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Waner et al.

[11] **3,832,967**

[45] **Sept. 3, 1974**

[54] **IMPROVED STEERING SYSTEM**

[75] Inventors: **Donald W. Waner**, Stow; **Roger F. Olson**, Cuyahoga Falls, both of Ohio

[73] Assignee: **Rockwell International Corporation**, Pittsburgh, Pa.

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[21] Appl. No.: **334,321**

Related U.S. Application Data

[62] Division of Ser. No. 199,548, Nov. 17, 1971, Pat. No. 3,747,428.

[52] **U.S. Cl.** ..... **114/144 R**

[51] **Int. Cl.** **B63h 25/10**

[58] **Field of Search** ..... 114/144 R, 144 A, 154, 114/160; 74/501, 502, 496, 495; 115/35

[56] **References Cited**

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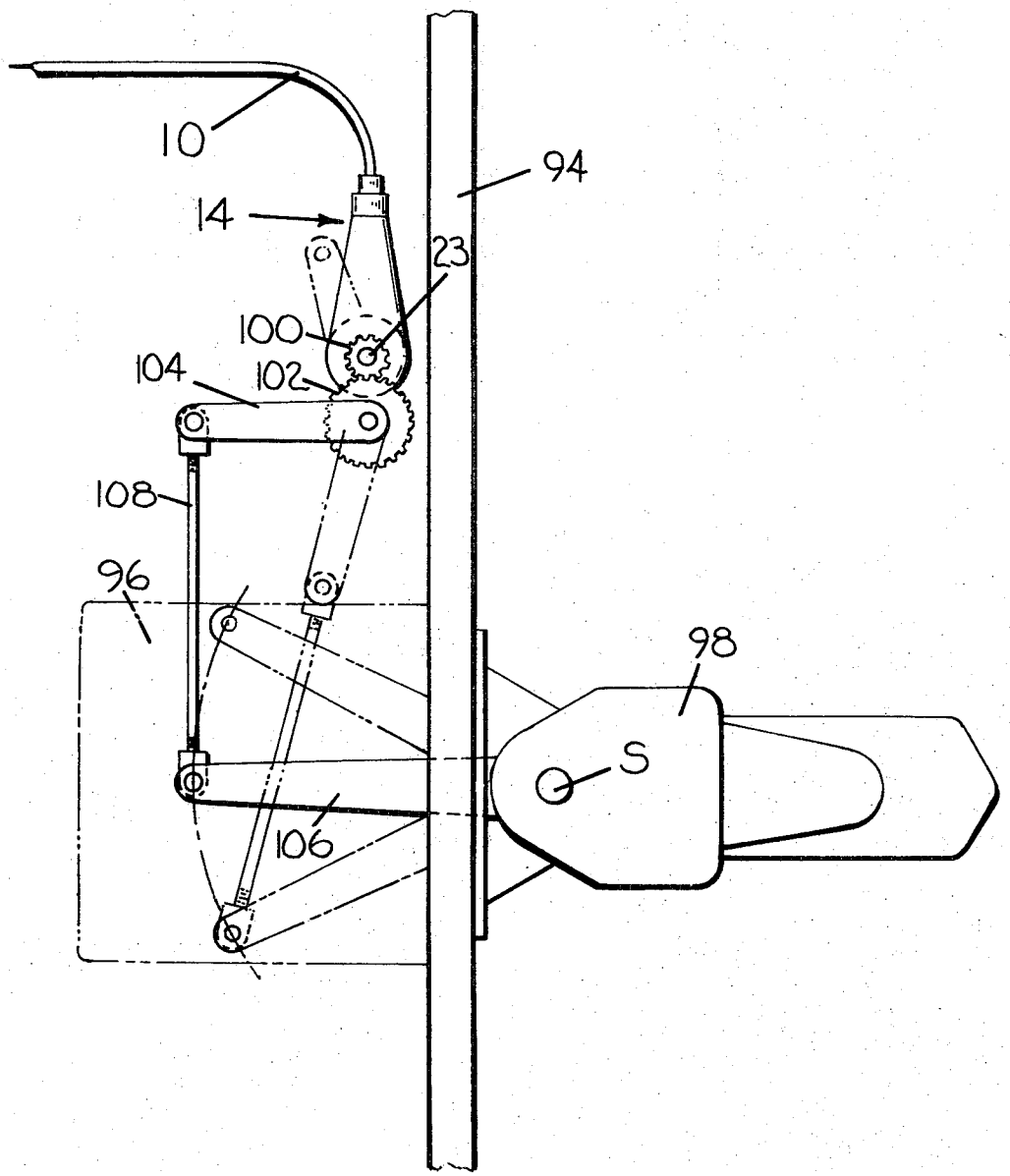
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Primary Examiner—Trygve M. Blix
Assistant Examiner—Stuart M. Goldstein

[57] **ABSTRACT**

An improved steering system for use with a marine propulsion unit comprising a steering force shaft, a steering force transmission cable in driving connection with the shaft, a tiller arm attached to a propulsion unit pivotally mounted to a transom, and a gear reduction arrangement operatively connecting the tiller arm to the transmission cable and adapted to vary the application of torque to the tiller arm between a minimum torque and a maximum torque in response to movement of the shaft to thereby pivot the propulsion unit.

1 Claim, 8 Drawing Figures



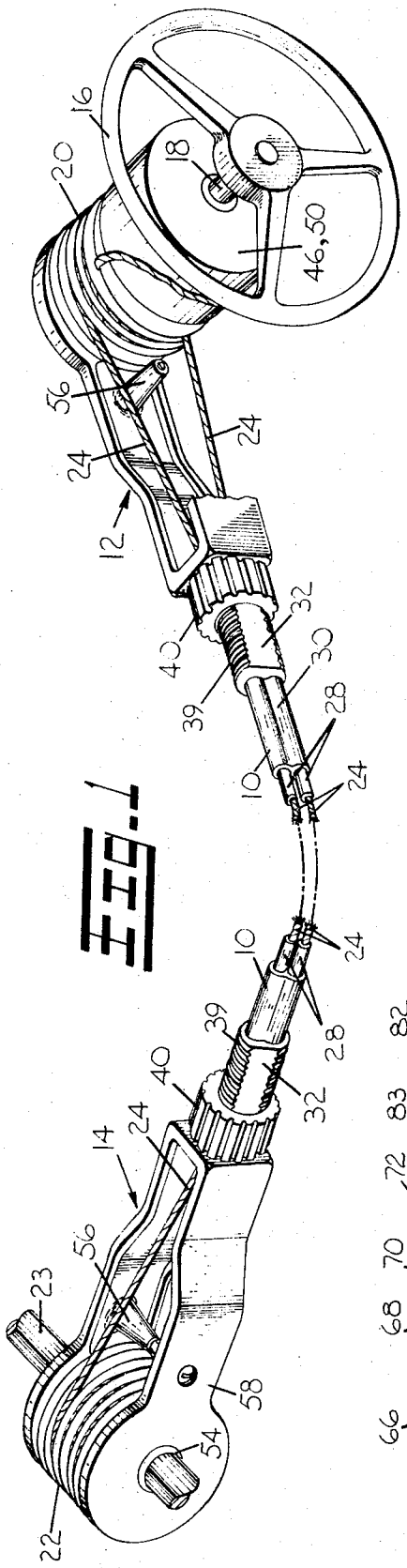


FIG. 1

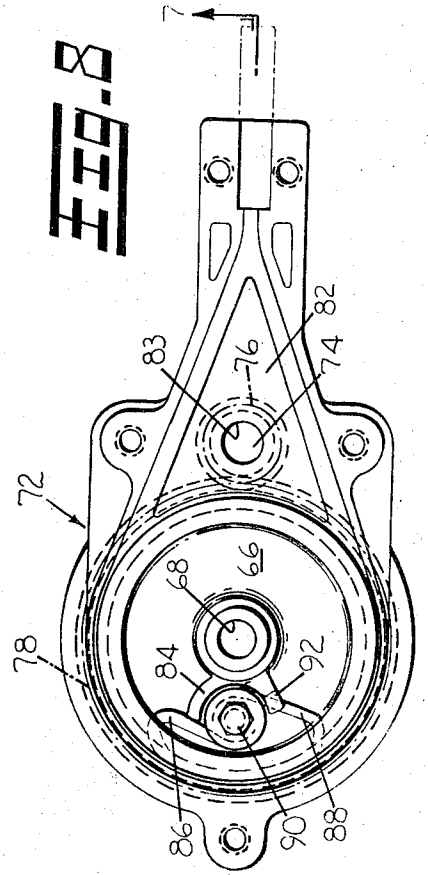


FIG. 8

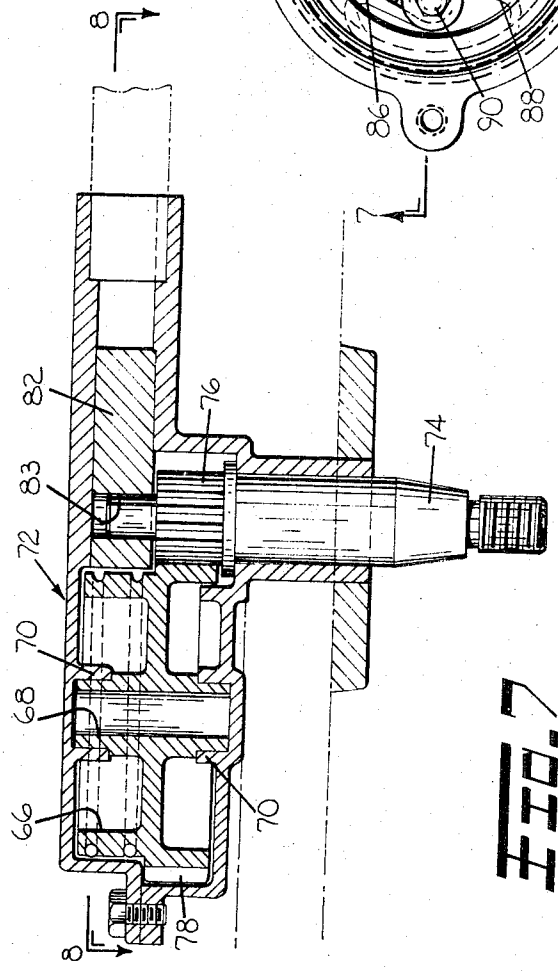


FIG. 7

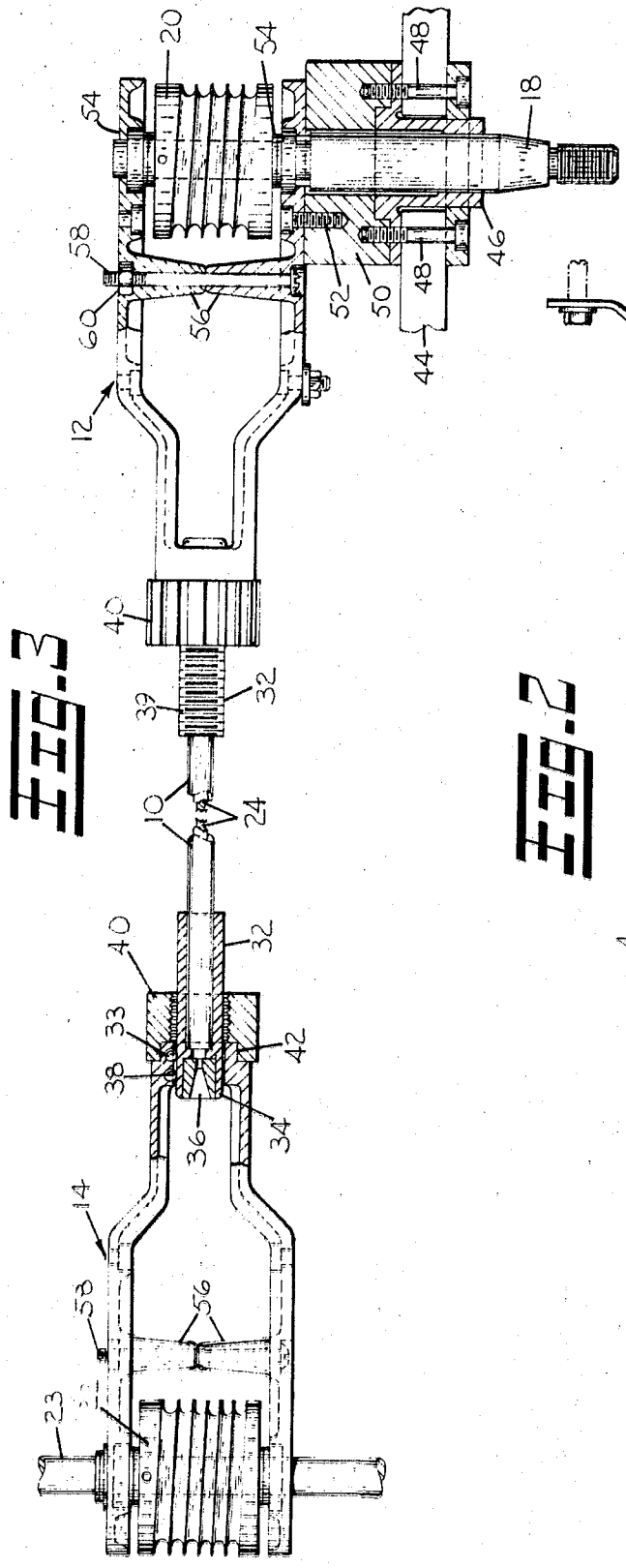

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FIG. 3

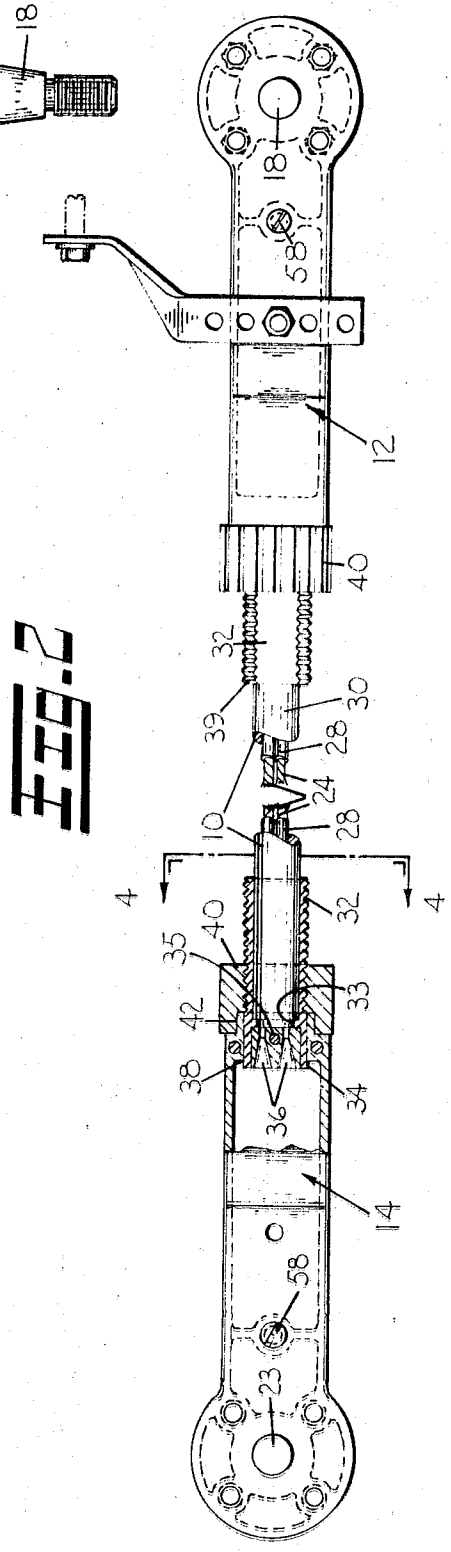
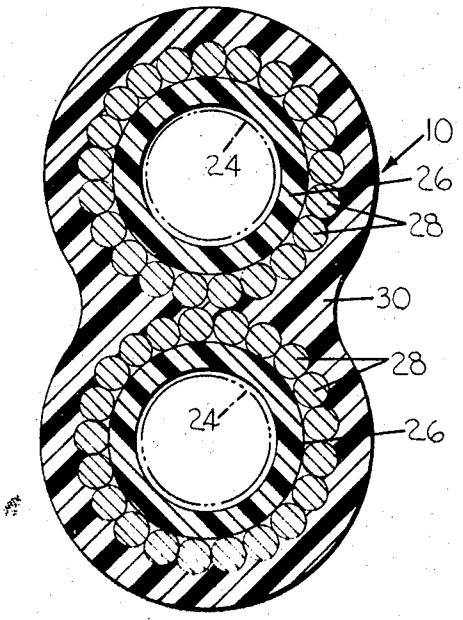

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FIG. 2

Fig. 4



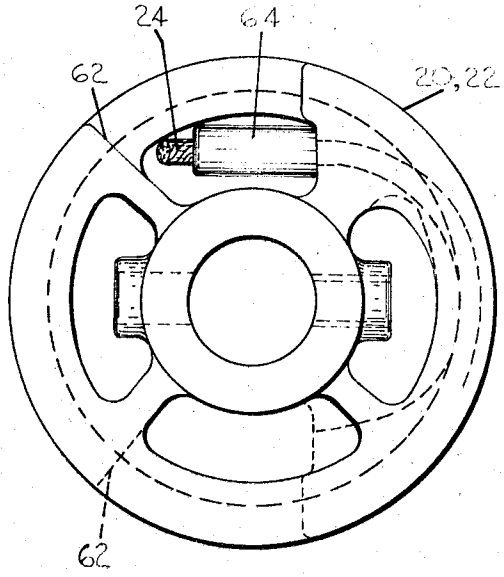


Fig. 5

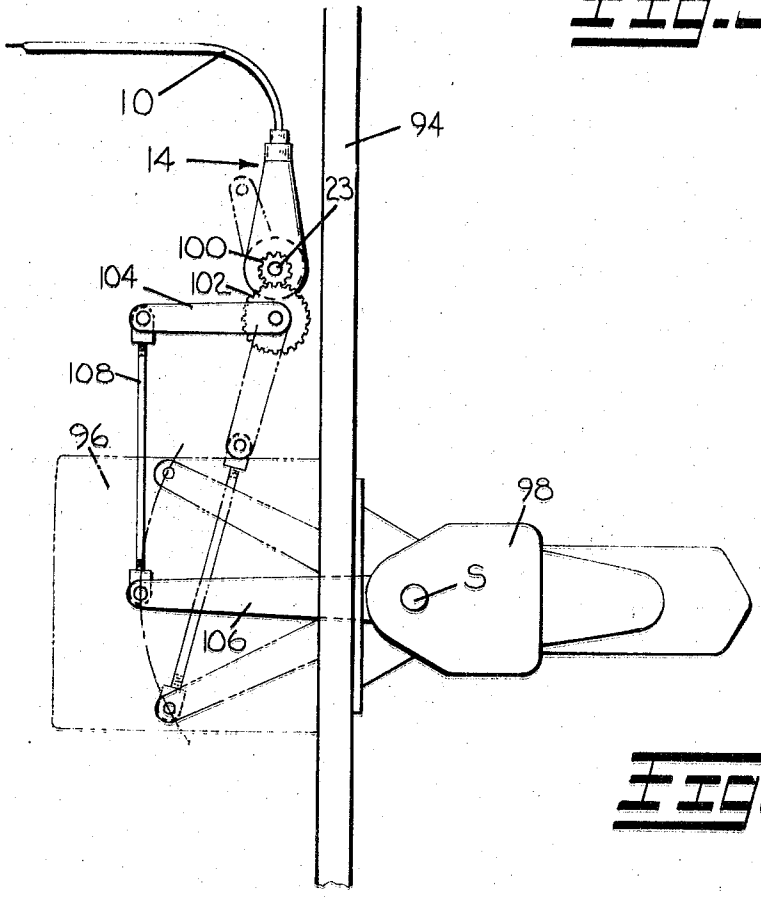


Fig. 6

IMPROVED STEERING SYSTEM

This is a division, of application Ser. No. 199,548, filed Nov. 17, 1971 now U.S. Pat. No. 3,747,428.

To date many different steering arrangements have been employed to accommodate the various turning and tilting actions of this type of propulsion unit.

One type of prior art steering system is of the push-pull cable variety. This system generally comprises a flexible tubular casing which is anchored at its ends and a flexible wire core element is axially movable within the casing by pushing or pulling at one end to exert a corresponding force on a device such as a drive assembly of an inboard-outboard propulsion system, which may be operatively attached to the other end of the wire core element. The wire core elements of this type system experience high levels of both tensile and compressive loads which tend to alternately length or shorten the wire element. A direct result of this alternate loading of the wire core element causes binding of the core element within the tubular casing, which may result in the premature failure of the steering system. Additionally, if the steering device or apparatus is utilized when the wire core element is bent or distorted, system backlash will occur.

Another type of prior art steering system is of the pull-pull cable variety. This system generally comprises a combination of flexible tubular casings which are anchored at their ends and flexible wire core elements are axially movable within the casings by pulling at only one of their ends. The pulling of the wire core element at one of its ends exerts a corresponding force on a device such as a drive assembly of an inboard-outboard propulsion system system which may be operatively attached to the other end of the wire core element. The wire core elements of this type system experience only tensile loads in that they are only operational in a pulling mode. The elimination of compressive loads on the wire core element results in an improved marine steering system particularly when adapted to Outdrive marine propulsion units. While the prior art pull-pull cable steering systems are an improvement over the typical push-pull cable steering systems, they still experience serious operational deficiencies. The prior art pull-pull cable steering systems typically comprise many moving parts and are bulky, difficult to install and maintain, inefficient to use and highly expensive to manufacture.

SUMMARY OF THE INVENTION

It is, therefore, a primary object of the present invention to provide a pull-pull steering apparatus and system which is simplistic in design, simple to install and maintain, efficient to use and inexpensive to manufacture.

A motion transmitting remote control assembly comprising a flexible conduit means, said conduit means having anchor means fixedly attached to at least one of its ends, said conduit means attached at its anchor members to frame members, motion transmitting members operatively connected to said frame means, core means axially movable in said conduit means and operatively connected to said motion transmitting members, anchor means engaging said frame means to prevent rotational movement thereof, tension adjusting means contacting said frame means and engaging said anchor means to axially move said anchor means to change the distance between said motion transmitting

members to thereby adjust the tension in said core means.

It is a further object of the present invention to provide a remotely operated control system for applying variable torque to a pivotally movable member comprising motion input means, flexible cable means operatively connected to transmit motion in response to movement of said input means, rotatable means operatively driven by said cable means to rotate in response to movement of said cable means, and torque application means operatively connected to said rotatable means and to said pivotally movable member, said torque application means varying the torque applied to said member in response to rotational movement of said rotatable member.

BACKGROUND OF THE INVENTION

The present invention relates generally to steering assemblies. More particularly, the present invention relates to an apparatus and system for steering a marine propulsion unit. Specifically, the present invention relates to an apparatus and system for steering the drive assembly of an inboard-outboard propulsion system.

Marine propulsion units utilizing an inboard engine which transmits its power through the transom of the boat to a drive assembly mounted exteriorly of the transom are generally referred to as "Outdrive" marine propulsion units.

Outdrive marine propulsion units are highly favored because they incorporate the advantageous features of both the inboard and outboard propulsion systems. Specifically, the Outdrive unit utilizes the inboard engine which may be larger and heavier and produce higher horsepower. At the same time the steering can be accomplished by controllably directing the thrust of the propeller, thus eliminating the need for a rudder, as used with inboard units. Moreover, the dependingly mounted drive assembly of the Outdrive unit tilts up when it strikes an underwater obstruction, thus incorporating one of the best features of the outboard and eliminating the rigidity of the rudder and propeller assembly used with inboard units. However, even with all these advantages there are problems, and the main problem of the Outdrive unit is the steering.

The details as well as other objects and advantages of the present invention will be apparent from a perusal of the description taken in conjunction with the drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a perspective view partly broken away of the improved pull-pull cable assembly adapted to transmit rotaty motion;

FIG. **2** is a side elevational view, in partial section, of the cable assembly shown in FIG. **1**;

FIG. **3** is a plan view, in partial section, of the cable assembly shown in FIG. **1** and FIG. **2**;

FIG. **4** is an enlarged cross sectional view of the double conduit cable hose taken along the line **4—4** of FIG. **2**;

FIG. **5** is an enlarged end view of a cable drum used in the cable assembly of FIG. **1**;

FIG. **6** is a plan view of a boat transom showing a variable torque mechanism steering a stern drive with movement of the tiller arm in various positions shown in phantom;

FIG. 7 is a sectional view of the helm end of the steering assembly similar to that of FIG. 2 taken generally on the plane 7—7 of FIG. 8, showing a modification thereof; and

FIG. 8 is a view taken generally along the line 8—8 of FIG. 7.

DESCRIPTION OF THE INVENTION

Referring now to the drawings there is shown in FIG. 1 a steering system in accordance with the present invention. A "pull-pull" cable housing **10** is mounted between a pair of spaced apart support brackets **12** and **14.** Bracket **12** is shown in a mounting relationship with a steering wheel control head assembly comprising an input means such as a steering wheel **16** mounted on an input shaft **18.** A cable drum **20** is mounted on one end of shaft **18** which is journaled to rotate in bracket **12.** A similar cable drum **22** is mounted on an output shaft **23** journaled to rotate in bracket **14.** Output shaft **23** may be connected to a device or apparatus which is to be remotely controlled by an input means such as wheel **16.**

It can be seen that rotation of steering wheel **16** causes a corresponding rotation of shaft **23.** This motion is transmitted by means of a pair of runs of cable cores **24** movably dispersed within the housing **10.** The cores **24** have their adjacent ends connected by suitable connecting means to cable drums **20** and **22.** The cable drums thus act in a pulley like manner thereby maintaining a constant pull-pull cable tension.

As can be seen in FIG. **4,** the housing **10** comprises a tubular plastic inner sleeve **26.** The cable core **24** may be made of tightly wound bundles of stainless steel. A plurality of circumferentially arranged reinforcing wires **28,** preferably suitably tempered spring wires, are laid in fairly long pitched helixes to form a helically wound grouping around each plastic inner sleeve **26.** A plastic outer casing **30** provides a flexible outer covering which encapsulates the wire reinforced inner sleeves **26** to complete the double conduit cable hose. Inner sleeves **26** may be made of a flexible, resinous material such as thermoplastic, nylon, polyethylene or linear polyethylene. If desired, inner sleeves **26** may be a self-lubricating liner comprising a mixture of adhesive resin and powdered or flocked polytetrafluoroethylene particles or a woven polytetrafluoroethylene fabric embedded in such resin. Sliding friction between a cable core and inner sleeve may also be reduced by utilizing a small amount of a lubricant such as molybdenum disulfide.

Plastic outer casing **30** restrains wires **28** from bulging outwardly under a compression load. The inner sleeves **26** restrain the helical wires surrounding them from bulging inwardly under tension. A preferred outer covering material for casing **30** is linear polyethylene which may be extruded in one piece around the inner sleeves. The diameter of the cable cores **24** may be made sufficiently smaller than the inner diameter of sleeves **26** to impart flexibility to the sleeve assembly.

As can be seen in FIGS. **1, 2** and **3,** the hose **10** is secured to the terminal brackets **12** and **14.** Each end of hose **10** is gripped by a tightly fitting tubular cable conduit anchor **32** having a generally oblong cross section As both anchor ends may be the same, only one will be described in detail. Cable cores **24** extend for operational attachment through openings provided in an inner wall **33** of the anchor **32.** A block insert **34,** preferably of plastic, is securely fastened in one end of anchor **32** by an anchor pin **35.** A pair of outwardly diverging frusto-conical recesses **36** define the inner surfaces of each terminal block and act as guide bearing surfaces for cable cores **24.** Cable anchor **32** may be made of a lightweight die cast material such as aluminum, zinc or magnesium and terminal block **34** may be made of a plastic material such as nylon or an acetyl polymer such as Delrin.

The end of cable anchor **32** which mounts the terminal block **34** is inserted in a socket opening **38** located at one end of a terminal support bracket. It may be seen from FIGS. **2** and **3** that the socket opening **38** has an oblong cross section slightly larger than the cross section of anchor **32.** Anchor **32** is free to move axially but not rotatably within the socket opening.

As best seen in FIG. **3,** anchor **32** has a pair of curved outer surface portions **38** which are threaded and engage an internal threaded bore of a tensioning nut **40.** Tensioning nut **40** has an internal, smoothly counterbored cylindrical surface at one end in bearing contact with a cylindrical bearing surface **42** of the terminal bracket **14.** It will be readily apparent that rotation of nut **40** moves anchor **32** axially thereby causing hose **10** to shorten or lengthen the distance between the cable drums **20** and **22** to thereby simultaneously control tension of both cable cores. Terminal block recesses **36,** which are frusto-conical in shape, guide cable cores **24** at different anchor tensioning positions.

As best shown in FIG. **3,** input shaft **18** is journaled in a bearing sleeve support **46.** Bearing sleeve support **46** may be fastened to the inside of dashboard **44** by attaching means such as a pair of bolts **48.** Bolts **48** also positionally fix a spacer sleeve **50** between the dashboard and one side of terminal bracket **12.** A number of screws **52** (only one of which is shown) fasten the spacer sleeve **50** to the terminal bracket **12.** Shaft **18** is also journaled in a pair of bearing members **54** such as ball bearings located in recesses of the wings of the terminal brackets. Each of said wings has a hollow arm extension **56** aligned opposite each other. A clamping bolt **58** passes through both extensions **56.** A nut **60** engages one end of the bolt **58** to thereby hold the two wing portions together. A similar terminal bracket **14** is disposed at the output end of the cable assembly.

As can be seen in FIGS. **1, 3** and **5,** the periphery of each cable drum **20** and **22** has a multiplicity of grooves around which the cable core runs are wrapped. The cable core runs first contact the grooves located centrally on the cable drums and then are wound in opposite directions axially outwardly with each cable core end secured in a terminal drum side pocket **62.** Each cable core **24** may have a swaged cylindrical end fitting **64** on each end which fits within a side pocket **62** to link the end of the run to the drum. Side pockets **62** are located on opposite sides of the drum and are substantially 180° apart.

A modified control head assembly is shown in FIGS. **7** and **8** in which the input cable drum **20** has been replaced by a combination pulley-gear **66.** Pulley-gear **66** has a hollow hub **68** that is journaled in a pair of sockets **70** of a terminal bracket **72.** A steering wheel drive shaft **74** has a pinion gear **76** attached at one end thereof. The gear teeth of gear **76** engage the gear teeth **78** on the larger pulley-gear **66.** This gear reduction allows multiple turns of the steering wheel without mak-

ing a complete rotation of the pulley at the output end of the cable assembly. The output pulley, of course, may be the same as that shown in the previously described embodiment. The pulley portion of the pulley-gear combination **66** has a pair of guide grooves **80,** one for each run of the cable cores **24.** The maximum length of a single cable core run which can be wrapped about the pulley **66** is limited to one wrapping. An advantage of using such a large diameter pulley as compared to the previously described cable drums is that less unit force is required to turn the pulley **66.** Further, the fatigue life of the cable cores is prolonged by reducing the number and the severity of the wrappings. The gear reduction additionally reduces backlash and gives a better operational "feel" to the operator. A triangular shaped core guide **82** is made part of the terminal bracket and is located between the pulley-gear **66** and the hose conduit anchor to guide the pair of cable runs. A recess **83** is provided in the core guide and is in bearing contact with one end of shaft **74.**

Referring to FIG. **8,** it may be seen that a single side pocket **84** is placed radially inwardly of the pulley circumference. The cable core ends are guided to the side pocket **84** by a pair of paths **86** and **88.** A single bolt **90** and a key washer **92** clamp the cable core ends in pocket **84.** The single nut tension adjusting means previously described may also be used with the embodiments of FIGS. **7** and **8.**

A further unique aspect of the subject steering system is the variable torque output mechanism shown in FIG. **6.** An output terminal support bracket **14** as previously described is mounted to a transom **94** of a boat. A conventional stern drive motor **96** drives a marine propulsion unit **98** pivotally mounted to the transom. Mounted in bracket **14** is a previously described cable drum and output shaft **23.** A small gear **100** non-rotatably mounted on one end of shaft **23** coacts with a large diameter gear **102** which may be mounted to the transom by a pair of support arms (not shown). A crank arm **104** is non-rotatably attached to gear **102.** A tiller arm **106** passes through an opening in the transom and is connected to the marine propulsion unit **98.** Movement of the tiller arm causes pivoting of the marine propulsion unit about steering axis S. A connecting rod **108** connects crank arm **104** to tiller arm **106.** Crank arm **104** is made shorter than tiller arm **106.**

In FIG. **6,** crank arm **104** is at a position where it exerts minimum torque on tiller arm **106.** Conversely, crank arm **104** applies maximum torque when it is rotated 90° in either direction from its minimum torque position. The position of crank arm **104** is controlled by the steering wheel operator through rotary movement of the steering wheel input shaft which movement is transmitted by the cable assembly **10** to the gear reduction set **100, 102.** Connecting rod **108** acts to apply varying torque to the tiller arm in response to the position of crank arm **104** thereby converting rotary motion to ocillatory motion.

The above-described variable torque mechanism is particularly useful when steering to a "hard right" or a "hard left" position for it provides the operator with increased steering torque as the tiller arm swings to its fully extended position.

The output cable drum **22** and reduction gearing set **100, 102** may also be replaced with a single large diameter output pulley (not shown) having cable core runs **24** linked thereto with crank arm **104** mounted on the output shaft of such a large diameter output pulley.

It is to be understood that the above-detailed description of the present invention is intended to disclose an embodiment thereof to those skilled in the art, but that the invention is not to be construed as limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of being practiced and carried out in various ways without departing from the spirit of the invention. The language used in the specification relating to the operation and function of the elements is employed for purposes of description and not of limitation, and it is not intended to limit the scope of the following claims beyond the requirements of the prior art.

What is claimed is:

1. An improved steering system for use with a marine propulsion unit comprising a steering force shaft means, a steering force transmission means in driving connection with said shaft means, a tiller arm means attached to a propulsion unit pivotally mounted to a transom, and means operatively connecting said tiller arm means to said transmission means and adapted to vary the application of torque to said tiller arm means between a minimum torque and a maximum torque in response to movement of said shaft means to thereby pivot said propulsion unit, said means for varying torque includes a crank arm rotated by said transmission means and a connecting rod pivotally linked to both said crank arm and said tiller arm means whereby said minimum torque occurs when said crank arm is at a first position and said maximum torque occurs when said crank arm is rotated 90° in either direction from said first position, said steering force transmission means includes a flexible double conduit cable control hose having a motion transmitting cable core slidably disposed in each conduit, said motion transmitting flexible cable cores having adjacent ends of their runs linked so that longitudinal movement of one run in one direction in said hose is accompanied by longitudinal movement of the other run in the opposite direction in said hose, said transmission means is in driving connection with gear reduction means whereby a complete rotation of said shaft means causes less than a complete rotation of said tiller arm means.

* * * * *