

[54] **MOTION TRANSMITTING ASSEMBLY**

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[51] Int. Cl. .... **F16c 1/10, G01p 17/00**

[58] Field of Search ..... **74/496, 495, 501, 74/502; 138/111, 174**

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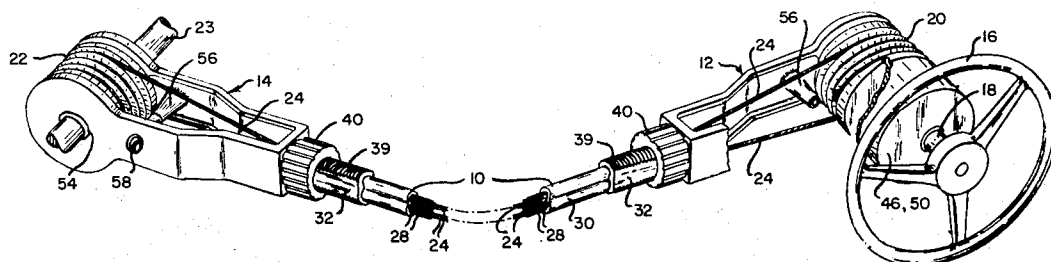
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[57] **ABSTRACT**

A motion transmitting remote control assembly comprising a flexible conduit having an anchor fixedly attached to at least one of its ends, the conduit is attached at its anchor members to frame members, motion transmitting members operatively connected to the frame. A core is axially movable in the conduit and is operatively connected to the motion transmitting members. The anchor engages the frame to prevent rotational movement thereof. A tension adjusting device contacts the frame and engages the anchor to axially move the anchor to change the distance between the motion transmitting members to thereby adjust the tension in the core.

**2 Claims, 8 Drawing Figures**



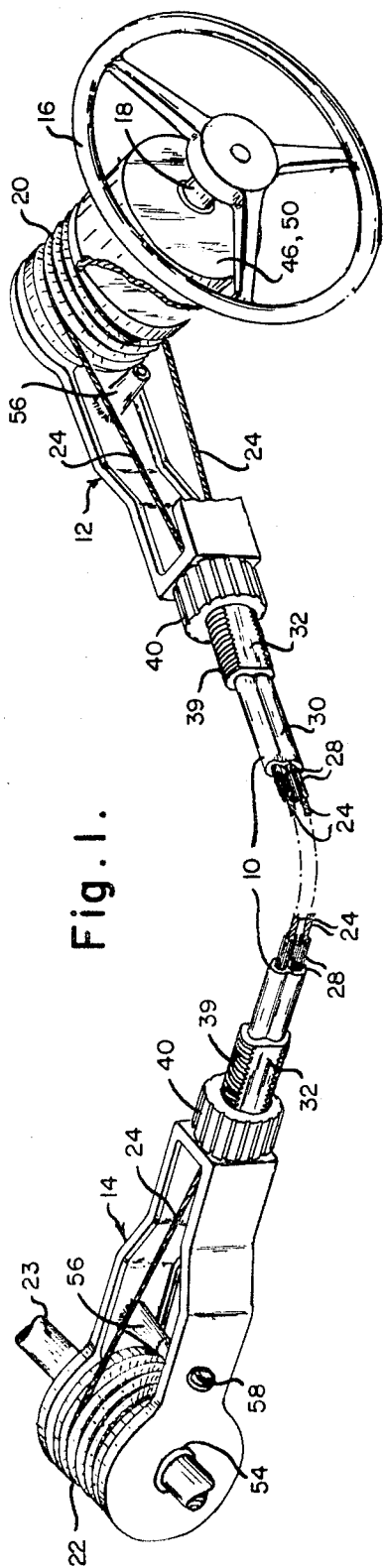


Fig. 1.

Fig. 7.

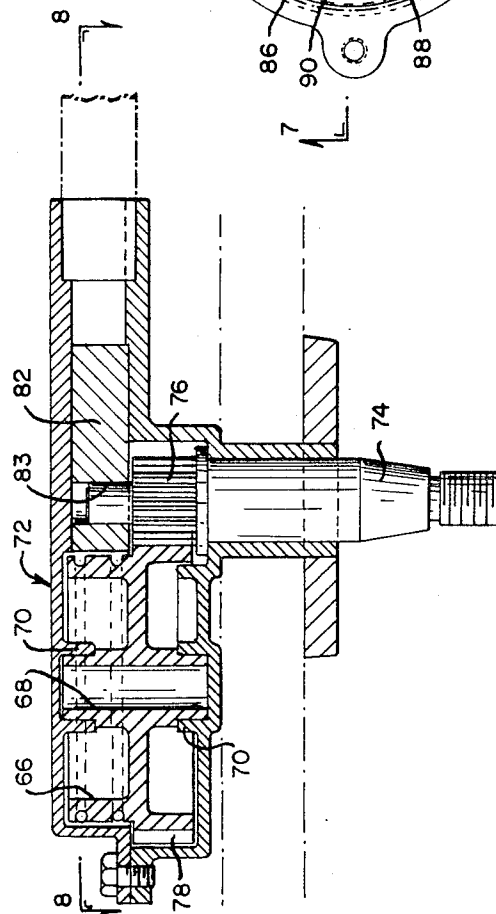


Fig. 8.

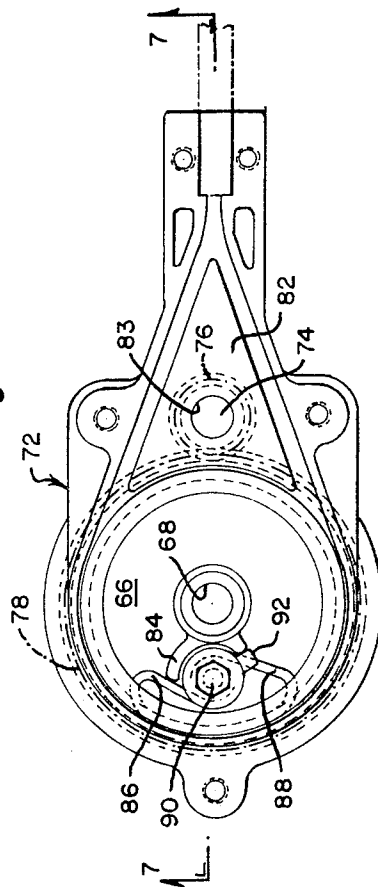


Fig. 3.

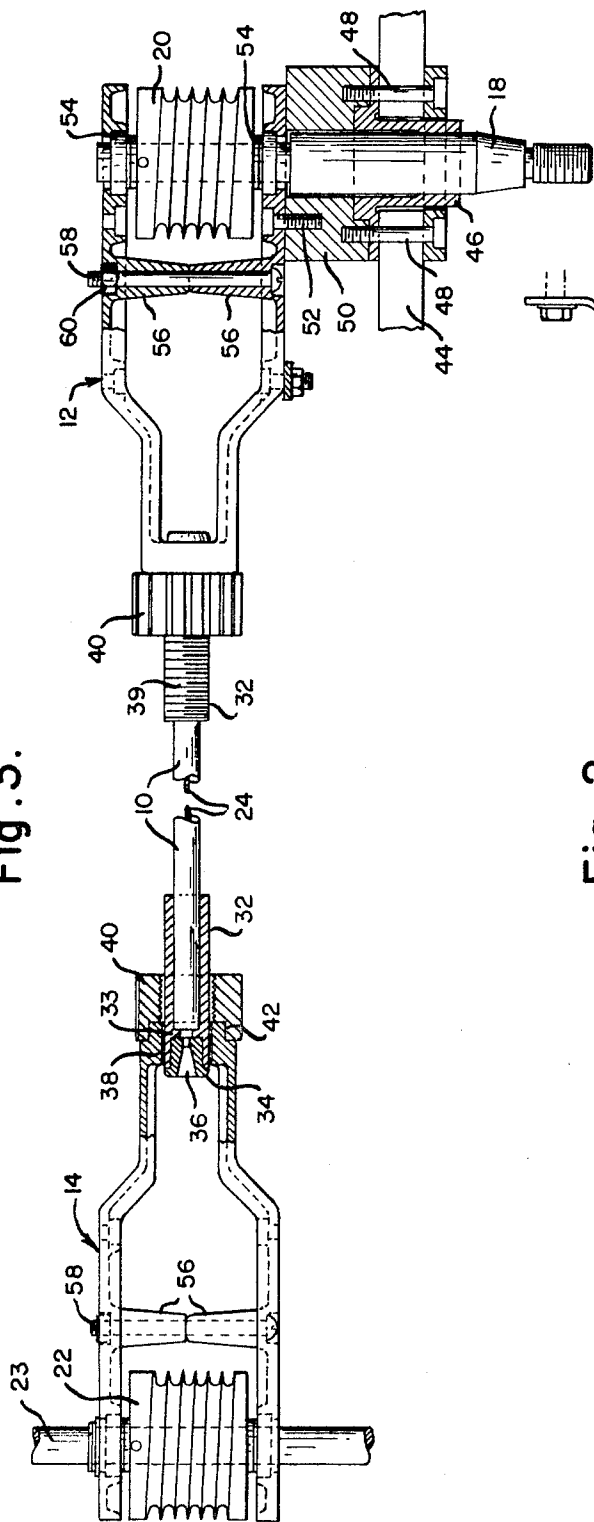


Fig. 2.

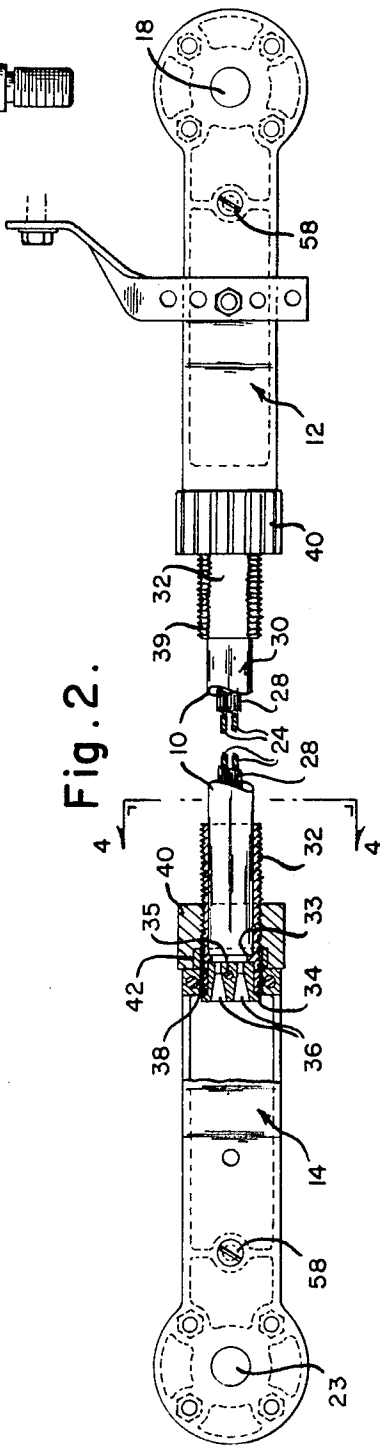


Fig. 4.

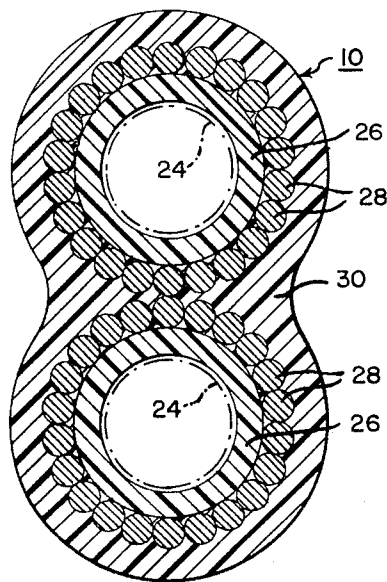
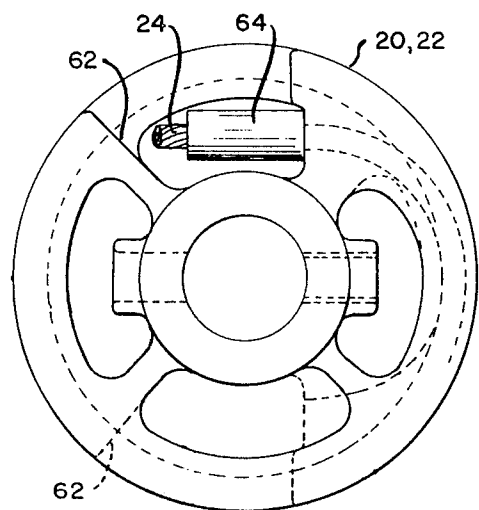
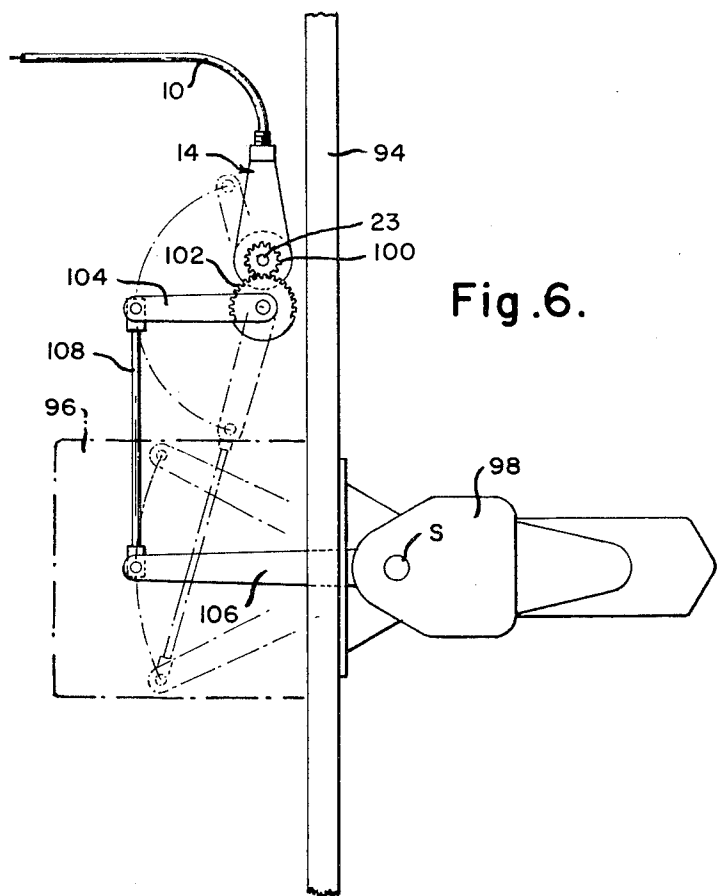


Fig. 5.



## MOTION TRANSMITTING ASSEMBLY

### 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 dependently 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.

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 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.

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 rotatory 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 helices 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 di-

verging 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 counter-bored 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 making 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 de-

scribed 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 oscillatory 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. A manually operated pull-pull cable control assembly having reduced backlash comprising an input shaft, a small diameter pinion gear driven by said input shaft, a large diameter gear driven by said pinion gear, a first large diameter rotatable pulley operatively connected to said large diameter gear, a second pulley mounted for rotation on an output shaft spaced from said first pulley, a flexible double conduit cable hose interposed between said first and second pulleys, and two flexible cable cores movably disposed in said hose with adjacent ends of said cable cores being respectively attached to said first and second pulleys so that longitudinal movement of one cable core in one direction is accompanied by longitudinal movement of the other cable core in the opposite direction in said hose, the maximum length of movement of one cable core being substantially equal to the circumference of said first pulley.

2. A remotely operated control system for applying variable torque to a pivotally movable member comprising a 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.

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