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BOAT STEERING DEVICE

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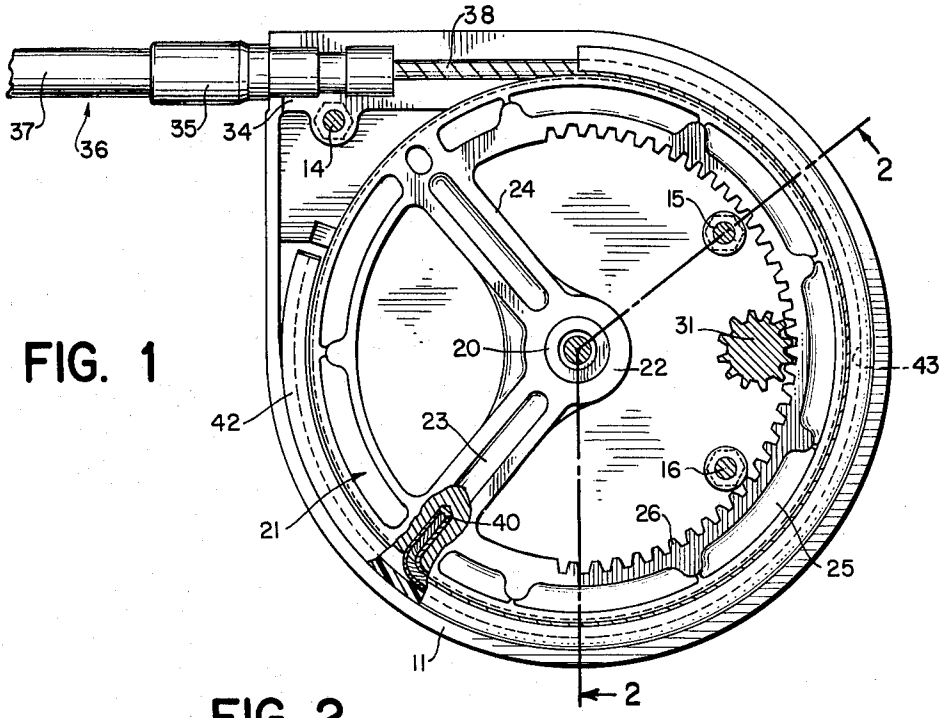
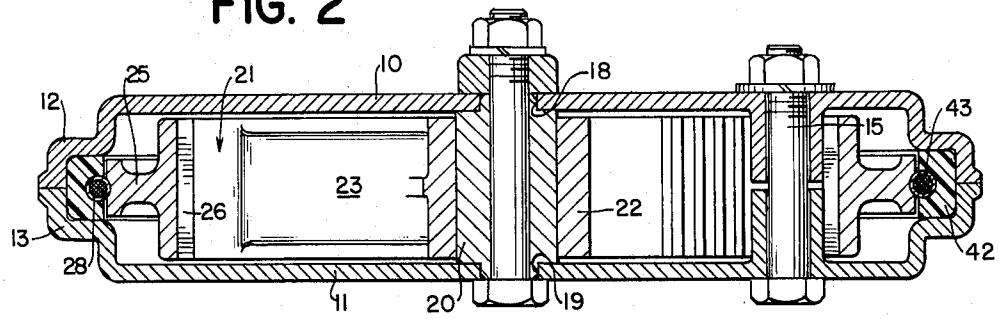


FIG. 1

FIG. 2



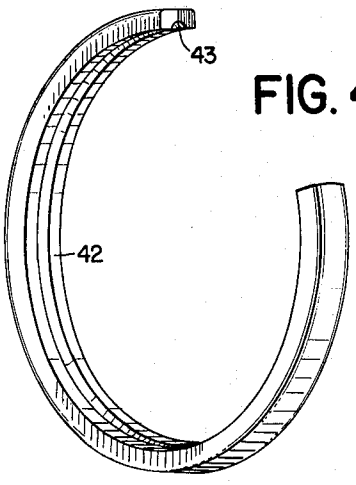


FIG. 4

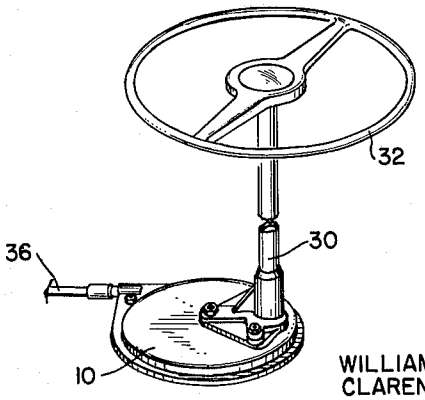


FIG. 3

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BOAT STEERING DEVICE

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This invention relates to boat steering devices of the type wherein a control cable flexible member is wound or unwound about a ring in a housing to push or pull, and thereby turn, the tiller or other steering means of a boat. More particularly, it is directed to improved bearing means in the housing of the steering device for restraining the flexible member against outward displacement off the ring.

It is a primary object of this invention to simplify and economize the design of otherwise satisfactory boat steering devices of the kind wherein the flexible member is held against outward displacement off its actuating ring by an array of rollers spaced apart around the ring. This object is achieved by substituting a particular curved bearing member of plastic material for the array of rollers around the ring, without appreciably increasing the frictional drag on the flexible member during operation and yet with a notable reduction in the fabrication, assembly and maintenance costs of the device.

Broadly stated, the improved bearing means is applicable to a boat steering device wherein a flexible member is adapted to be wound and unwound on the circumference of a rotatable ring and to pass tangentially with respect thereto through an opening in a housing surrounding the ring. The new bearing means comprises a curved member fixed within the housing about substantially all of the circumference of the ring except where the flexible element passes tangentially therefrom through the housing. This curved member is of plastic material and it has a smooth circular inner bearing surface opposed to the circumference on the ring and in slideable engagement with substantially the full length of the flexible member on the ring. As a result of this construction, the flexible member slides easily over and is restrained against outward displacement by the plastic bearing surface of the curved member as the flexible member is wound and unwound by the ring.

Prior to the aforementioned use of roller arrays in this field, no significant attempt was made to contain the flexible member about the ring by means which at the same time could reduce frictional drag during operation. Instead, the ring was enclosed in a close-fitting circular metal housing which could only achieve the desired restraint of the flexible member against radially outward displacement by frictionally retarding its longitudinal movement to a great extent. Because of the high coefficient of friction between the flexible member and the adjoining housing, this drag effect was most severe when the flexible member transmitted a pushing force during unwinding, since it would then bow outwardly and bind against the housing. The bearing means of the present invention solves this without resort to roller arrays by interposing between the flexible member and the housing a smooth self-lubricating containing member of plastic material, preferably acetal resin.

A preferred embodiment of the invention is described hereinbelow with reference to the accompanying drawing, wherein

FIG. 1 is a plan view of the steering device partly broken away and with half the housing removed to expose the inner parts;

FIG. 2 is an enlarged section taken along the line 2—2 of FIG. 1;

FIG. 3 is a perspective illustrating the use of the steering device when installed on a boat; and

FIG. 4 is a perspective of the curved bearing means of the invention.

Referring first to FIGS. 1 and 2, the device includes a housing consisting of two matched housing plates **10** and **11**. The housing plates **10** and **11** may advantageously be of die cast zinc and they are of similar right and left hand construction so that the device can be installed to operate a control cable extending to one side or the other. Each of the housing plates **10** and **11** has an outer peripheral flange **12** and **13** respectively which register when assembled to define a substantially fully enclosed space within the housing. The plates are held together by at at least three bolts **14**, **15** and **16**, which appear in section in FIG. 1. Aligned circular holes **18** and **19** are formed in the geometric center of the housing plates.

Fitted within the holes **18** and **19** in the housing plates **10** and **11** is a steel bushing **20** disposed coaxially with the center line of the housing. This bushing **20** rotatably supports an internal gear ring **21** of die cast zinc, which includes a hub portion **22** held against axial displacement by the housing plates **10** and **11**. The internal gear ring **21** also includes two asymmetrical spoke portions **23** and **24** as shown in FIG. 1 which define an included angle of about 100°. These spoke portions support an outer annular portion **25** which is formed with gear teeth **26** on its inner surface substantially throughout the larger arc between the two spoke portions **23** and **24**. Formed about the entire circumference of the ring **21** is a central arcuate groove **28** of less than semi-circular shape. The diameter of the ring **21** is such that its grooves **28** is spaced closely adjacent the flanges **12** and **13** of the assembled housing plates **10** and **11**.

Suitably journalled in aligned holes in the housing plates **10** and **11** is a drive shaft **30** which is offset from the center of the device as shown in FIG. 1. The shaft **30** has splined to it a pinion **31** which meshes with the gear teeth **26** on the inside of the ring **21**. As shown in FIG. 3, the drive shaft **30** may be rotated by means of a manual steering wheel **32** to turn the ring **21** clockwise or counterclockwise. The limits of rotation of the ring **21** are established by the connecting bolts **15** and **16** extending through the housing plates **10** and **11**, clockwise movement of the ring **21** being limited by engagement of the spoke portion **23** with the bolt **16** and counterclockwise movement of the ring **21** being limited by engagement of the spoke portion **24** with the bolt **15**.

Both of the housing plates **10** and **11** include corner portions **34**, only one of which is shown in FIG. 1 since the housing plate **10** is removed in that view. The third connecting bolt **14** extends between the housing plates **10** and **11** in the region of the corner portions **34** and it clamps the corner portions about a cylindrical end fitting **35** of a push-pull cable **36**. Though the corner portions **34** of the housing plates surround the circumference of the end fitting **35**, they leave an opening through which the end fitting **35** projects. The end fitting **35** is thereby held securely in a position such that its central axis is substantially tangential with the groove **28** formed in the circumference of the ring **21**.

There is included in the push-pull control cable **36** an outer casting **37** and an inner flexible member **38** of circular cross section, perhaps defined exteriorly by closed convolutions of a helical flat wire. The end of the push-pull cable **36** remote from the steering device is associated with the tiller or other steering device of the boat, so that a push or a pull transmitted by the reacting casing **37** and flexible member **38** turns the tiller or other device in the desired direction. At the steering device, the casing **37** terminates within the end fitting **35**, but the flexible element **38** extends beyond the end fitting **35** tangentially

into the groove 28 formed in the ring 21. Depending upon the position of the ring 21, the flexible member 38 wraps around it in the groove 28 to a varying extent terminating in a radial hole 40 in the annular portion 21 of the ring where it is held fast, as shown in FIG. 1. The hole 40 should be located such that part of the flexible member 38 remains in the groove 28 when the ring 21 is rotated to its counterclockwise limit and the flexible member is fully extended.

By the construction described above, rotation of the shaft 30 by means of the steering wheel 32 turns the ring 21 and causes the flexible member 38 to wind or unwind about the ring in the groove 28. Upon clockwise rotation of the ring 21 as seen in FIG. 1, the flexible member 38 is wound onto the groove 28 of the ring 21 and a pull is transmitted through the flexible member. Upon counterclockwise rotation of the ring 21 as seen in FIG. 1, the flexible member 38 is unwound from the groove 28 of the ring 21 and a push is transmitted through the flexible member 38. It is during this counterclockwise unwinding rotation of the ring 21 that the flexible member 38 tends to displace radially outwardly from the groove 28 and to buckle or bind instead of transmitting the desired push. The primary object of this invention is to provide means for restraining the flexible member 38 from such radially outward displacement out of the groove 28 and to achieve such a restraining effect without frictionally retarding the longitudinal displacement of the flexible member 38 tangentially out of the steering device and through its casing 37.

To this end a separate substantially C-shaped member 42 of plastic material, shown in perspective in FIG. 4, is included in the assembled housing plates 10 and 11. An acetal resin may be particularly advantageous for the member 42, such as that sold by E. I. du Pont de Nemours & Co. under the trademark "Delrin." This can be made very smooth with a somewhat slippery surface and high strength to provide an excellent self-lubricating bearing element. In certain instances, other plastic materials such as nylon or polyethylene may prove equally suitable.

The C-shaped member 42 is fixed within the flanges 12 and 13 of the housing plates 10 and 11 concentrically about substantially all of the circumference of the ring 21 except where the flexible element 38 passes tangentially therefrom through the housing opening in the corner portions 34, as shown in FIGS. 1 and 2. The C-shaped member is formed with a smooth inner bearing groove 43 of slightly more than circular cross section. The bearing groove 43 and the groove 28 in the ring 21 are opposed to one another and together they define a space of substantially the same uniform circular cross section as the flexible member 38. Thus, the bearing groove 43 is in slideable engagement with substantially the full length of the flexible member 38 wound in the groove 28 about the ring 21.

As the ring 21 is rotated in a counterclockwise direction to unwind and transmit a push through the flexible member 38, the flexible member 38 slides easily in and is restrained against outward displacement by the smooth self-lubricating bearing groove 43. Since the coefficient of friction of the flexible member 38 in the bearing groove 43 is so very minimal, there is virtually as little friciton drag on the flexible member 38 during unwinding as there is when rollers are provided about the ring 21. Of course there is no comparison between the minor amount of frictional retardation caused by the C-shaped plastic member 42 and that critically high friction which would exist if the member 42 were not included and the flanges 12 and 13 or other metal parts of the housing were relied upon to restrain the flexible member 38 against outward displacement. This being so, the incorporation of the new plastic bearing means in a rotary-type steering device constitutes a marked simplification over devices which employ an array of rollers and an enormous improvement in functional efficiency over those devices which include no anti-friction bearing means at all.

We claim:

1. In a boat steering device wherein a ring is rotatable in a housing to wind and unwind a flexible member into and out of a circumferential groove in the ring through an opening in the housing with outward displacement of the flexible member resisted during unwinding by a curved plastic bearing member which the housing surrounds, said device being improved in that

(a) the plastic bearing member is rigidly abutted along substantially its entire outer curved surface by the surrounding housing so that both the bearing member and the flexible member are fixed against outward displacement during unwinding, and

(b) the plastic bearing member is formed along its inner curved surface with a bearing groove opposed to the circumferential groove in the ring and defining therewith a space through which the flexible member passes of substantially the same cross section as the flexible member.

2. A boat steering device according to claim 1 wherein the cross section of the flexible member is circular and the plastic bearing member is of acetal resin.

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