

[54] TOWING GUIDE

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[58] **Field of Search**..... 114/235 B; 308/238

[56] **References Cited**

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[57] **ABSTRACT**

A towing guide having support structure within the periphery and extending longitudinally beyond the rotor, with a tow attachment means longitudinally outward from each end of the rotor and bearing means for the rotor between the attachment means thereby providing a single-beam towing guide free of braces spanning the rotor for direct application of towing forces to the opposite ends thereof. The towing guide has a stationary end baffle mounted on a rotor support and extending radially beyond the rotor to impede endwise flow therearound, the baffle and the rotor having closely spaced, generally parallel opposing surfaces providing an extended narrow gap to permit rotation of said rotor while impeding water flow therethru between the exterior and interior of the rotor.

16 Claims, 5 Drawing Figures

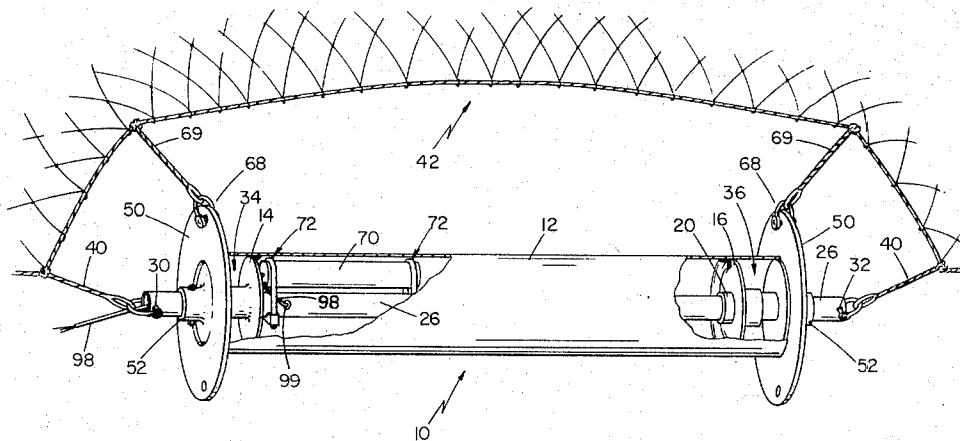


FIG 1

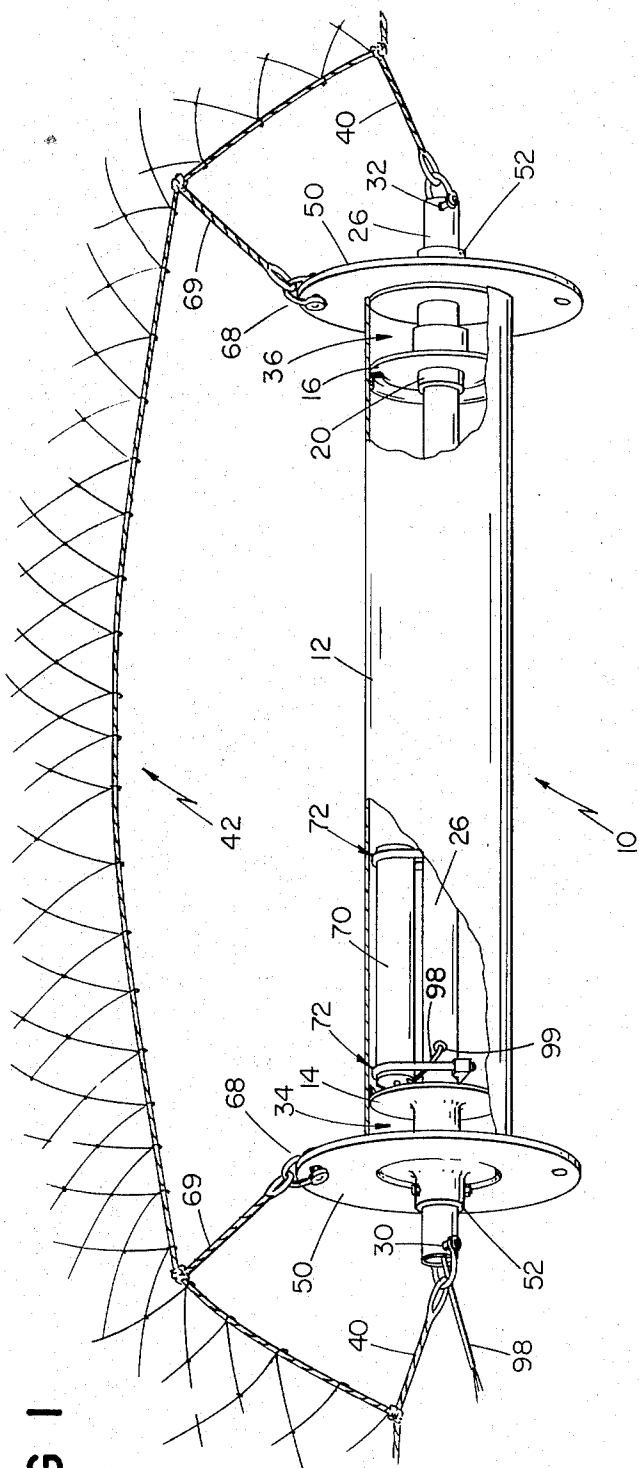
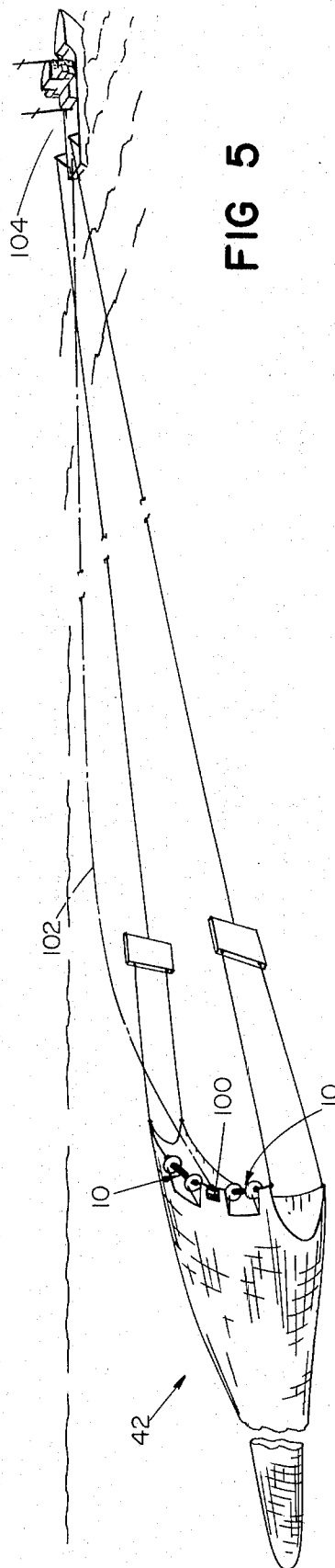
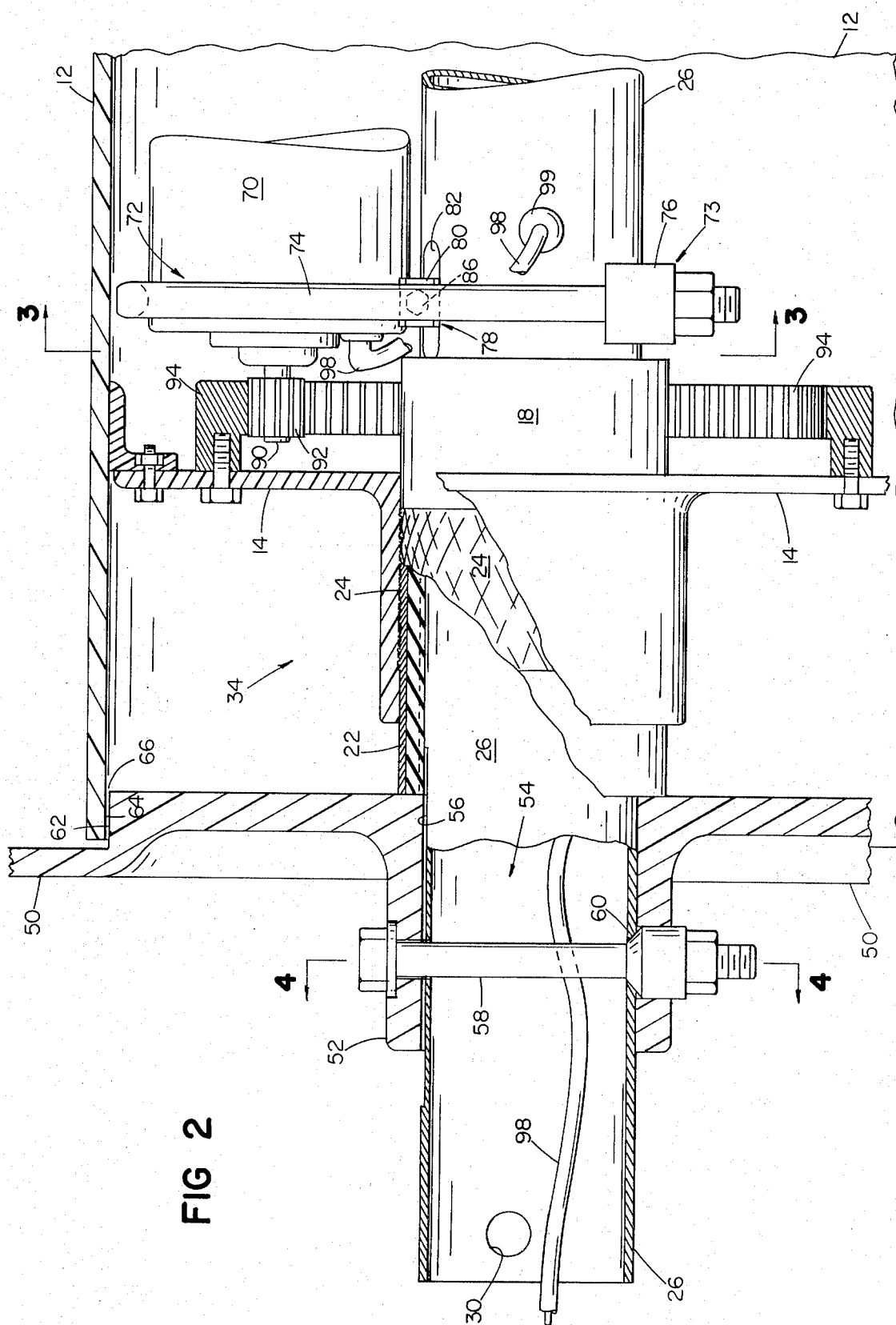


FIG 5





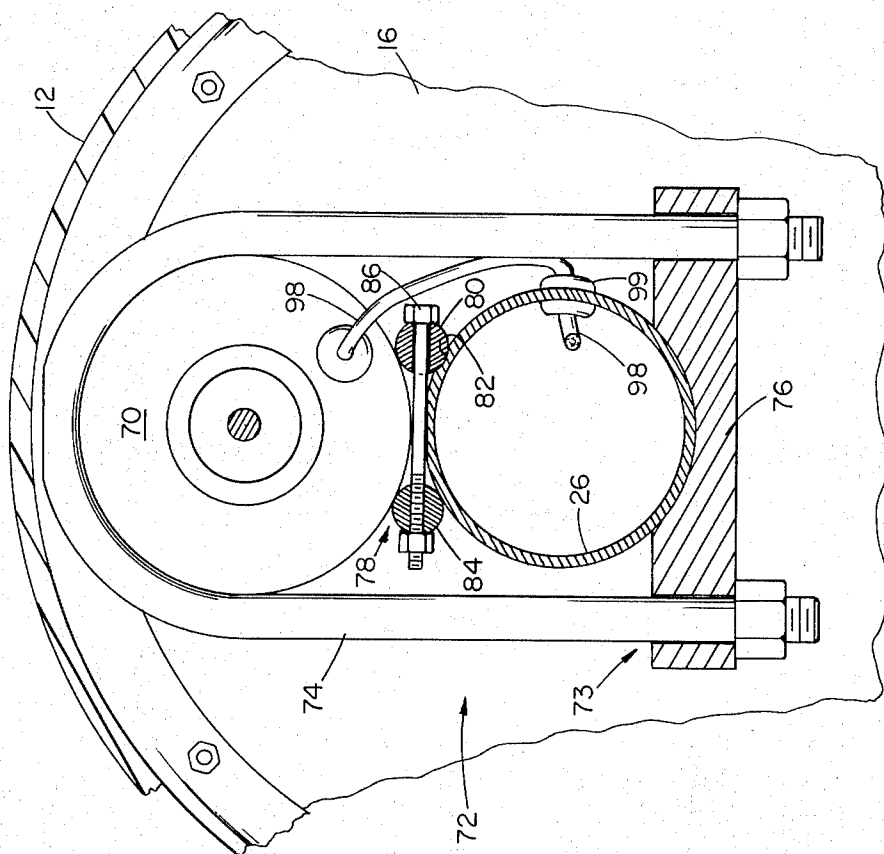


FIG 3

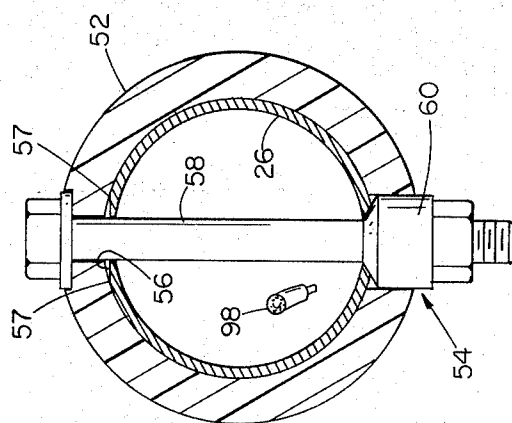


FIG 4

TOWING GUIDE

BACKGROUND OF THE INVENTION

This invention relates to controlling the path of a submerged, towed body, such as a fishing net. Towing guides with rotors, to control the path of submerged towed bodies, have been described. In such devices, the rotor is caused to rotate while the guide is towed forward through the water. The rotating rotor interacts with the flowing water through which it moves to modify the motion of the water and to generate forces oblique to the direction of motion which are transferred to the towed body to affect its path. By selectively operating the rotor in different directions and at different rotation rates, variable forces may be obtained to control the path of the towed body as desired.

Heretofore known guides of this nature have had structural elements external to and spanning the rotor which have adversely affected the performance of the guide by interfering with the desired flow field around the rotor. These structures have also made the guide susceptible to fouling and entanglement in operation and bulky and inconvenient in handling and stowage. Previous guides also have been expensive and have severely compromised desirable qualities including lightness, and corrosion resistance in order to achieve the required fit of parts in their rotor support and drive mechanism.

SUMMARY OF THE INVENTION

A primary object of the present invention is to improve the performance of rotor-type towing guides by eliminating deleterious disturbances in the flow pattern near such guides and by minimizing flow around the ends and between the interior and exterior of the rotors of the guides. Other objects include providing such a guide that is free of flow disturbing braces spanning the rotor, that is constructed with material having desirable qualities, but susceptible to warpage, that is compact, that is not prone to fouling, and is easily and inexpensively built.

One aspect of the invention features a towing guide having support structure within the periphery and extending longitudinally beyond the rotor, with a tow attachment means longitudinally outward from each end of the rotor and bearing means for the rotor between the attachment means thereby providing a single-beam towing guide free of braces spanning the rotor for direct application of towing forces to the opposite ends thereof. A specific embodiment features a rigid, non-rotating axle extending through the rotor to which are affixed towing attachments, bearing means for the rotor, end baffles with cantilevered attachment to the axle extending radially beyond the rotor and a motor adjustably positioned between the axle and the rotor. The end baffles are affixed to the axle by a hub fitting around the axle and clamped thereto by a clamp mechanism which presses the hub against the axle in two distinct regions for more secure attachment.

Another aspect of the invention features a towing guide having a stationary end baffle mounted on a rotor support and extending radially beyond the rotor to impede endwise flow therearound, the baffle and the rotor having closely spaced, generally parallel opposing surfaces providing an extended narrow gap to permit rotation of said rotor while impeding water flow there-

thru between the exterior and interior of the rotor. A preferred embodiment features baffles with a diameter twice the diameter of a tubular rotor and an outward facing portion opposing an inward facing portion of the rotor to provide a narrow gap between baffle and rotor irrespective of warping of the baffle.

Other objects, features and advantages will appear from the following description and the drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 shows a guide according to the invention attached to a net and partly cut away to reveal interior parts.

FIG. 2 shows a portion of the guide of FIG. 1 partly cut away and partly sectioned to reveal interior parts.

FIG. 3 is a partial cross-section of the guide of FIGS. 1 and 2 taken at the plane 3—3 shown in FIG. 2.

FIG. 4 is a section of the guide taken at the plane 4—4 shown in FIG. 2.

FIG. 5 shows the guide of FIG. 1 operationally attached to a fishing net and towed by a boat.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the drawings, a towing guide 10 according to the invention is shown. Hollow tubular rotor 12 is attached to and supported by support webs 14 and 16. Support web 14 is affixed to bearings 18 by snug engagement with knurled portion 24 of bearing sleeve 22 (as shown particularly in FIG. 2). Web 16 is similarly attached to bearing 20. Bearings 18 and 20 are journaled for unlimited rotation on support axle 26 within and extending through rotor 12. Axle 26 carries tow structures 30 and 32, located distally on the axle with respect to journals 34 and 36. Tow portions 30, 32 are attached to head rope 40 of net 42. End baffles 50, extending radially outward from rotor 12 and having a diameter twice that of rotor 12, are attached through hub portions 52 to axle 26 by means of clamp mechanism 54. Hub 52 fits closely around axle 26 and over a relieved portion 56 milled into the surface of axle 26. Bolt 58 of mechanism 54 draws up fitting 60 to press axle 26 into firm contact with hub 52 to cause hub 52 and axle 26 to bear on each other along the edges 57 of relieved portion 56. Outward facing surface portion 62 of end baffle 50 opposes inward facing surface portion 64 of rotor 12 across narrow gap 66. End baffles 50 carry attachment fittings 68 from which lines 69 run to net 42.

Three phase electric induction motor 70 is affixed to axle 26 by two locking mechanisms 72, one of which is shown more particularly in FIG. 3. Locking mechanism 72 includes U-bolt 74 and crossbar 76 which together form clamp 73 pressing axle 26 and motor 70 against spacer 78. First spacer element 80 with a cylindrical surface fits into depression 82 in axle 26 and bears against motor 70. Spacer element 84 bears against the surface of axle 26 and against motor 70. Link bolt 86 pierces elements 80 and 84 and limits their separation one from another. Shaft 90 of motor 70 is attached to spur gear 92 which in turn engages and drives ring gear 94. Ring gear 94 is in turn affixed to web 14 to cause rotation of rotor 12. By adjusting link bolt 86 together with a corresponding adjustment of clamp 73, the separation of motor 70 and axle 26 may be selectively adjusted. Electric conduit 98 from motor 70 passes into axle 26 through aperture 99 and leads out of the device through the interior of axle 26 beneath bearing 18.

Conduit 98 joins with additional electrical circuits from another similar device and from a net sounding device 100 to form electrical cable 102 leading to the towing boat 104. A conventional, variable frequency electric generator (not shown in the figures) is situated on boat 104 and is connected to provide power through cable 102 to electrical conduit 98.

In operation, the vessel being under way and towing net 42 forward through the water, the captain or other person on the boat manipulates controls suitably to cause the on-board generator to produce an electrical output of selected phase rotation and frequency. The output of the generator is transmitted through cable 102 and conduit 98 to electric motor 70 which is thereby caused to rotate in a direction and at a rate corresponding to the generator output. The motor, acting through gears 92 and 94 and web 14, in turn causes the rotor to rotate with a direction and speed corresponding to the electrical input. The rotating rotor modifies the flow pattern of the water flowing past the device to produce a substantial pressure differential between the portion of the outer rotor surface moving in the direction of the tow and the corresponding portion of the surface moving in opposition to the tow. The resultant force on the rotor from this pressure differential is transmitted through webs 14 and 16 to bearings 18 and 20 thence to axle 26 and headline 40 to modify the path of net 42. Since the magnitude and direction of this force is related to the rotation rate and direction of the rotor, the amount of the force and the resulting position of the net can be controlled by appropriately selecting the output of the generator on the deck of boat 104. The pressure differential between opposite sides of the rotor tends also to produce a flow around the ends of the rotor which would be detrimental to the operation of the device. End baffles 50 extending radially outward from the rotor impede this undesirable flow and minimize its effects. An alternative path for the end flow passing through gap 66 and the interior of the rotor is impeded by the narrowness of gap 66. The rotor's rotation also generates a torque acting on the device. This torque is resisted to prevent rotation of the device as a whole by a reactive torque applied through lines 69 and fittings 68.

The rotor 12, end baffles 50, and webs 14 and 16 are advantageously made of an organic polymer based material such as fiberglass because this material is strong, light weight, and corrosion resistant. Such material, however, has the disadvantage that it is subject to dimensional distortion in manufacture so that close dimensional tolerances can be maintained only with considerable difficulty and cost. End baffles 50 especially are susceptible to warping into a saucer shape. The employment of outward facing surface portion 62 of baffles 50 closely opposed to inward facing surface portion 64 of rotor 12 to form gap 66 ensures that a narrow, flow resisting gap will be provided irrespective of warping of baffles 50 or webs 14 and 16. Web 14 is advantageously affixed to bearing 18 by integrally forming web 14 around bearing 18 while the material is in a plastic state. The knurled surface portion 24 of bearing cover 22 firmly locks the bearing and web into an integral unit. Bearings 18 and 20 are advantageously water lubricated rubber bearings which have the advantage of being corrosion resistant, but are not susceptible to a high degree of dimensional control. The locking mechanisms 72 affixing motor 70 to axle 26 provide for ad-

justment of the position of motor 70 with respect to axle 26. (Adjusting of link bolt 86 to pull elements 80 and 84 together while correspondingly relieving clamp 73 makes the motor and axle move farther apart.) The adjustment is useful in enabling a precise fitting of gears 92 and 94 despite the low dimensional tolerances of the structural parts. The positioning of element 80 into depression 82 effectively prevents any rotation of the motor around the axle when the device is bumped or knocked about. End baffles 50 are secured to axle 26 by frictional pressure produced in locking mechanism 54. The relieved area 56 in the surface of axle 26 ensures that the axle and hub will bear against each other in two parallel zones along the edges of the relief and thereby provide a joint effectively resisting relative rotation around the axis of bolt 58.

Baffles 50 advantageously extend to about twice the rotor radius corresponding to the extent of the pressure differential produced by the rotor.

What is claimed is:

1. A towing guide for controlling the path of a towed, submerged object, said guide having a powered rotor for interacting with flowing water and thereby generating control forces, said guide having support structure within the periphery and extending longitudinally beyond said rotor, said structure supporting tow attachment means positioned longitudinally outward from each end of said rotor and free of flow disturbing elements longitudinally spanning said rotor, said structure supporting bearing means for said rotor between said attachment means, thereby providing a single-beam towing guide free of elements spanning said rotor for direct application of towing forces to the opposite ends thereof.

2. The guide of claim 1 including two end baffles with cantilevered attachment to said support structure, said baffles being free of spanning braces and providing unimpeded space therebetween outside said rotor for undisturbed flow of water.

3. A towing guide for controlling the path of a towed, submerged object, said guide being of the type having a rotor for interacting with flowing water to generate control forces comprising:

a rigid, non-rotating axle within said rotor and extending therethrough,

two tow structures, for receiving tow forces, each tow structure affixed to said axle beyond an end of said rotor, said axle maintaining said tow structures in fixed relationship to each other against towing forces,

bearing means connected to said axle between said two tow structures supporting said rotor for unlimited rotation, and

motive means connected to said rotor for rotation thereof,

said guide being free of flow disturbing elements longitudinally spanning said rotor.

4. The towing guide of claim 3 including an end baffle affixed to said axle near an end thereof and extending radially beyond said rotor for impeding flow endwise around said rotor.

5. Device of claim 3 wherein said rotor is supported on a bearing having a metal outer sheath with surface irregularities and wherein a web of organic polymer material formed in place to fixedly engage said sheath through said irregularities supports said rotor.

6. A towing guide for controlling the path of a towed, submerged object, said guide being of the type having a rotor for interacting with flowing water to generate control forces comprising:

- a rigid, non-rotating axle within said rotor and extending therethrough,
- two tow structures, for receiving tow forces, each tow structure affixed to said axle beyond an end of said rotor,
- bearing means connected to said axle between said two tow structures supporting said rotor for unlimited rotation, and
- motive means connected to said rotor for rotation thereof, and
- an end baffle affixed to said axle near an end thereof and extending radially beyond said rotor for impeding flow endwise around said rotor, said end baffle having a hub portion fitting closely around said axle and secured to said axle by a clamp mechanism including a rod element piercing said axle and said hub transversely, a first clamp element held on said rod element and bearing on said axle, and a second clamp element held on said rod element and bearing on said hub to press said hub firmly against a side of said axle.

7. The guide of claim 6 wherein said side of said axle is relieved and said hub bears against said axle in two distinct regions.

8. A towing guide for controlling the path of a towed, submerged object, said guide being of the type having a rotor for interacting with flowing water to generate control forces, comprising:

- a rigid, non-rotating axle within said rotor and extending therethrough,
- two tow structures, for receiving tow forces, each tow structure affixed to said axle beyond an end of said rotor, said axle maintaining said tow structures in fixed relationship to each other against towing forces,
- bearing means connected to said axle between said two tow structures supporting said rotor for unlimited rotation, and
- motive means connected to said rotor for rotation thereof, said motive means for rotating said rotor including a motor situated within said rotor and affixed to said axle, said motor having a shaft rotating with respect to said axle to drive said rotor.

9. The guide of claim 8 wherein said motor is between said axle and said rotor.

10. The guide of claim 9 wherein said motor is affixed to said axle between two rotor bearings.

11. The guide of claim 10 wherein said motor is an electric induction motor and wherein leads for said motor are led out of said rotor past said bearings through the interior of said axle.

12. A towing guide for controlling the path of a towed, submerged object, said guide being of the type having a rotor for interacting with flowing water to generate control forces comprising:

- a rigid, non-rotating axle within said rotor and extending therethrough,
- two tow structures, for receiving tow forces, each tow structure affixed to said axle beyond an end of said rotor,

bearing means connected to said axle between said two tow structures supporting said rotor for unlimited rotation, and

motive means connected to said rotor for rotation thereof including a motor affixed to said axle within said rotor and between said axle and said rotor, wherein said axle has a cylindrical surface portion with a depression therein and wherein said motor is affixed to said surface portion with a locking mechanism comprising a clamp limiting separation of said motor and said axle and a spacer, said spacer including

- a first spacer element fitting into said depression and in bearing contact with said motor and said axle,
- a second spacer element in bearing contact with said motor and said axle, said first and second spacer element being disposed on opposed sides of the region of closest approach of said motor and said axle,
- a link engaging said first and said second spacer elements and limiting their separation one from another.

13. The guide of claim 12 wherein said link is adjustable to establish a preset maximum distance between said first and second spacer elements and thereby adjust the position of said motor.

14. In a towing guide for controlling the path of a towed, submerged body, said guide being of the type having a generally cylindrical hollow rotor for producing control forces by interaction with ambient water, the improvement comprising a stationary end baffle mounted on a rotor support and extending radially beyond said rotor to impede endwise flow therearound, said baffle having a radially outward facing surface portion overlapping and closely opposing an inward facing surface portion of said rotor to provide a narrow gap together with clearance irrespective of warping of said end baffle to permit rotation of said rotor while impeding water flow therethru between the exterior and interior of said rotor.

15. In a towing guide for controlling the path of a towed submerged object, said guide being of a type having a rotor for interacting with flowing water and thereby generating control forces, the improvement comprising in combination:

- a rigid, non-rotating axle within said rotor and extending therethrough,
- two tow attachments for receiving tow forces affixed to said axle beyond ends of said rotor, said axle maintaining without rotor-spanning braces said tow structures in fixed relationship to each other against towing forces,
- bearing means supporting said rotor for rotation affixed to said axle between said tow attachments,
- a motor for rotating said rotor affixed to said axle, and situated between said rotor and said axle, said motor having a shaft rotating with respect to said axle, and
- an end baffle affixed to said axle closely opposing said rotor near an end thereof to impede flow endwise around said rotor.

16. The guide of claim 15 in combination with a fishing net and attached thereto.

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