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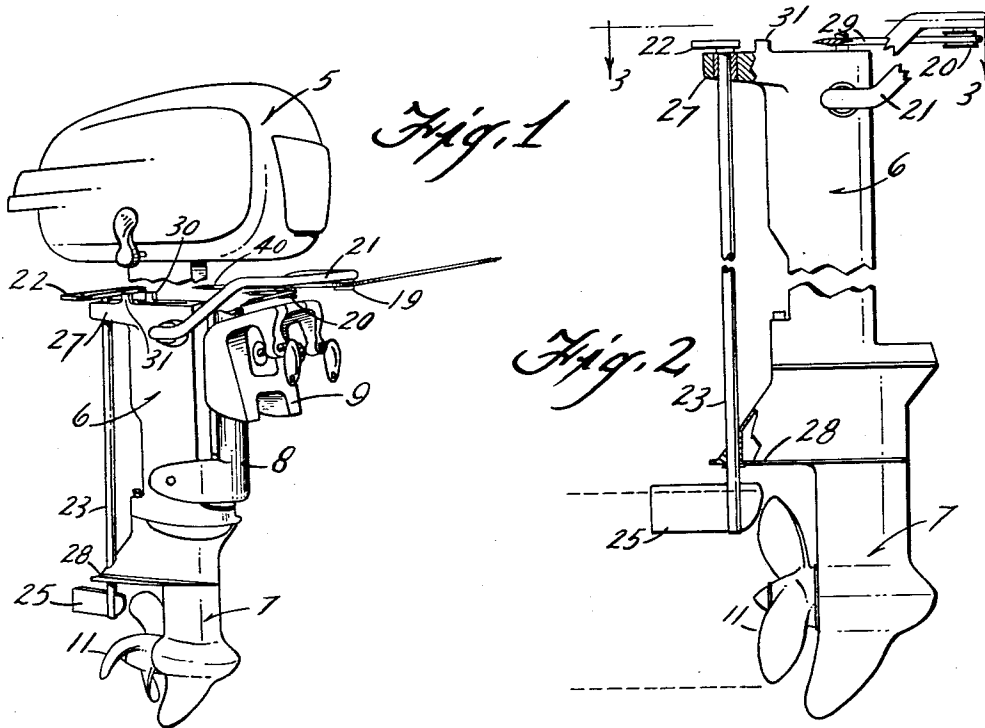
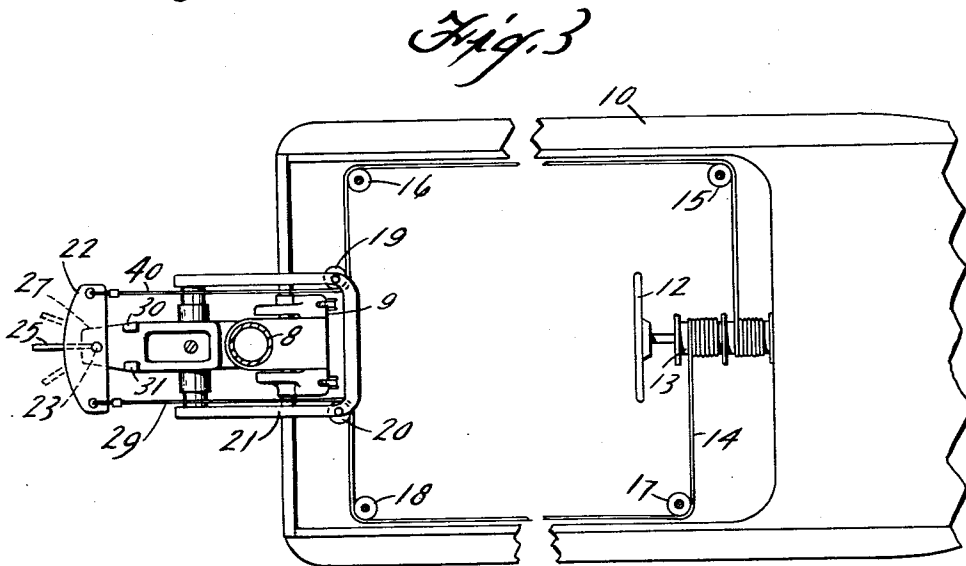
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PROPELLER ASSISTED STEERING AND AUTOMATIC TORQUE
COMPENSATION FOR AN OUTBOARD MOTOR

Filed Aug. 5, 1957

2 Sheets-Sheet 1



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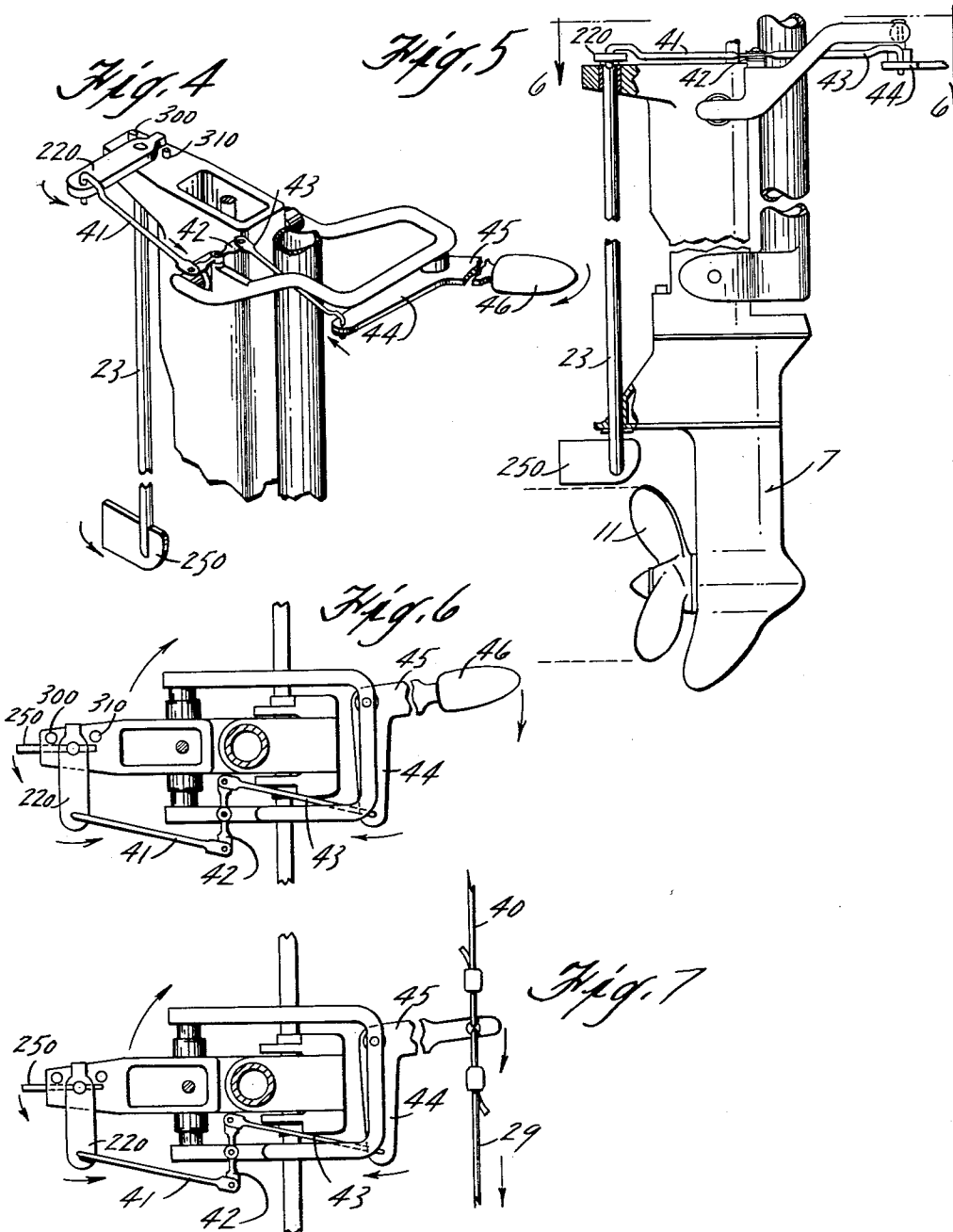
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PROPELLER ASSISTED STEERING AND AUTOMATIC TORQUE COMPENSATION FOR AN OUTBOARD MOTOR

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This invention relates to propeller assisted steering and automatic torque compensation for an outboard motor lower unit or comparable dirigible drive.

The invention has particular application to outboard motors. A self-feathering miniature control rudder or trim tab is attached to the dirigible propeller shaft housing, usually being positioned to lie in the slip stream of the propeller, and usually having a very limited range of oscillation (about 30° in practice). The trim tab is off center regarding its own axis in order to insure that the resultant center of pressure of forces acting on the tab will trail the axis. If its greatest area is aft of the axis, it will be subject at all times to bias tending to restore it to center and will be more stable in operation. In steering, either by means of a tiller handle or from a remote wheel, the connections are such that steering movement is first effective on the miniature rudder or trim tab to turn this in a direction to exercise its steering effect to oscillate the dirigible parts of the outboard motor in the desired direction. Boat direction is changed only by oscillation of the dirigible unit.

After the trim tab reaches its limit of movement, further action of the tiller or steering cable is transmitted mechanically to the dirigible propulsion unit of the outboard motor to turn this, aided by the rudder, in the desired direction upon its steering axis. Ordinarily, except when the outboard motor engine has stopped, or is in very slow speed operation, the displacement of the miniature rudder is sufficient in itself to effect steering oscillation of the outboard motor to the desired steering angle, using the thrust of the propeller slip stream to effect steering movement. With the engine in slow speed operation, the slip stream may be inadequate to effect steering movement, but the thrust exerted by the control rudder will aid steering.

Thus, the steering is either power effected or power assisted under all conditions by the propeller of the outboard motor when in operation. With the propeller at rest or in reverse, the control rudder will have little or no effect. Assuming that the control rudder is behind the steering axis, its direction of rotation will be opposite to the direction of rotation of the dirigible unit, but forces caused by its deflection in the opposite direction are too small to interfere with the steering effect of the rudder-shaped gear housing of the dirigible unit itself.

In the drawings:

FIG. 1 is a front quarter perspective view of an outboard motor embodying the invention, portions being broken away to expose the steering mechanism.

FIG. 2 is a fragmentary view on an enlarged scale showing the outboard motor in side elevation, the power head being removed and portions being broken away to a vertical fore and aft section.

FIG. 3 is a diagrammatic plan view showing the outboard motor applied to a boat, the power head being removed.

FIG. 4 is a fragmentary view in perspective showing an arrangement whereby the control rudder is actuated by a tiller mechanically linked thereto for the operation of the control rudder and, ultimately, the oscillation of the dirigible portions of the outboard motor.

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FIG. 5 is a view in side elevation of the dirigible propulsion unit portion of an outboard motor, portions being broken away and the power head being omitted.

FIG. 6 is a plan view of the parts shown in FIG. 4.

FIG. 7 is a view similar to FIG. 6 showing how the same device can be remotely controlled by connecting cables to the tiller.

Except for the power assisted steering herein described, the outboard motor may be of any conventional design.

The power head 5, shaft housing 6 and lower unit or gear housing 7 are unitarily connected and mounted on pintle 8 from transom bracket 9 to oscillate for steering. The streamlined gear housing or lower unit 7 acts as a rudder, but the steering of the boat 10 on which the transom bracket is mounted is primarily effected by directing to one side or the other the slip stream of propeller 11.

When such an outboard motor is to be steered from some remote point, as from the bow of the boat 10, one conventional practice is to provide at the remote point a steering wheel 12 having a drum 13 upon which the steering cable 14 is wound. The pulleys 15, 16, 17 and 18 fixed to the boat guide the steering cable and its ends are normally connected to the dirigible portions of the outboard motor well forward of the steering pintle 8 whereby the rotation of the steering wheel 12 will oscillate the outboard motor steering unit in either direction, according to the direction of rotation of the steering wheel. Rotation of the steering wheel clockwise as viewed by the operator looking forward will wind onto the drum 13 that portion of the cable which passes about pulleys 15 and 16 to oscillate the dirigible unit of the outboard motor counterclockwise as viewed in FIG. 3. In the course of this steering movement, the length of cable passing about pulleys 17 and 18 will be paid off of the drum 13 to accommodate the counterclockwise swinging movement of the dirigible unit. A converse movement of the steering wheel 12 in a counterclockwise direction as viewed by the operator will wind onto the drum the cable passing about pulleys 17 and 18 and pay out cable passing about pulleys 15 and 16 to effect clockwise oscillation of the outboard motor dirigible unit as viewed in FIG. 3.

However, instead of being connected rigidly to the forward portions of the dirigible unit, the two lengths of cable pass about the pulleys 19 and 20 which are mounted on carrying handle 21 or some other part of the motor well forward of pintle 8 which is firmly attached to the dirigible unit. The end of cable length 40 is attached to a tiller 22 at the port side of the control rudder post 23 on which control rudder 25 is mounted. The shaft housing 6 is provided with an arm at 27 which projects aft to provide a bearing support for the rudder post 23. A lower bearing support for the rudder post 23 is provided in the aft end of the anticavitation plate 28 as best shown in FIG. 1 and FIG. 2.

A portion 29 of the cable is led from the pulley 20 to connect to the starboard end of the tiller 22. Stops 30 and 31 are positioned in the path of oscillation of the tiller lever 22 to limit it to a range of approximately 30° in either direction of oscillation from its normal position longitudinal of the boat.

While it is broadly immaterial whether or not the rudder 25 is located behind the dirigible portions of the outboard motor, it is preferred that it be located directly in the slip stream of the engine driven propeller 11 of the outboard motor. It is small enough so that it will have no appreciable steering effect except as acted upon by the powerful slip stream from the propeller. Consequently, it has no substantial effect on the steering of the boat as a whole but, with the propeller in normal powered operation, the slip stream exerts on the control

rudder 25 a very considerable thrust tending to oscillate the dirigible unit of the outboard motor upon its steering pintle 8 in a steering direction which is necessarily exactly opposite to the angle to which the control rudder 25 is adjusted.

This angle will be accurately controlled by the wheel 12 because the steering cable is not fed directly to the tiller 22 at the rear of the dirigible unit but passes about pulleys 19 and 20 which are mounted on the front of the unit. Thus, as the unit turns, the cable which was wound up is relaxed and that which was payed out is tensioned, causing the control rudder to center itself. This self-feathering effect is a very desirable feature of the device. It occurs in every position to which the steering wheel is adjusted.

Moreover, if the steering wheel or cables (if these are employed) are held fixed, the rudder will automatically adjust itself to oppose any externally caused displacement of the lower unit or dirigible part of the outboard motor. To the extent to which there is any thrust whatever exerted by the slip stream on the control rudder 25, such thrust opposes the displacement of the control rudder from its normally centered position and the reaction of this thrust requires the cable to exert steering tension on one or the other of the pulleys 19 or 20 to oscillate the dirigible unit of the outboard motor in the desired steering direction. The operator in turn must continue to exert sufficient force on wheel 12 to keep control rudder 25 turned until he wishes to stop the dirigible unit from further movement. Accordingly, in all instances of normal use with the propeller in operation, the effect is one of power assisted steering rather than entirely automatic steering and the dirigible unit will respond accurately in direction and extent of movement to the movement of the wheel 12.

If there is no substantial propeller thrust, there will, obviously, be little or no reaction forces as above described but, after the control rudder has yielded to the limited extent permitted by the stops 30 and 31, the steering cable will, in effect, be locked between drum 13 and the forward portion of the dirigible unit of the outboard motor to which it is connected by passing about the now stationary pulley 19 or 20. Accordingly, after a limited amount of lost motion resulting from the free movement of the tiller, the steering will take place exactly as it would without the control rudder.

The embodiment shown in FIGS. 4 to 7 achieves these objectives in a slightly different manner. Here the rudder 250 is mounted on rudder post 23 slightly above the propeller 11. The lever 220 on the top of the steering post oscillates between the stop lugs 300 and 310 which limit its range of oscillation to the angle which is appropriate for the independent oscillation of the rudder. The link 41 connects rudder post lever 220 with one end of a lever 42, the other end of which is connected by link 43 with a bell crank 44 extending laterally from a manually operable tiller 45. The tiller has a hand grip at 46 intended to be grasped by the operator during operation. However, for remote control purposes, the hand grip may be removed and linkages, push-pull cable, or the illustrated lengths of solid steering cable 29 and 40 may be connected directly to the tiller 45 as shown in FIG. 7.

The operation of the device shown in FIGS. 4 to 7 is identical with that already described. In any steering movement of the tiller, whether effected through manual engagement of grip 46 or remotely through the cables 29 and 40, it is first communicated to the trim tab or rudder 250. If the parts are in rapid motion through the water, this may be adequate in and of itself to cause the dirigible portion of the outboard motor to adjust its position in the desired direction of steering, the adjustment stopping when the water pressure on the trim tab or rudder is balanced. If, for any reason, the trim tab action does not of itself effect the desired steering movement of the dirigible parts of the outboard motor, the engagement

of lever 220 with one or the other of the stops 300 or 310 will arrest further independent movement of the tiller and linkage whereby continued steering movement will be communicated directly to the dirigible parts to effect manual positioning thereof, aided by the trim tab or rudder if the outboard motor is in motion.

Due to the illustration of the trim tab or rudder in its preferred position behind the steering axis, it will be applied to pivot in a direction opposite the direction of oscillation desired for steering purposes. It is only on this account that the intermediate lever 42 is required to reverse the direction of oscillation of the rudder post as compared with the desired direction of steering oscillation.

I claim:

1. An outboard motor comprising a dirigible unit having a powerhead, a shaft housing and a gear casing in rigid unitary connection and including a drive shaft in the housing, a propeller shaft in the gear casing and a propeller mounted upon said shaft, means pivotally supporting said unit for steering movement, and means for effecting the oscillation of said unit by pressure of the water in which it is operated, said means comprising a control rudder pivotally connected with said unit and provided with means for its oscillation, the effect of the control rudder being to tend to oscillate said dirigible unit in a desired direction for steering.

2. The device of claim 1 in which said control rudder is mounted at the rear of said unit and connected to oscillate in a direction opposite to the desired steering oscillation of said dirigible unit.

3. A marine drive having a steering assisting means and comprising in combination a dirigible unit provided with a power-operated propeller, means pivoting such unit for oscillation about a vertical axis for steering, means for effecting the oscillation of said unit by pressure of the water in which it is operated, said means comprising a control rudder pivotally connected with said unit and provided with means for its oscillation, a tiller pivotally connected with the dirigible unit and having a lost motion connection with such unit for the steering thereof, the tiller being pivotally movable independently of the dirigible unit in a range of oscillation provided by the lost motion connection aforesaid, and a motion transmitting connection from the tiller to the rudder for the tiller-operated actuation of the rudder in such range, and means defining the limits of such range and constituting means for limiting the oscillation of the control rudder, the control rudder being mounted behind said unit and the connection of the tiller therewith including means for effecting control rudder oscillation in a direction opposite to the direction of oscillation of the tiller upon its pivotal connection with the dirigible unit.

4. The device of claim 3 in which said tiller is provided with connections for its oscillation from a remote point.

5. An outboard motor comprising a fixed unit, a dirigible unit having a power head, a shaft housing and gear casing in unitary connection, bearing means between the fixed unit and the dirigible unit in which said dirigible unit is oscillatable, the torque to which said unit is subject about the axis of its oscillation being substantially in balance by reason of the unitary connection of the power head shaft housing and gear casing, a propeller mounted on the gear casing and normally directed aft, a rudder post in a generally upright position behind the propeller, a control rudder mounted on the post at the rear of the propeller in the path of the slip stream therefrom and adapted to effect dirigible movement of the said dirigible unit, and supporting means respectively connected with the shaft housing and gear casing and provided bearings in which the rudder post is oscillatable, and means for oscillating the rudder in a direction opposite that in which steering movement of said dirigible unit is desired.

6. The device of claim 5 in which the means for oscillating the rudder comprises a tiller lever in pivotal connection with said dirigible unit and having a motion trans-

mitting connection with the rudder post, and means limiting the rudder post to a limited oscillation.

7. An outboard motor comprising a fixed unit, a dirigible unit having a shaft housing and gear casing in unitary connection, bearing means between the fixed unit and the dirigible unit in which said dirigible unit is oscillatable, a propeller mounted on the gear casing and normally directed aft, a rudder post in a generally upright position behind the propeller, a control rudder mounted on the post at the rear of the propeller in the path of the slip stream therefrom and adapted to effect dirigible movement of the said dirigible unit, and supporting means respectively connected with the shaft housing and gear casing and providing bearings in which the rudder post is oscillatable, and means for oscillating the rudder in a direction opposite that in which steering movement of said dirigible unit is desired, means for oscillating the rudder comprising a tiller lever in pivotal connection with said dirigible unit and having a motion transmitting connection with the rudder post, and means limiting the rudder post to a limited oscillation, the pivotal connection of the tiller with said dirigible unit being disposed forwardly of the axis on which the unit is oscillatable in said bearing means and the connection from the tiller to the rudder post including linkage having means for reversing the direction of motion transmission, whereby the direction of oscillation of the rudder post is opposite the direction of oscillation of the tiller lever, the rudder comprising means for the dirigible movement of said unit in the direction in which the tiller lever oscillates.

8. A marine drive having a steering assisting means comprising in combination a dirigible unit provided with a power-operated propeller, means pivoting such unit for steering movement, and a control rudder pivotally connected with said unit and provided with means for its oscillation, the effect of the control rudder being to tend to oscillate said dirigible unit in a desired direction for steering, said dirigible unit comprising a power head, a gear housing on which the power-operated propeller is mounted, and means rigidly connecting the power head and gear housing to turn as a unit upon the means pivoting said unit for steering.

9. A marine drive having rudder assisted steering and comprising in combination a fixed unit, a dirigible unit provided with a power-operated propeller, means mounting said dirigible unit on said fixed unit for steering movement, means for the steering oscillation of said dirigible unit and comprising a control rudder in pivotal connection with said dirigible unit, steering means connected to said rudder to oscillate said rudder with respect to said dirigible unit in a direction to cause said dirigible unit to oscillate with respect to said fixed unit, the connection of said steering means with said rudder including lost motion connection between the steering means and the dirigible unit to oscillate said dirigible unit with respect to the fixed unit in the same sense that the rudder tends to oscillate the dirigible unit with respect to the fixed unit, means limiting the steering oscillation of said rudder with respect to said dirigible unit, the rudder being adapted to effect movement of said unit to a position in which the rudder is in balance with respect to pressure exerted thereon by the water in which it is immersed, and tending to respond automatically in response to any unbalance of

pressure in a direction to oscillate said unit toward a position in which said balance is restored.

10. The device of claim 9 in which said rudder is located aft of said dirigible unit and said steering means is located forwardly of the steering axis of said dirigible unit, the steering means having motion transmitting mechanism connecting it with said rudder for oscillating said rudder in a direction opposite to the direction of steering oscillation required of said unit.

11. A marine drive having a steering assisting means comprising in combination a dirigible unit provided with a power operated propeller, means pivoting such unit for steering movement, a control rudder pivotally connected with said unit and provided with means for its oscillation, the effect of the control rudder being to tend to oscillate said dirigible unit in a desired direction for steering, said control rudder being operatively mounted at the rear of the dirigible unit and in proximity to the propeller to be subject to propeller slip stream, means for limiting the oscillation of the control rudder, and steering means connected with the control rudder, said steering means having a secondary connection effective upon the dirigible unit when the control rudder reaches the limit of its oscillation whereby said dirigible unit will be moved in the same direction as normally urged by said rudder.

12. A marine drive having a steering assisting means comprising in combination a dirigible unit provided with a power operated propeller, means pivoting such unit for steering movement, a control rudder pivotally connected with said unit and provided with means for its oscillation, the effect of the control rudder being to tend to oscillate said dirigible unit in a desired direction for steering, a tiller pivotally connected with the dirigible unit and having a primary connection with said control rudder, and means for limiting the oscillation of the control rudder whereby said tiller is effective to bring about the oscillation of said dirigible unit when the control rudder reaches the limit of its movement, such oscillation of said dirigible unit being in the same direction as normally urged by said rudder.

13. The device of claim 12 in which the rudder has a rock shaft provided with a grooved tiller segment and the means for rudder oscillation comprises tiller cables crossing adjacent said segment and trained about the grooves thereof and connected to opposite sides of the segment.

14. The device of claim 12 in which the control rudder is provided with a rock shaft and is disposed at the rear of the propeller in the slip stream thereof, said tiller comprising a lever on the rock shaft, the means for oscillation comprising tiller ropes trained from opposite directions and connected with said lever at opposite sides of the rock shaft, the rudder being positioned by the tiller ropes.

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