to the attachment arm 32 by any suitable means. It is to be understood by duplicating this arrangement at the other side of the transom 14, attachment of two tow ropes may be permitted.

By employment of the automatic towing stabilizer means of the present invention on a tow boat and when the tow rope is attached to the control crank as shown in either FIGS. 3 or 6, the control crank will swing in the direction that the rope is pulling and thus turning the rudder in the same direction, but not necessarily the same angle. The force developed by the rudder in this position tends to swing the stern to the side opposite the skier and to turn the boat back towards the skier. In this manner, the towing stabilizer automatically counteracts the side swing and turning tendency which the skier produces without need of corrective steering by the operator of the boat.

While particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. A steering stabilizing means on a boat, having a primary steering apparatus for, towing a laterally swinging load from a tow line having its opposite ends connected to the load and boat respectively comprising:

an auxiliary steering means in addition to and in spaced relationship to the primary steering apparatus rotatably carried on the stern of the boat below the waterline thereof;

control means operably carried on said auxiliary steering means for rotating said auxiliary steering means in response to movement of said control means; and

attachment means carried on said control means detachably connected to the tow line and said control means being responsive to move laterally following the swing of the load so that said auxiliary steering means counteracts any tendency of the boat to deviate from its intended course and heading.

2. The invention as defined in claim 1 wherein said auxiliary steering means includes a rudder offset from the longitudinal centerline of the boat and from the primary steering apparatus; and

said control means includes a torque device rotatably mounted on the transom of the boat and a crank arm lying in a vertical plane with said rudder.

3. The invention as defined in claim 2 wherein the dimensional length of said crank arm is substantially equal to the dimensional distance from the leading edge of said rudder to the center of rudder pressure.

4. The invention as defined in claim 3 including an attachment arm rotatably carried on the transom of the boat in spaced apart parallel relationship with respect to said crank arm;

an interconnecting link pivotally secured at its opposite ends to said attachment arm and said crank arm respectively; and

said attachment means carried on the free end of said attachment arm.

5. The invention as defined in claim 4 including means for adjusting the length of said attachment arm and said crank arm.

6. The invention as defined in claim 3 wherein said torque device comprises a turning shaft mounted in bearing supports attached to the transom of the boat.

7. The invention as defined in claim 1 wherein said control means includes an endless cable carried about a pair of spaced apart pulleys rotatably mounted on the transom of the boat wherein said attachment means is carried on one side of said cable and said auxiliary steering means is carried on the opposite side of said cable.

8. A steering stabilizer for a boat, having a primary steering apparatus, towing at least one waterskier by a tow line connected at its opposite ends to the skier and the boat respectively comprising the combination of:

rudder means movably carried at the stern of the boat below the water line in spaced relationship to said primary steering apparatus thereof; and

control linkage means carried on said boat operably coupled to said rudder means and connected to said tow line responsive to lateral movement of the skier for translation into a side force at the stern of the boat via said rudder means to counteract an opposite side force at the stern of said boat induced by the load of the water skier whereby said boat automatically maintains its intended heading and course via said primary steering apparatus.

9. The invention as defined in claim 8 wherein said rudder means includes a blade downwardly depending from a torque rod rotatably carried about a vertical axis; and

said control linkage means includes a control arm connected to said torque rod in fixed spaced relationship to said blade and lying in the same vertical plane as said blade.

10. The invention as defined in claim 9 wherein the dimensional length of said control arm is equal to the dimensional distance from the leading edge of said blade to its center of pressure.

11. The invention as defined in claim 8 including a pivot connection attaching the end of said tow rope to said control linkage means; and wherein

the dimensional distance from the pivot point of said pivot connection to line attachment point is substantially the same as the dimensional distance from the rudder pivot axis to the center of pressure of said rudder means.

12. The invention as defined in claim 8 including a pivot connection attaching the end of said tow rope to said control linkage means whereby a balancing force is generated at the stern of the boat equal to the load of the skier by the submerged rudder means.

13. The invention as defined in claim 12 wherein said rudder means is offset from the longitudinal center line of the boat.

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