

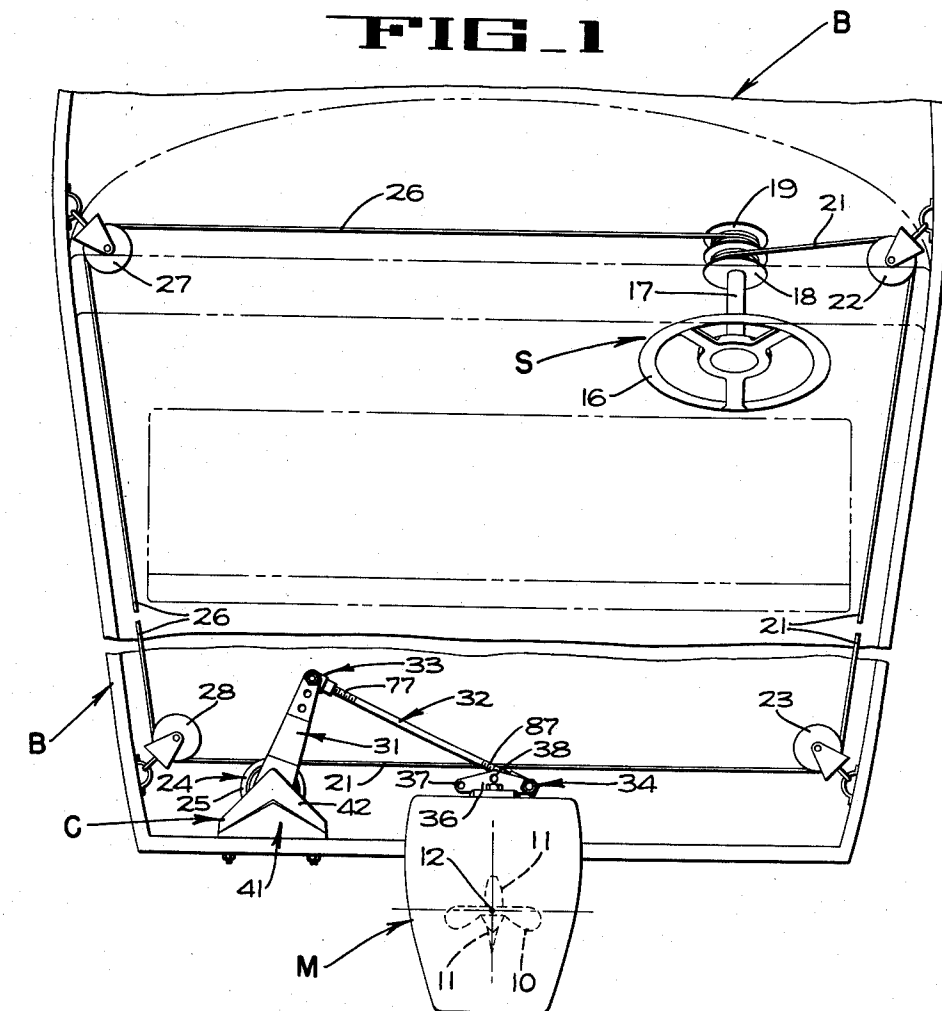
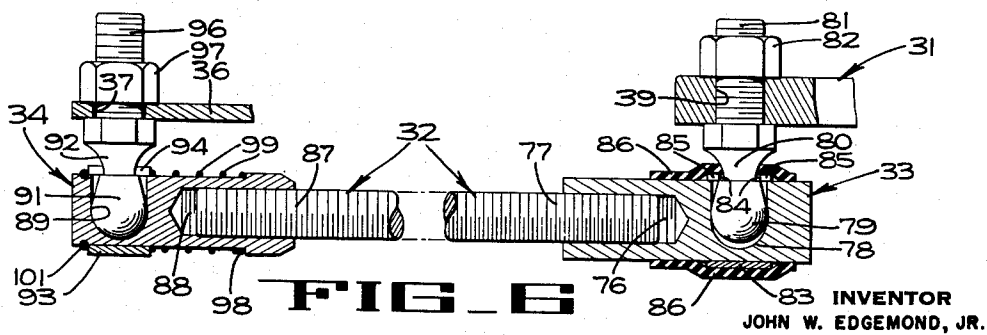
March 12, 1963

J. W. EDMOND, JR
BOAT STEERING MECHANISM

3,080,953

Filed Jan. 6, 1960

4 Sheets-Sheet 1



BY *Hans G. Hoffmeister*
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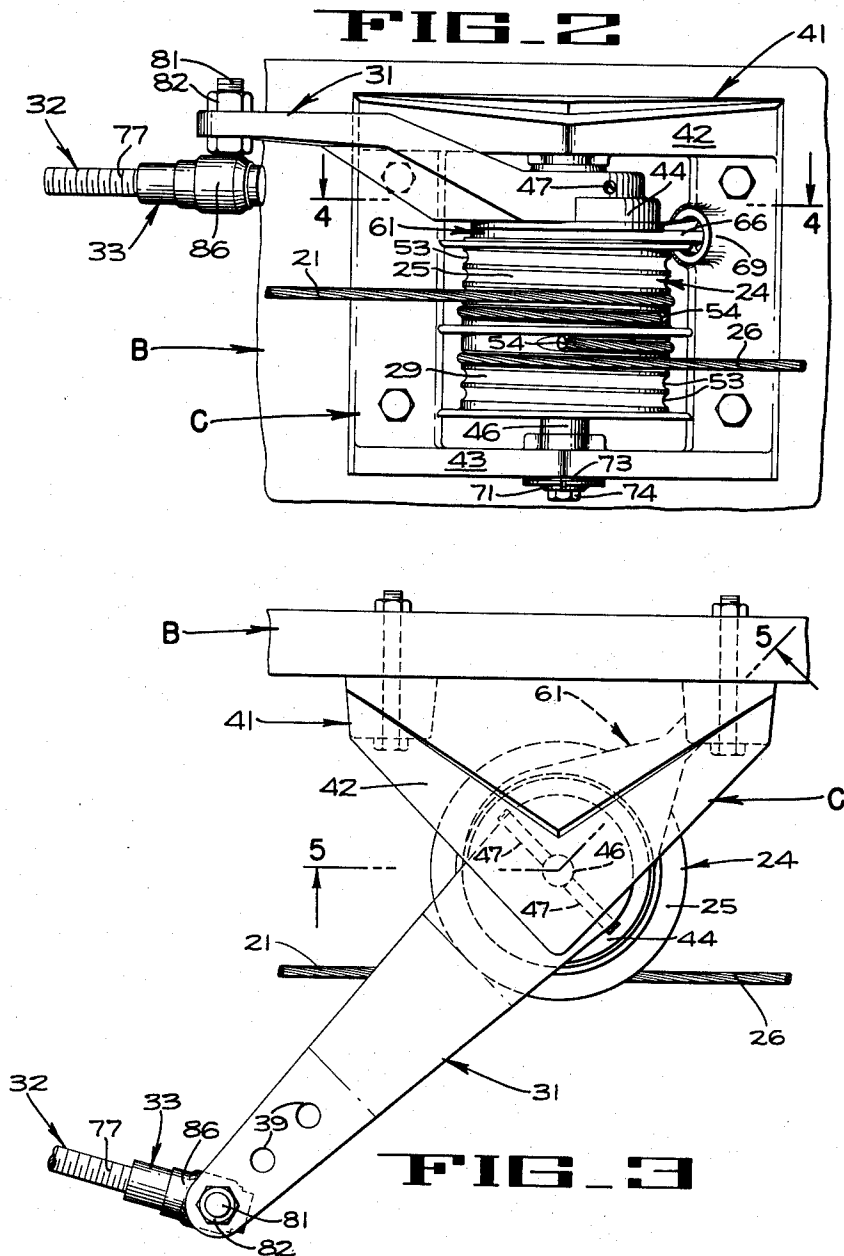
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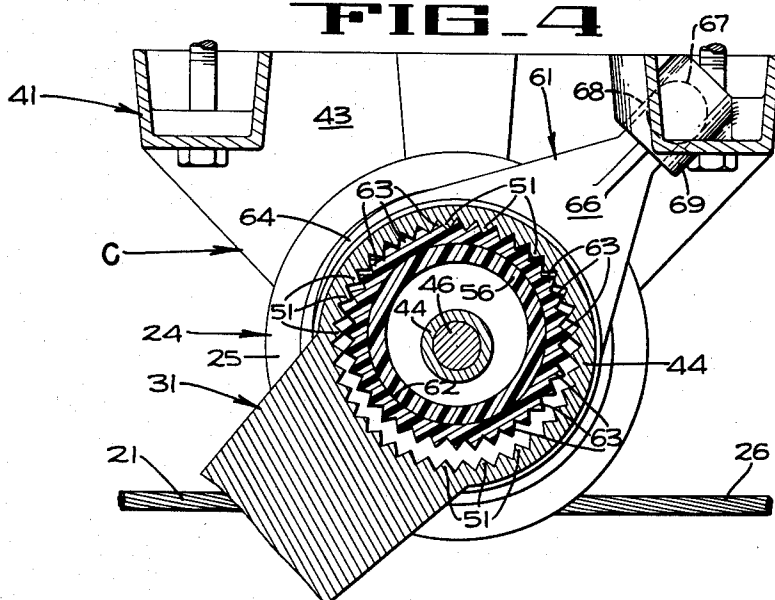
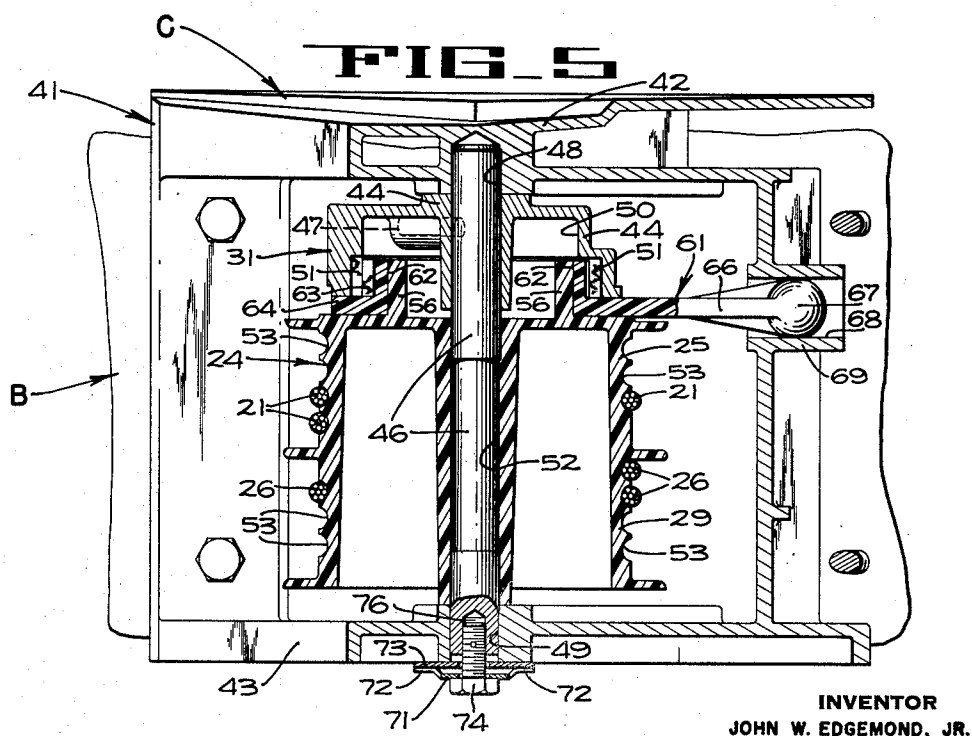
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FIG. 4



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FIG 7

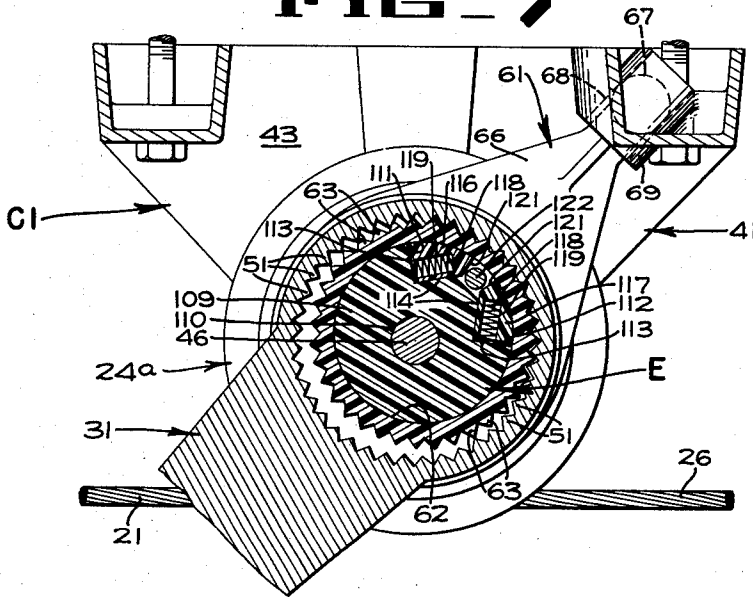
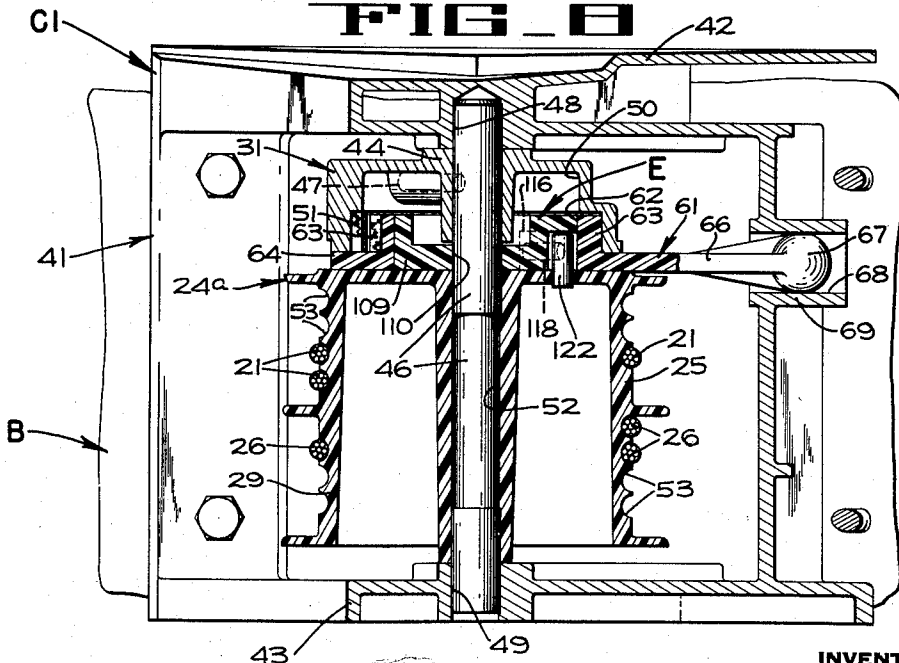


FIG 8



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3,080,953

BOAT STEERING MECHANISM

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7 Claims. (Cl. 192—8)

This invention relates to remote steering controls for crafts having a rudder, which rudder is controlled or steered by remote manually operable means such as a steering wheel or the like connected to the rudder by tension cables. The embodiment of the invention to be described is particularly adapted for application in such systems when employed on small boats embodying outboard motors, the rudder being an integral part of the motor as is well known in this art.

The invention may be best understood if a typical tension cable steering mechanism for a small boat is first briefly described. In such systems the outboard motor, which is almost always provided with means for tilting the motor so as to raise the propeller, is pivotally mounted on the transom of the boat. The manual steering means, usually a steering wheel, is mounted forward of the motor and carries a cable drum. Extending oppositely from the drum is a pair of cable reaches, each reach of which passes aft to the motor over direction changing pulley blocks. Since, as mentioned these motors are usually provided with means to permit them to be tilted forwardly, a pair of terminal pulley blocks is attached at each side of the motor body through which the cables pass, to be anchored to the hull of the craft by means of coil tension springs. The purpose of the coil spring arrangement is to provide a cable connection between the steering wheel and the motor which is functionally of constant length to make possible reasonably precise steering control, but which length can be temporarily changed when the motor is tilted, such change being accommodated by extension of the anchoring coil springs at the end of each reach of cable.

The typical installation just described has several undesirable and possibly dangerous features. For example, since the crankshafts of outboard motors of this type are generally vertical, the torque reaction to the propeller thrust is about the pivot or steering axis of the motor on the craft so that in operation there is a constant tendency of the motor and its integral rudder to veer or turn in one direction, which force must be continuously counteracted by the application of a restoring or restraining force to the steering wheel. There are other forces during operation of the boat that tend to swing the motor about its steering axis, such as wave action in rough water, yawing and pitching of the boat, and so forth. Should the motor be firing unevenly, there will be torque pulses applied to the steering mechanism and conducted to the steering wheel, which not only tire the pilot but cause fatigue in the connecting cable members.

Many manufacturers of motors of this type provide friction brake devices or friction drags between the motor and its mount to damp out or minimize the undesirable effects described, but it can be understood that if the frictional resistance is sufficient to adequately overcome the disturbances referred to, the steering will be stiff and unresponsive, and furthermore, the high order stiffening of the steering that results from these frictional devices if they are to be effective, puts additional and unwanted loads on the steering cables.

A very serious objection to prior cable control steering systems such as that described, is that cable failure is accelerated, and if a cable fails there is loss of control of the boat with the attendant danger of capsizing or striking obstructions that will damage the hull. Also, if

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the boat is employed to tow water skiers, their lives are endangered if control of the boat is lost. These severe and dangerous loads on the steering cables of conventional systems are aggravated in many installations because of the fact that there is a progressive trend towards motors of ever increasing horsepower, which motors are quite heavy and impose large loads on the cables. There is also a trend toward the use of tandem motor installations steered from a single remote control, and this too aggravates the stresses applied to the steering cables and increases the danger of cable breakage in service.

As mentioned, it is customary to provide for tilting the motors forwardly to clear obstructions and for other reasons so that the anchoring springs are included in the cable system to provide such tilting while maintaining the functionally constant length of steering cable. The inclusion of these springs prevents precise and positive control of the motor and its associated rudder, and furthermore permits vibrations and pulsations of the motor to occur even though the steering wheel is held firmly, which action aggravates cable wear and promulgates early breakage of the cables in service.

It is an object of the present invention to absorb the reaction to the torque of the motor and external forces caused by rough water or the like, before such reactions reach the steering cables, and to attain such reaction absorbing function without interference with the free and easy steering of the craft.

Another and allied object of the invention is the elimination of steering cable failure, that might be caused by motor reactions, vibration, excess stresses and the like, so that a boat equipped in accordance with the invention can be operated with safety and security.

Another object of the invention is that of facilitating tilting of an outboard motor connected into the system without requiring the inter-positioning of tension springs or the like in the cable system, thereby providing precise and positive control of the motor and its rudder, as well as further reducing cable wear due to resiliently restrained vibrations and pulsations of the motor that occur in a spring loaded system.

Another object resides in the provision of free, easy steering of the motor, which is made possible by elimination of the need for a one-to-one friction drag, brake or other mechanism interposed directly between the motor and its mounting support. An important advantage inherent in the system of this invention is that operator fatigue is greatly reduced and the operator is given freedom of action in that he need grip the steering wheel, tiller, or the like only when he wishes to change course, because the reactions from the motor and rudder mounted on the craft are absorbed by the hull rather than being transmitted to the steering wheel through the steering cables.

The manner in which these objects and advantages may be accomplished will become apparent from the following detailed description of a specific embodiment of the invention employing tension cable steering. The particular embodiment of the invention selected for illustration is one wherein an outboard motor is pivotally and tiltably mounted on the boat, which motor has integrally formed thereon the usual steering rudder. However, it is to be understood that the remote control steering system of the invention can be applied directly to a rudder in a boat having an inboard motor or in fact may be applied to the rudder of any craft including crafts wherein the medium acted upon is air, for example.

In the drawings,

FIG. 1 is a plan view of an outboard motor installation embodying the invention in a small boat.

FIG. 2 is a front elevation of the combined rudder actuating and holding device of the invention.

FIG. 3 is a plan view of the device.

FIG. 4 is a horizontal section through the device taken on line 4—4 of FIG. 2, with the actuating arm broken away.

FIG. 5 is a vertical section through the device taken on line 5—5 of FIG. 3 with the arm broken away.

FIG. 6 is a fragmentary section of the ends of the connecting link that extends between the rudder control device and the outboard motor.

FIG. 7 is a horizontal section similar to that of FIG. 4 but showing a modified form of friction brake.

FIG. 8 is a vertical section similar to that of FIG. 5, showing the modified form of the invention.

Referring to FIG. 1, in the embodiment of the invention selected for illustration, the outboard motor M is pivotally and tiltably mounted on a base that is clamped to the transom of a boat B in the usual manner. As is well known, the motor includes a propeller wheel 10 and serves as a mount for a rudder 11, and is pivotally mounted on its mounting base for steering rotation about a generally vertical axis indicated by the intersection of broken lines at 12.

Mounted forwardly of the motor in the hull is the remote steering apparatus indicated generally at S. In the embodiment illustrated, the steering apparatus includes a steering wheel 16 for turning a shaft 17 upon which are fixed a pair of connected cable drums 18 and 19. Wrapped around drum 18 and extending therefrom is a starboard cable 21, rove through starboard pulley blocks 22 and 23 and connected to a drum 24 forming part of a combined rudder actuating and holding device indicated generally at C. The cable drums 18, 19 form bi-directional cable tensioning means, in that rotation of the drums in one direction tensions one cable and pays off the other, and vice versa. The holding device C, forming part of this invention, is fixed or bolted to the transom of the boat hull. The starboard cable 21 is connected to an upper half 25 of drum 24. A port steering cable 26 is wrapped oppositely around the other steering drum 19 fixed to the steering shaft 17, and is rove through port pulley blocks 27 and 28, the cable leading to a lower drum portion 29 (FIG. 2) forming part of the drum 24 on the rudder control device C. As also is seen in FIG. 1, extending forwardly from the rudder holding and control device C is a rudder actuating arm 31.

In order to connect the holding device C to the motor M for rigid transmission of steering torque, a link 32 is provided, which has a ball and socket assembly 33 connected to the arm 31 at one end of the link, there being another ball and socket assembly 34 at the other end of the link connected to a bracket 36 suitably bolted to or otherwise fastened to the body of the motor M. The bracket 36 is formed with a pair of apertures 37 that are offset from the midplane of the motor. One of the apertures mounts the link 32, usually the one remote from the control device. Thus the axis of arm 31, the steering axis 12, and the ends of the link, form a generally rectangular parallelogram in the dead ahead position of the motor. Aperture 38 in bracket 36 is provided for tandem motor connection. The ball and socket assemblies of the link provide for swivel motion about the axis of the link, to permit tilting the motor, as will be described in more detail presently. Also, as will be described in more detail as this specification proceeds, there is an irreversible, step-down drive mechanism incorporated in the rudder holding and control mechanism C, which drive mechanism is incorporated between the drum 24 and the rudder actuating arm 31 in such a manner that rotation of the drum is readily effected by the cables, which rotation results in motion of the rudder actuating arm 31 in one direction or the other, depending upon which of the cables 21 or 26 is under tension supplied by the steering mechanism S. Motion of the arm 31 in response to motion of the steering mechanism S, is converted into rotation of

the motor M about its steering axis 12 by link 32, in order to change or control the direction of boat. Since the driving means between the drums on the rudder control mechanism C and the rudder actuating arm 31 is free but irreversible, reaction forces applied to the motor M will be taken by the hull and will not be transmitted back to the drums and hence to the tension cables 21 and 26, the advantages of which have been described.

The construction of the rudder actuating and holding device C will now be described in detail with reference to FIGS. 2-5 of the drawings. The mechanism is mounted in a base or frame 41 that is bolted or otherwise fastened to the boat hull or transom, which frame has an upper horizontal flange 42 and a lower horizontal flange 43 projecting forwardly therefrom. The actuating arm 31 has a hub 44 bored to receive a pivot pin 46 fastened to the arm by means of set screws 47. The upper flange 42 of the frame is socketed as at 48 to receive the upper end of the pivot pin, and the lower flange 43 of the frame is bored as at 49 to receive the lower end of the pivot pin. The hub of actuating arm 31 is formed with a cavity 50, the lower peripheral wall of which carries an annular set of internal gear teeth 51, projecting radially inwardly and forming an external annular gear part of the irreversible epicyclic drive mechanism being described. It has been found that a one piece arm formed as a zinc die casting gives excellent service.

The cable drum indicated generally at 24 has an axial bore 52 for receiving the pivot pin 46 and the upper and lower drum portions 25 and 29, respectively, are grooved as at 53 to receive the tension steering cables, there being the usual apertures 54 (FIG. 2) at one end of each groove for anchoring the cable ends. In order to convert rotation of the drum in response to the steering mechanism to pivotal motion of the arm 31, the upper portion of the drum has an integrally projecting circular boss 56 (FIG. 5), the center of the circular boss being offset from the axis of pivot pin 46 by a predetermined distance or eccentricity, which distance is one factor that determines the gear reduction provided by the irreversible drive mechanism. The drum is preferably molded of a dimensionally stable, impact resistant plastic such as an acrylonitrile-butadiene-styrene polymer.

In addition to the actuating arm and drum members just described, the irreversible drive mechanism includes a third element in the form of an orbit plate indicated generally at 61. The plate has a bore 62 that snugly fits the eccentric boss 56 projecting from the drum. A set of external gear teeth 63 (FIG. 4) having the same diametral pitch as that of the internal gear teeth 51 on the arm are formed on the plate, with the pitch circle of teeth 63 on the orbit plate being concentric with the bore 62 in the plate. The orbit plate is also formed with a flat lower flange 64 (FIG. 5) the lower surface of which is in pressure engagement with the upper surface of the drum. The upper surface of the flange 64 of the orbit plate is in engagement with the lower surface of arm 31 at the internal gear teeth 51. The orbit plate flange has an extension 66 terminating in a semi-spherical head or ball member 67. The ball member is snugly but slidably mounted in a radial bore 68 formed in a guide boss 69 integral with the base of the frame. At this point it can be seen that the orbit plate 61 cannot rotate relatively to the frame of the apparatus, but that the external gear teeth 63 on the plate can be translated in a small, generally circular orbit in response to rotation of the drum and its eccentric boss. Rotation of the orbit plate is prevented by the engagement of the ball 67 with guide bore 68, but the aforesaid orbital translation of the orbit plate gear teeth is accommodated by a combined sliding and pivoting action of the ball in its guide bore. The orbit plate is preferably molded of a tough, slightly resilient self-lubricating plastic material such as a polymerized formaldehyde acetyl resin.

In the particular embodiment of the invention being

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described, means are provided to impose a friction load between the high speed drum 24 and the relatively substantially stationary orbit plate 61. The friction force is applied by a cup-shaped spring washer 71 having radially extending fingers 72 at its periphery. A flat washer 73 is disposed between the fingers 72 and lower flange 43 of the base. The washer 71 is placed under compression by means of a cap screw 74 threaded into an axial bore 76 formed in the pivot pin 46. When cap screw 74 is tightened, the washer 71 and its spring fingers are deformed somewhat, so as to resiliently urge the pivot pin downwardly through bore 49 in lower flange 43 of the frame. Since the pivot pin is pinned or fastened to the arm 31, the downward force exerted by the spring washer on the pin 46 presses the arm against the upper surface of flange 64 on orbit plate 61, the lower surface of flange 64 of the orbit plate being in turn pressed against the upper surface of the drum 25. This interaction applies a braking or friction loading force between the relatively high-speed drum and the relatively stationary orbit plate 61.

In operation, when the drum is rotated in response to taking in and paying off of the cables connected to it, the eccentric boss 56 on the drum imparts the previously described orbital substantially translatable motion to the external gear teeth 63 of the orbit plate. The teeth move in a generally circular path having a radius equal to the eccentricity or offset of the eccentric boss 56 on the drum from the drum axis. As a result of this construction, rotation of the drum and its eccentric causes the teeth 63 on the orbit plate to progressively walk around the internal teeth 51 on the arm, and each complete rotation of the drum and eccentric produces a partial rotation of the arm. The gear reduction or step down provided by the gearing is determined by the eccentricity of the drum boss and the diametral pitch of the internal teeth 51 on the arm 31. The external teeth 63 on the orbit plate 61 have the same diametral pitch as do the internal teeth 51, but there are fewer external teeth, the pitch diameter of the external teeth being smaller than that of the internal teeth by a distance equal to the total throw of the eccentric boss, or twice the eccentricity of that boss.

An example of a suitable design is one wherein the eccentricity of the eccentric boss 56 formed on the drum is one-eighth of an inch giving a total throw of one-quarter of an inch. The pitch diameter of the internal gear teeth 51 on the arm is two and one-half inches, and forty teeth are provided giving a diametral pitch of sixteen teeth per inch of pitch diameter. The pitch diameter of the external teeth 63 on the orbit plate is less than that of the internal teeth 51 on the arm by a distance equal to the total one-quarter inch throw of the drum eccentric, giving the teeth on the orbit plate a pitch diameter of two and one-quarter inches. Since the external gear on the orbit plate has the same diametral pitch as does the internal gear on the arm, i.e., a diametral pitch of 16, the external gear will have 36 teeth.

With these dimensions, the gear teeth will mesh perfectly and without interference during each revolution of the drum, and the step down ratio will be ten to one, that is, it will require ten revolutions of the drum 24 to produce one revolution of the actuating arm 31. In operation, the actuating arm 31 is never rotated throughout a complete revolution but rather is merely pivoted back and forth over a circular arc, to steer the boat by means of the connecting link 32. In the embodiment of the invention being described the radial distance from the pivot pin to the outermost aperture 39 in arm 31 is five times the effective diameter of the drum, and since the irreversible drive has a step down reduction of ten to one, the link 32 connected to the outermost aperture 39 in the arm will have a linear motion equal to one-half the linear motion of the cables connected to the drum.

The purpose of the friction brake mechanism previously described is to insure complete irreversibility of the drive under excessive or extraordinarily heavy loads ap-

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plied directly to the arm 31 through the link 32. Because of the ten-to-one step down in the drive mechanism between the drum and the arm, which drive can only be reversed by causing the orbit plate itself to drive the drum eccentric on the drum and the orbit plate 61 is sufficient to render the drive irreversible under all but extreme or abnormal loads applied to the arm. If this friction were to be overcome by the application of an unusually large force to the arm 31, the drum would rotate at ten times the speed of the arm, and it can thus be seen that application of a relatively small frictional brake or dragging force between the drum and a relatively stationary part of the device such as the orbit plate, will effectively prevent reversibility in the drive mechanism. As previously described, such a frictional braking force is engendered between the lower surface of the flange 64 of the orbit plate 61 and the upper face of the drum by the spring washer assembly, and since the flange 64 has no true rotational motion, the friction brake assembly effectively prevents drive reversal even though it applies a relatively small restraining force to the drum. Such force does not interfere with the ease of steering and in fact is beneficial in that it discourages accidental or unintentional displacement of the steering wheel which might otherwise occur.

As previously described, link 32 serves as an axially rigid motion transmitting connection between the arm 31 on the control device, and the bracket 36 mounted on the motor. In addition, the link 32 is constructed so as to provide for tilting of the motor without disconnecting the link. Furthermore, the link 32 is arranged to provide for disconnection of the link from the motor bracket. To obtain these results, the end members 33 and 34 of the link are constructed as follows. As seen in FIG. 6, end member 33, which is the member connected to the arm 31, is internally threaded at 76 for receiving the threaded end 77 of the link, thus providing for partial adjustment of the effective length of the link. End portion 33 is socketed at 78 for receiving a ball 79 which is integral with a necked down stem 80 from which stem extends a threaded shank 81 mounted in the arm 31 by means of a nut 82. The ball is retained in its socket by split sleeve 83 bent around the end portion 33 there being an aperture 84 formed in the abutting ends 85 (one only being shown) of the sleeve for receiving the stem 80 extending from the ball. The sleeve 83 is surrounded by a rubber dust cover 86. The sleeve 83 may partake of limited sliding and rotative motion on the end 33 of the link in response to pivoting of the ball in its socket. However, the sleeve prevents radial dislodgement of the ball from the socket, and the stem 80 extending through aperture 84 in the sleeve prevents axial displacement or dislodgement of the sleeve from the end portion 33.

The other end portion 34 of the link assembly, is similarly constructed except that means are provided for quickly disconnecting the end of the link from its ball. This end of the link is externally threaded as at 87 these threads being of the same hand as the threads 77 on the other end of the link, and threads 87 are threaded into a threaded bore 88 formed in the end portion 34. The end portion 34 is also formed with a socket 89, which receives a ball 91 from which a reduced neck or stem 92 extends. A sheet metal retaining sleeve 93 is partially wrapped around the end portion 34, the ends of the sleeve being spaced to form an axial slot 94 engaging the neck 92 extending from the ball. The ball has an integral threaded shank 96 for connection to the motor bracket 36 and is retained thereon by a nut 97. This construction provides for limited axial and circumferential pivotal motion of the ball and stem assembly in the end portion 34, and the sleeve 93 prevents radial dislodgement of the ball from the assembly. In order to provide for quickly disconnecting the link from the ball attached to the motor bracket, the sleeve 93 is formed to freely slide on the end portion 34 which portion has an inner shoulder 98 and a spring 99 that engages the shoulder 98 on the inner

end of sleeve 93. The spring urges the sleeve outwardly against a snap ring 101 fitted in a groove in the outer end of the portion 34. When it is desired to disconnect the link 32 from the ball attached to the motor bracket, sleeve 93 is merely slid along the end portion 34 against the force of spring 99 until the slot 94 in the sleeve clears the ball, whereupon the end portion 34 of the link may be moved free of the ball to completely free the motor from the steering control assembly.

Having completed the description of a particular embodiment of the invention it can be seen that the objects and advantages described in the introduction to this specification are obtained by a relatively simple and rugged mechanism. All forces, pulses, vibrations and the like, imparted to the motor are taken by the steering control mechanism C and passed on directly to the transom or hull of the boat, thereby relieving the cables of heavy loads and fatigue-inducing vibratory stresses. The cables, in response to actuation of the remote steering mechanism, need only overcome the relatively small amount of friction imparted by the friction brake, in addition to the usual load or resistance to turning provided by the motor itself, although this resistance is cut in half by the dimensions of the apparatus shown wherein the arm 31 is of such a length relative to the drum diameter that with a ten-to-one step down in the irreversible gearing the overall step down between the drum and the link 32 is two to one. However, even if there were no final step down, that is, if the arm 31 were long enough so that linear motion of the cable were translated directly into a corresponding linear motion of the link 32, in the system of this invention only the relatively small forces required to turn the motor and steer the boat must be overcome by the cables, and all other forces including the relatively large forces of shock and the relatively destructive forces of vibration are taken up by the mechanism and not transmitted to or back through the cables. Also, it can be seen that this device has a further advantage in that the operator can temporarily relinquish control of the steering wheel, as in trolling for example, without danger of sudden changes in course. It can further be seen that nothing special need be done to the steering wheel shaft and hub assembly, which can be of conventional design.

Also, where the system is employed to steer a tiltable outboard motor, no extra pulleys at the motor, and no accommodation springs for anchoring the cables to the hull, are required to permit tilting of the motor in service. In this invention the ends of the cables are simply connected directly to the drum 24 on the control device, and the link assembly 32 accommodates tilting of the motor. The plurality of link mounting apertures 39 provided at the end of the arm 31 makes possible selection of a geometry of installation most suitable for the particular size motor at hand.

In the embodiment of the invention selected for illustration, a pair of opposed free tension cables has been shown running from the steering drum and over pulleys along the sides of the boat to the control apparatus, because this is the most common and inexpensive type of installation. However, it will be apparent to those skilled in the art that the invention is not limited to free, pulley block guided cables. For example, another cable steering system known in the art is one wherein each cable slides in a flexible sheath leading from the steering drum to the control device. The sheaths are usually layed side by side and are affixed to the hull in suitable locations, thereby serving the same function as do the pulley blocks, with the cable in one sheath being advanced under tension and the other being payed off in response to motion of the steering wheel. Obviously this type of installation with a control device C has the same mode of operation as that previously described.

In the embodiment of the invention illustrated in FIGS. 7 and 8, the external friction brake assembly previously described is eliminated and replaced with an eccentric

wedge block assembly which positively insures irreversibility of the drive regardless of the magnitude of the loads applied against the actuating arm and yet provides virtually no friction or restraint to rotation of the drum of the control device. In this form of the invention the modified control device C1 is in all respects like that of the device C previously described except for the incorporation of the eccentric wedge block brake device, which requires minor modifications of the control arm and the drum. The eccentric boss 56 that extends integrally from the drum in the previously described embodiment of the invention is eliminated and replaced by an eccentric brake assembly E. This assembly comprises a circular disk 109 formed of a tough plastic material such as that forming the drum. The disk has an eccentric bore 110, the eccentricity of bore 110 relative to the periphery of the disk 109 being the same as that of the eccentric boss 56 integral with the drum in the previously described embodiment of the invention. A pair of complementary cavities 111 and 112 are formed in the disk. Each cavity has a generally radial end wall 113 and a bottom wall 114. The bottom walls 114 form chords of the circular periphery of the eccentric member and each converges from the radial wall 113 toward the periphery of the member. Wedge blocks 116 and 117, likewise formed of a plastic material such as that forming the drum, are disposed in the cavities 111 and 112 respectively, and the blocks engage bottom walls 114 of their respective cavities. The blocks have peripheral surfaces formed along an arc of the same curvature as that of the bore 62 of orbit plate 61, in which the eccentric disk is mounted. Each wedge block is provided with a compression spring 118 mounted in a bore 119 formed in the block, the outer ends of each spring engaging their respective cavity end walls 113, the construction being such that the blocks are normally in resilient wedging engagement with the bottom wall 114 of a cavity and the circular inner wall of bore 62 of the orbit plate. The wedge blocks have opposed generally radial faces 121 that face a combined release and drive pin 122, pressed into the upper flange of the slightly modified drum 24a. The dimensions of the parts are such that the wedge blocks engage the wall of bore 62 in the orbit plate under action of springs 118 before striking the pin 122 extending from the drum, so that there is a slight clearance or lost motion between the drum pin 122 and the opposed faces 121 of the wedge blocks when the device is in its neutral position.

The eccentric wedge brake and lock mechanism operates as follows. The coil springs in each block tend to project the block from the cavity, but this is prevented by engagement of the arcuate outer edge of the block with the wall of bore 62 in the orbit plate, so that the blocks come into wedging position between the eccentric disk and the orbit plate before engaging pin 122, as mentioned previously. This provides a double-acting self locking friction brake which prevents rotation of the eccentric relative to the orbit plate in either direction, when both blocks are free to engage the orbit plate as described. This frictional wedging engagement exerts a very powerful braking or restraining force against forces tending to drive the arm 31 and hence tending to reverse the normal direction of drive of the control unit. This powerful force is engendered because of the ten to one step-down or gear reduction between the drum and the arm obtained by the gear teeth 51 and 63 as previously described, so that the arm, under reverse forces, can only rotate the drum by reverse driving the eccentric disk 109 at a speed which is ten times the speed of rotation of the arm. Thus the wedging force of the blocks in the eccentric disk is, in effect, magnified by a factor of ten and the eccentric disk cannot slip relative to the orbit plate upon application of force to the arm 31 without actually destroying the parts. However, when the drum is rotated in response to actuation of the steering mechanism by

the operator, the pin 122 extending from the drum strikes one of the faces 121 of either block 116 or 117, depending upon the direction of drum rotation. This releases one of the blocks from its wedging engagement with the orbit plate and brings the block against the rear end wall 113 of the cavity in which the block fits. When this occurs, the eccentric disk 109 will rotate with the drum and cause the orbital motion of the orbit plate 61, and the attendant step-down drive to the arm 31, exactly in the manner previously described wherein the eccentric disk 56 is an integral part of the drum. The other block, that is the one not engaged by the pin, is now a trailing block, and hence is self releasing as the eccentric disk rotates within the orbit plate. Thus the cavities and their blocks can be said to be circumferentially opposed in the sense that one set brakes in one circumferential direction of motion and is released in the other, whereas these functions are performed in the opposite circumferential direction of motion by the other set. The springs urging the blocks into wedging engagement with the orbit plate need not be strong, so that when the drum is rotated to release the leading block followed by rotation of the eccentric relative to the orbit plate, the spring mounted in the other or trailing block is continuously compressed, thereby releasing the braking or wedge action of that block, which is merely dragged around the wall of bore 62 in the orbit plate. This dragging of the trailing block offers an insignificant frictional resistance to operation of the device in the forward direction, and yet the eccentric assembly provides for complete irreversibility short of destroying the parts.

While a particular embodiment of the present invention has been shown and described, it will be understood that the device is capable of modification and variation without departing from the principles of the invention and that the scope of the invention should be limited only by the scope and proper interpretation of the claims appended hereto.

The invention having thus been described, what is claimed and desired to be secured by Letters Patent is:

1. In a craft of the type having a pivotable rudder mount and a tension cable type steering system including a control member movable in either of two directions and two cables connected thereto so that each cable is tensioned in response to movement of the control member in one of said directions, a remotely controlled rudder mount turning and holding device comprising a base for fixed attachment to the craft, a cable drum, said two cables being oppositely wound on the cable drum, means rotatably mounting said drum on said base, an eccentric member rotatable with said drum and having a circular periphery whose center is offset from its axis of rotation, an orbit gear surrounding said eccentric member and having external teeth, means for preventing rotation of said orbit gear while accommodating orbital movement thereof in response to rotation of said eccentric member, an arm mounted on said base for pivotal motion about the axis of rotation of said drum and eccentric member, internal gear teeth on said arm engaging the teeth on said orbit gear, the pitch diameter of said internal gear teeth on the arm exceeding the pitch diameter of the external teeth on said orbit gear, and link means connected to the arm of said device and adapted for connection to the rudder mount of the craft.

2. In a craft of the type having a pivotable rudder mount and a tension cable type steering system including a control member movable in either of two directions and two cables connected thereto so that each cable is tensioned in response to movement of the control member in one of said directions, a remotely controlled rudder turning and holding device comprising a base for fixed attachment to the craft, a cable drum, said two cables being oppositely wound upon said drum, means rotatably mounting said drum on said base, an eccentric member fixed to said drum and having a circular periphery whose

axis is offset from its axis of rotation, an orbit gear surrounding said eccentric member and having external teeth, means for preventing rotation of said orbit gear while accommodating orbital movement thereof in response to rotation of said eccentric member, an arm mounted on said base for pivotal motion about the axis of rotation of said drum and eccentric member, internal gear teeth on said arm engaging the teeth on said orbit gear with the pitch diameter of said internal gear teeth on the arm exceeding the pitch diameter of the external teeth on said orbit gear, and link means connected to the arm of said device and adapted for connection to the rudder mount of the craft.

3. In a craft of the type having a pivotable rudder mount and a tension cable type steering system including a control member movable in either of two directions and two cables connected thereto so that each cable is tensioned in response to movement of the control member in one of said directions, a remotely controlled rudder turning and holding device comprising a base for fixed attachment to the craft, a cable drum, said two cables being oppositely wound on the drum, means rotatably mounting said drum on said base, an eccentric member fixed to said drum and having a circular periphery whose axis is offset from its axis of rotation, an orbit gear surrounding said eccentric member and having external teeth, means for preventing rotation of said orbit gear while accommodating orbital movement thereof in response to rotation of said eccentric member, an arm mounted on said base for pivotal motion about the axis of rotation of said drum and eccentric member, internal gear teeth on said arm engaging the teeth on said orbit gear with the pitch diameter of said internal gear teeth on the arm exceeding the pitch diameter of the external teeth on said orbit gear, means for frictionally restraining rotation of said drum, and link means connected to the said arm of said device for connection to the rudder mount of the craft.

4. In a craft of the type having a pivotable rudder mount and a tension cable type steering system including a control member manually movable in either of two directions and two cables connected thereto so that each cable is tensioned in response to movement of the control member in one of said directions, a remotely controlled rudder turning and holding device for connection to the rudder mount and to the steering cables, said device comprising a base for fixed attachment to the craft, a cable drum upon which the cables are oppositely wound, a pin rotatably mounting said drum on said base, an eccentric member carried by said drum for rotation therewith and having a circular periphery whose center is offset from its axis of rotation, an orbit gear having an internal circular wall surrounding and engaging said eccentric member and having external teeth, means for preventing rotation of said orbit gear relative to said base while accommodating orbital movement thereof in response to rotation of said eccentric member by said drum, an arm pivotably mounted on said pin, internal gear teeth on said arm engaging the teeth on said orbit gear, the pitch diameter of said internal gear teeth on the arm exceeding the pitch diameter of the external teeth on said orbit gear by a distance equal to twice the eccentricity of the periphery of said eccentric member, circumferentially opposed cavities in the periphery of said eccentric member, a resiliently loaded wedge block in each cavity normally engaging the peripheral wall of said orbit plate, and actuating means driven by said drum and extending between said blocks, rotation of said drum in either direction first causing said actuating means to release one of said blocks from its wedging engagement between said eccentric member and said orbit gear, continued rotation of said drum causing said actuating means to turn said eccentric member and cause orbital motion of said orbit gear, and link means connected to the arm of said device for connection to the rudder mount of the craft.

5. In a craft of the type having a pivotable rudder mount and a tension cable type steering system including a control member movable in either of two directions and two cables connected thereto so that each cable is tensioned in response to movement of the control member in one of said directions, a remotely controlled rudder turning and holding device for connection to the rudder mount and to the steering cables, said device comprising a base for fixed attachment to the craft, a cable drum, said two cables being oppositely wound on said drum, a pin rotatably mounting said drum on said base, an eccentric member rotatable with said drum and having a circular periphery eccentric to its axis of rotation, an orbit gear having an internal circular wall surrounding and engaging said eccentric member and having external teeth, means for preventing rotation of said orbit gear relative to said base while accommodating orbital movement thereof in response to rotation of said eccentric member with said drum, an arm pivotally mounted on said pin, internal gear teeth on said arm engaging the teeth on said orbit gear, the pitch diameter of said internal gear teeth on the arm exceeding the pitch diameter of the external teeth on said orbit gear by a distance equal to twice the eccentricity of the periphery of said eccentric member, circumferentially opposed cavities in the periphery of said eccentric member, each of said cavities being bounded by a radially inner wall disposed along a chord of the circular periphery of said eccentric member and a generally radial wall, said inner cavity wall converging from the radial wall toward the periphery of said eccentric member, a resiliently loaded wedge block in each cavity normally engaging the radially inner wall of the cavity and the peripheral wall of said orbit gear, and actuating means driven by said drum and extending between said blocks, rotation of said drum in either direction first causing said actuating means to release one of said blocks from its wedging engagement between the radially inner wall of the associated cavity and the internal wall of said orbit gear, continued rotation of said drum causing said actuating means to turn said eccentric member and cause orbital motion of said orbit gear, and link means connected to the arm of said device for connection to the rudder mount of the craft.

6. In a craft of the type having a rudder mount and a tension cable type steering system including a control member movable in either of two directions and two cables connected thereto so that each cable is tensioned in response to movement of the control member in one of said directions, a remotely controlled rudder turning and holding device for connection to the rudder mount and to the steering cables, said device comprising a base for fixed attachment to the craft, a cable drum, said cables being oppositely wound upon said drum, means rotatably mounting said drum on said base, an arm pivotally mounted on said base in coaxial relation with the drum, an eccentric member rotatable with said drum and having a circular periphery eccentric to its axis of rotation, a drive member having an internal circular wall surrounding and engaging said eccentric member, positive step down drive means between said drive member and said arm, circumferentially opposed cavities in the periphery of said eccentric member, each of said cavities being bounded by a radially inner wall disposed along a chord of the circular periphery of said eccentric member

and a generally radial wall, said inner cavity wall converging from the radial wall toward the periphery of said eccentric member, a resiliently loaded wedge block in each cavity normally engaging the radially inner wall of the cavity and the peripheral wall of said drive member, and actuating means driven by said drum and extending between said blocks, rotation of said drum in either direction first causing said actuating means to release one of said blocks from its wedging engagement between the radially inner wall of the associated cavity and the internal wall of said drive member, continued rotation of said drum causing said actuating means to turn said eccentric member and cause said drive member to turn said arm, and link means connected to the arm of said device for connection to the rudder mount of the craft.

7. In a craft of the type having a rudder mount and a tension cable type steering system including a control member movable in either of two directions and two cables connected thereto so that each cable is tensioned in response to movement of the control member in one of said directions, a remotely controlled rudder turning and holding device for connection to the rudder mount and to the steering cables, said device comprising a base for fixed attachment to the craft, a cable drum, said cables being oppositely wound upon said drum, means rotatably mounting said drum on said base, an arm pivotally mounted on said base in coaxial relation with the drum, positive step down drive means between said drum and said arm for pivoting the arm at a reduced rate in response to rotation of the drum, said drive means including two members of circular form rotatable relatively to each other while pivoting the arm, circumferentially opposed cavities in the periphery of one of said circular members, a resiliently loaded wedge block in each cavity normally engaging the other of said circular members, and actuating means driven by said drum and extending between said blocks, rotation of said drum in either direction first causing said actuating means to release one of said blocks from its wedging engagement between said circular members and, continued rotation of said drum causing said actuating means to pivot said arm, and link means connected to the arm of said device and adapted for connection to the rudder mount of the craft.

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