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United States Patent

Lunde

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[45] Feb. 29, 1972

[54] ROUGH-WATER TOWING SYSTEM

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[21] Appl. No.: 858,829

[52] U.S. Cl. ..... 114/235 R
[51] Int. Cl. B63b 21/00
[58] Field of Search 114/235, 77

[56] References Cited

UNITED STATES PATENTS

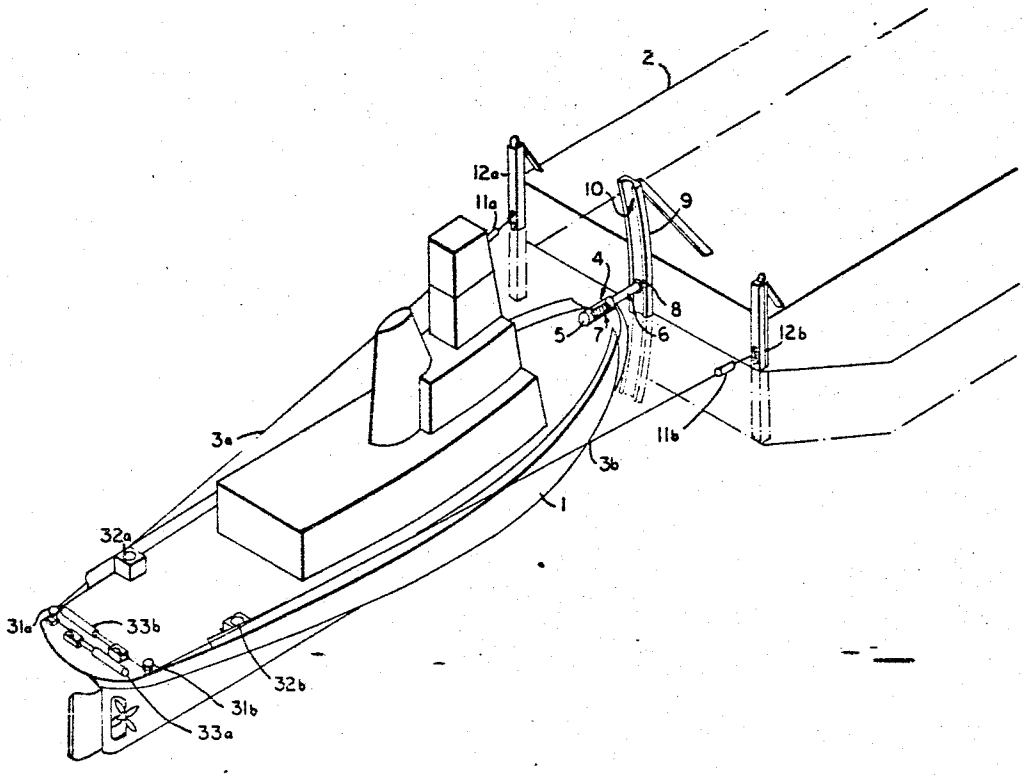
3,353,512	11/1967	Mathews et al.	114/235
3,461,829	8/1969	Mosvold	114/235

Primary Examiner—Trygve M. Blix
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[57] ABSTRACT

A pusher towboat normally propels a load carrying vessel by pushing contact at the centerline of the stern of the vessel with a towboat-mounted shock absorbing pusher knee. A pair of tensioned rapidly detachable tiller lines interconnecting the vessel and the stern of the towboat lash the vessel and towboat together with a force substantially greater than the astern power of the towboat and stores energy in the pusher knee to rapidly separate towboat and vessel upon detachment of the tiller lines. A connected, but normally nonoperational, pull-towline enables pull-tow control of the vessel upon tiller line detachment. The points of connection of the tiller lines to the vessel, the point of pushing contact between towboat and yessel, and the points of connection of the tiller lines to the stern of the towboat lie in substantially the same horizontal plane. Relative length of the two tiller lines is adjustable under load but at equal tension, so that towboat thrust is available for steering the load carrying vessel by a variation in longitudinal alignment of the towboat with respect to the vessel.

14 Claims, 16 Drawing Figures



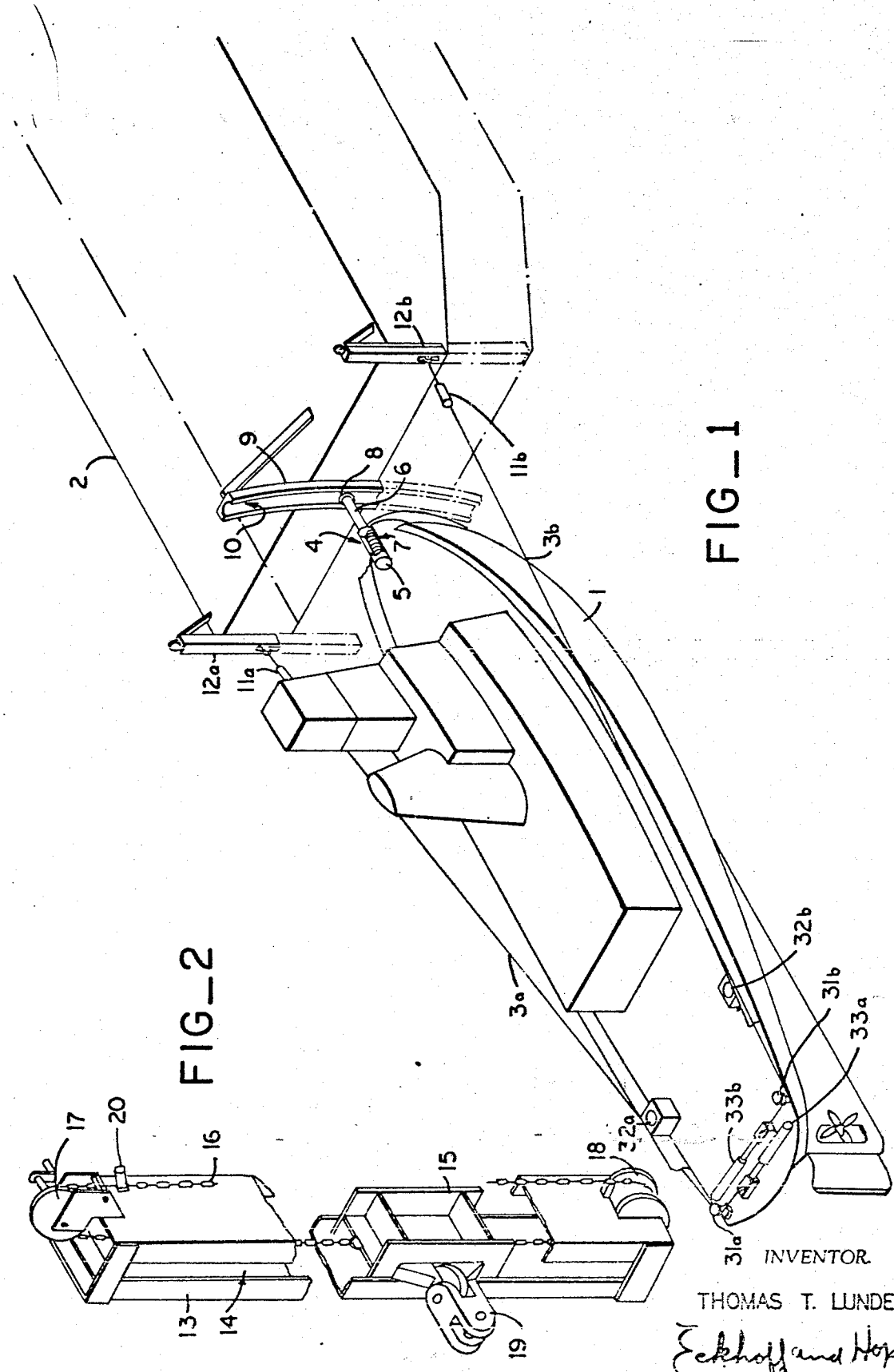


FIG_1

FIG_2

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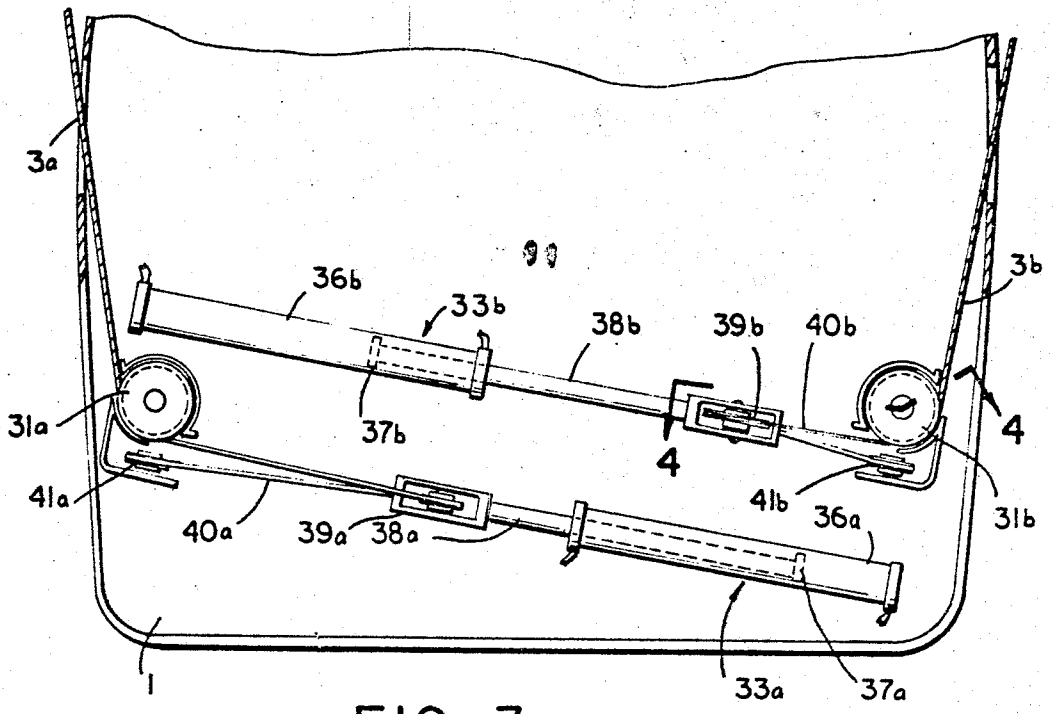


FIG_3

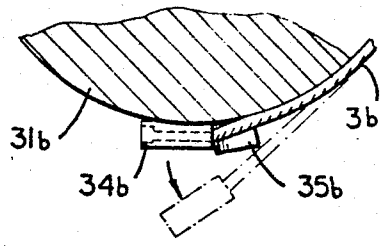


FIG_5

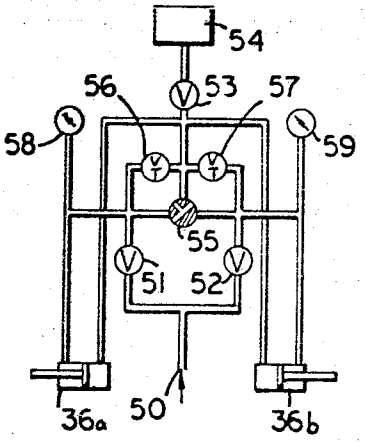


FIG_6

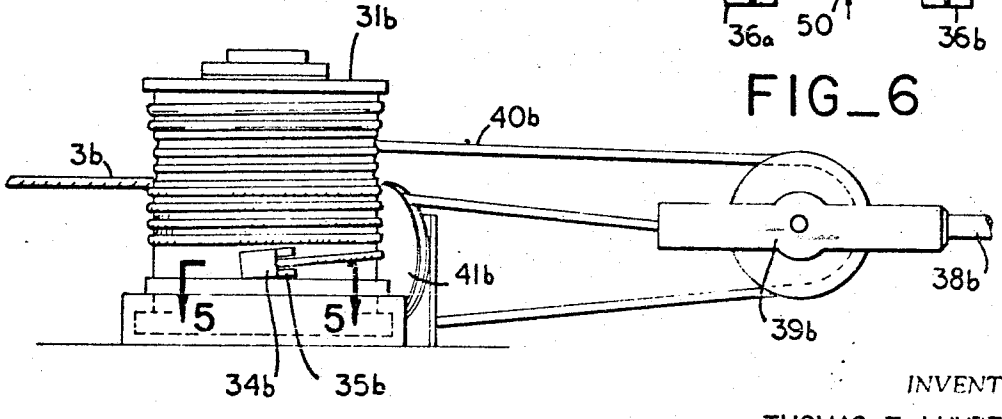


FIG_4

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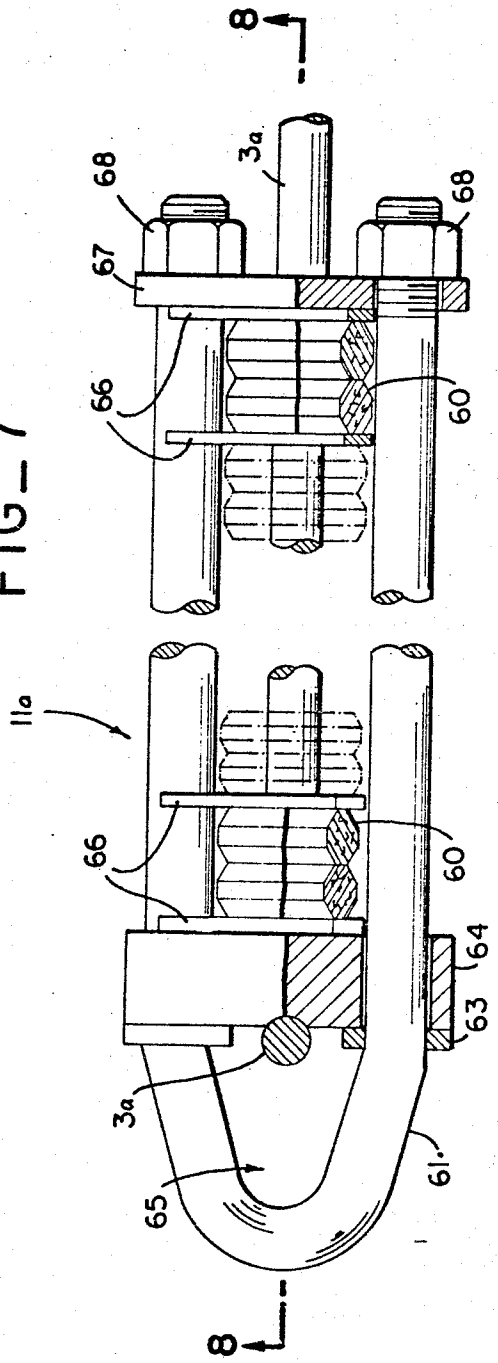


FIG_7

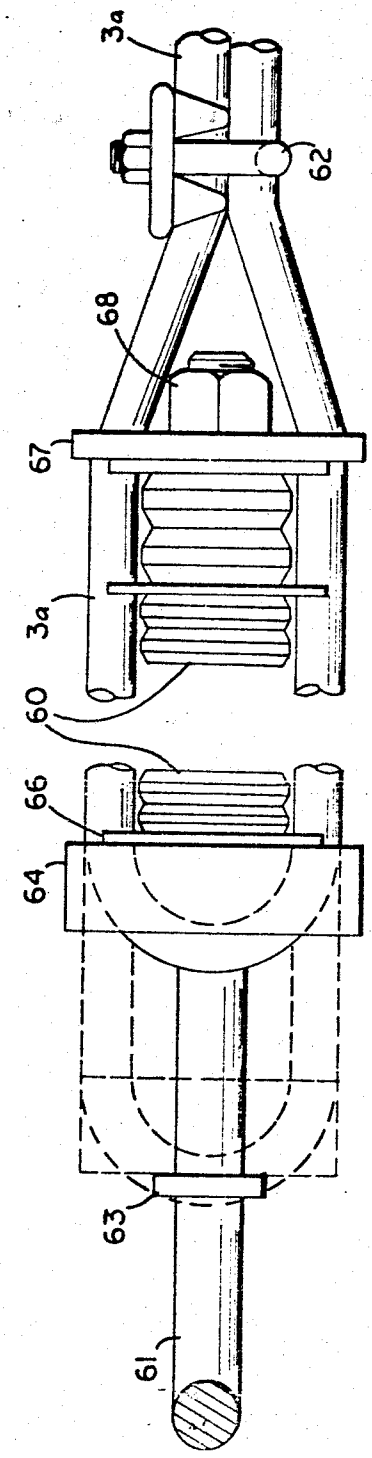


FIG_8

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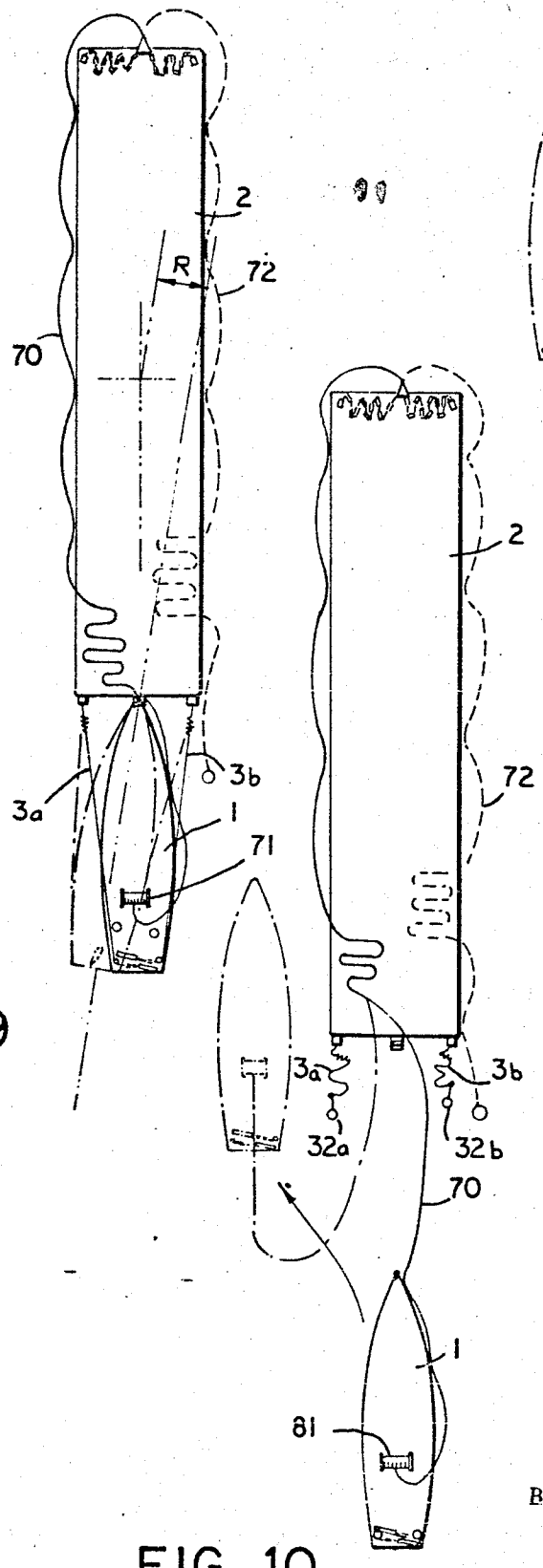


FIG_9

FIG_10

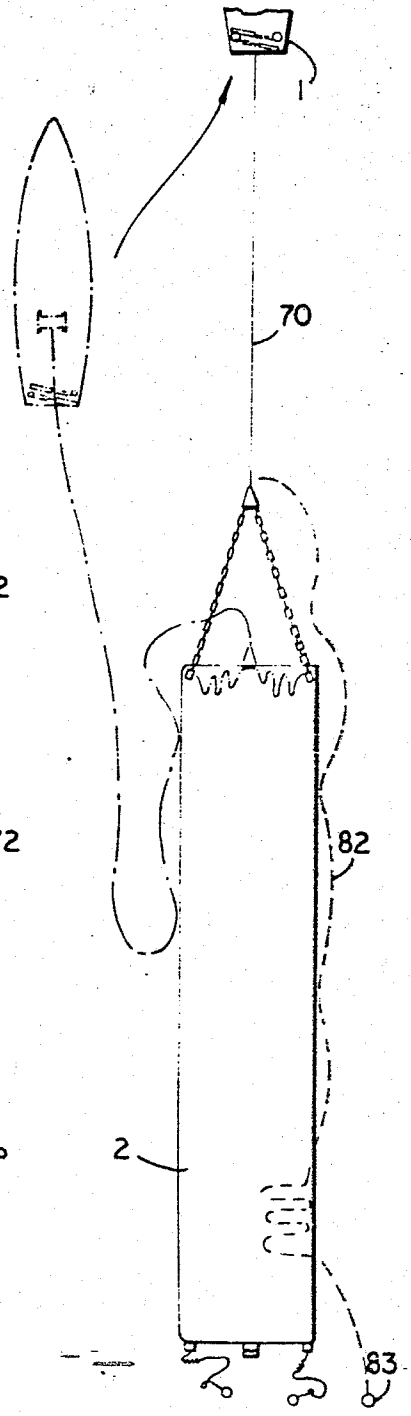


FIG_11

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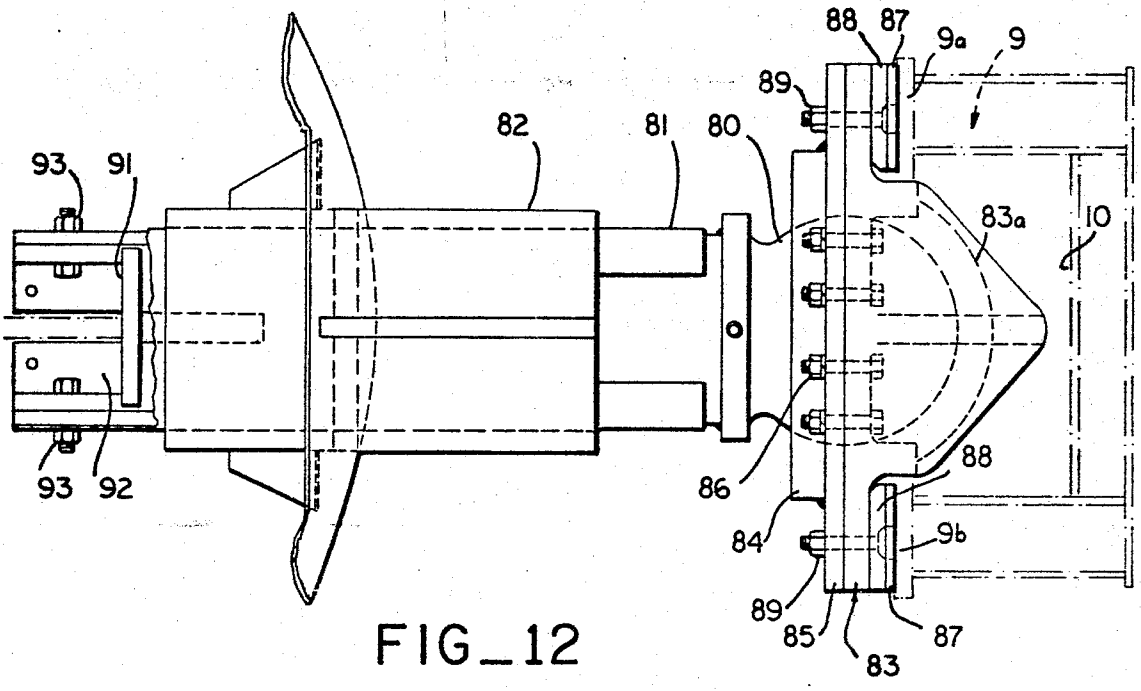


FIG_12

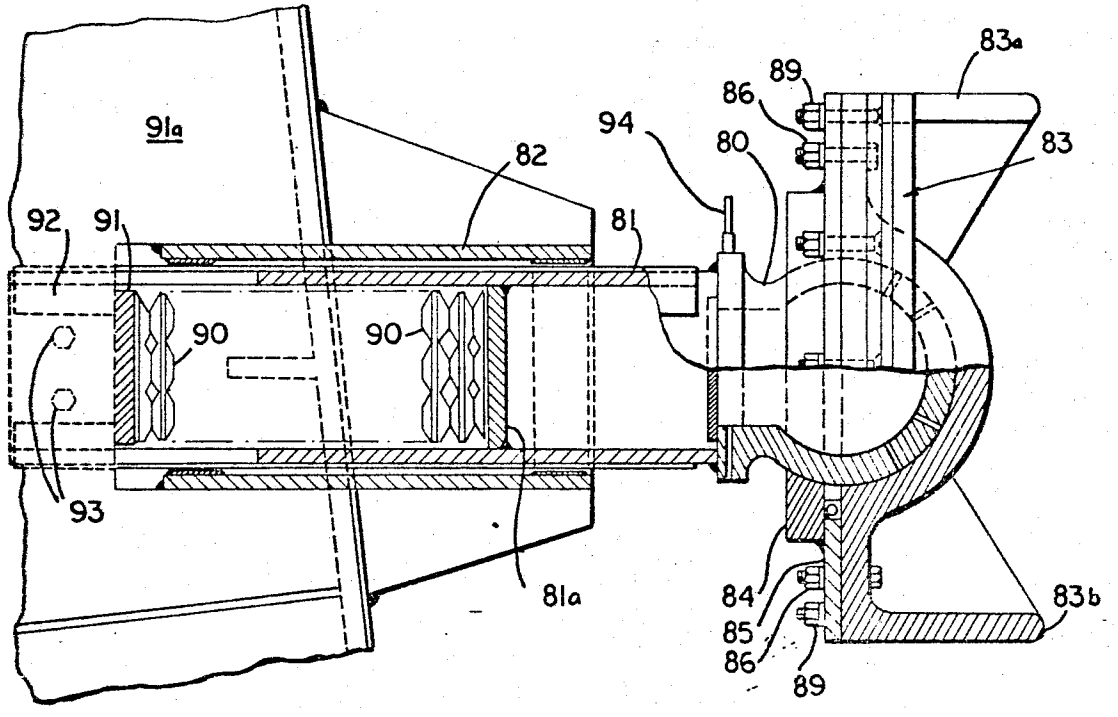


FIG_13

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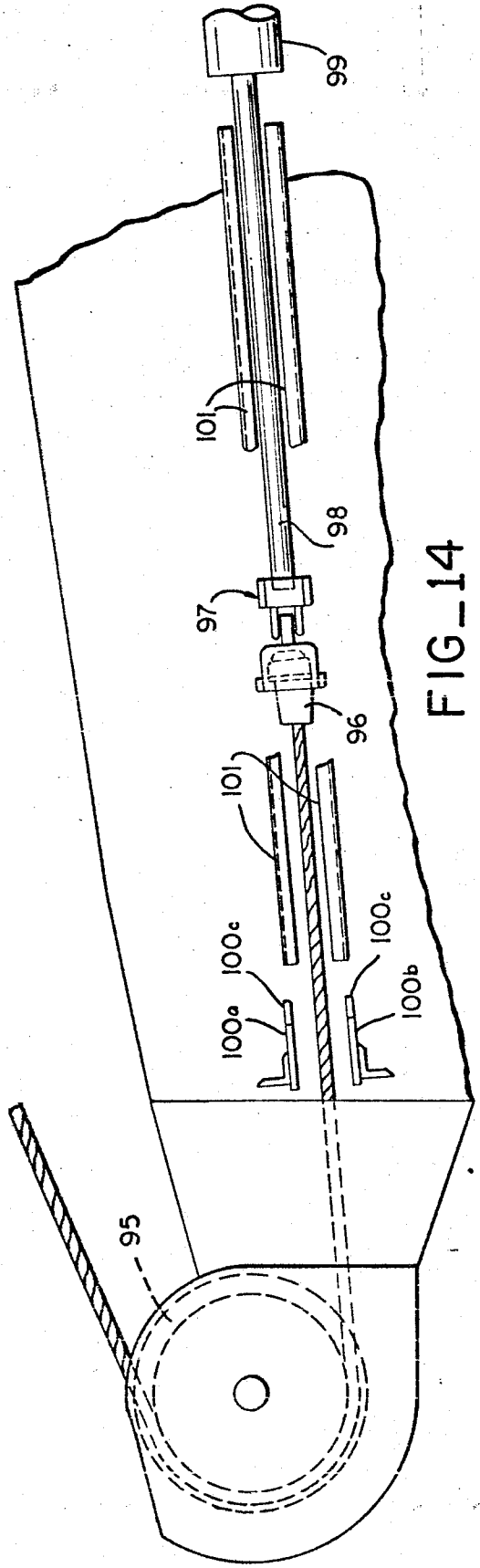


FIG_14

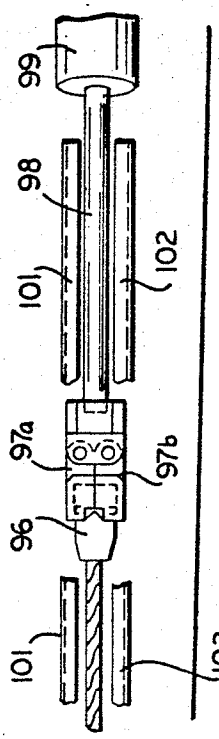


FIG_15

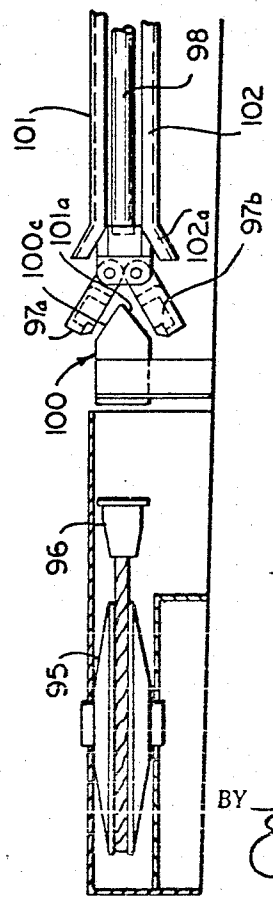


FIG_16

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ROUGH-WATER TOWING SYSTEM

This application relates generally to methods and means for propelling load carrying vessels by a towboat and more particularly relates to a safe method and means for push-towing in rough water.

Heretofore, towing of load carrying vessels, such as barges, in heavy seas has been accomplished by pulling the vessel with the towboat by means of a long pull-towline hanging substantially in a catenary to accommodate instantaneous variations in forward motion of the two vessels. Although push-towing has been quite common in protected waters, even improved techniques, such as that disclosed in U.S. Pat. No. 2,984,202 for Lashing Arrangement for Pusher Towboat and Barge, become extremely dangerous in the rough water encountered in off-shore or deep sea towing service. The danger in part results from the inability of these arrangements to cast off and rapidly separate towboat and barge, if necessary; or, from the dynamic load occurring upon reengagement of towboat and barge after a sea-caused separation; or, from possible foundering of a heavily laden tow.

The system of this invention normally lashes the towboat and barge in pushing contact without separation with highly tensioned tiller lines and simultaneously develops stored energy in the pusher knee to augment astern propeller thrust for rapid separation of the vessels should the need arise to drop the tow at sea. The lashing is rapidly detachable and carries resilient means for automatic takeup of variations in tiller line length caused by relative pitching, yawing, or rolling motion between vessels.

One object of the present invention is to provide a towing system in which the towboat can be cast off rapidly from the laden vessel in rough weather and can be quickly and positively separated from it before any possible collision can occur.

Another object of this invention is to provide a method and means whereby the towboat can be cast off from its push-towing relation to the laden vessel and switched to conventional pull-towing with a deep sea towline if unusually rough weather or unsafe weather should occur and then can easily resume the push-tow as such weather subsides.

An object of this invention also is to provide a push-towing system in which towboat thrust is available for steering the load carrying vessel by varying the angularity between towboat and vessel.

Still another object of the invention is to provide a method and means for changing tension in the tiller lines and for continuously sensing the load in those lines while under way.

Other objects and advantages of this invention will become apparent from a consideration of the following detailed description and the accompanying drawings wherein like parts are identified by like reference numbers throughout.

FIG. 1 is a perspective view of the towboat and a barge showing the pushing relationship of the vessels;

FIG. 2 is a detail perspective view of one means for attaching the tiller lines to a barge;

FIG. 3 is a plan view of the stern of the towboat illustrating one form of quick release means and tension means for attaching the tiller lines to the towboat;

FIG. 4 is an elevational view taken along lines 4—4 of FIG. 3;

FIG. 5 shows in plan one means for connecting the tiller line to the drums of FIG. 3 taken along lines 5—5 of FIG. 4;

FIG. 6 is a schematic diagram of an hydraulic system used to tension the tiller lines;

FIG. 7 is a partial sectional view of the spring means incorporated in the tiller lines;

FIG. 8 is a partial sectional view of the same spring means taken along lines 8—8 of FIG. 7;

FIG. 9 is a diagrammatic plan view showing the push-towboat and a barge in push-towing relation using boat thrust for steering the barge;

FIG. 10 is a diagrammatic plan view showing the push-towboat shortly after it has cast off from the barge;

FIG. 11 is a diagram of the push-towboat moved into and in towing relationship with the barge;

FIG. 12 is a top plan view of a preferred embodiment in a knee construction for engaging the stern of a barge with a push-towboat;

FIG. 13 is a side elevation and partial section of the knee construction shown in FIG. 12;

FIG. 14 is a plan view of a second embodiment in a quick release mechanism for disconnectably securing tiller lines to a push-towboat;

FIG. 15 is an elevation of a portion of the quick release connection, taken on lines 15—15 of FIG. 14; and

FIG. 16 is an elevation illustrating positions for quick release mechanism when the tiller lines are being disconnected from the piston rod of a cylinder.

FIG. 1 illustrates a towboat 1 lashed in pushing relationship to a load carrying barge 2 by means of highly tensioned tiller lines 3*a* on the port side and 3*b* on the starboard side, both lines extending from the stern of the towboat to the stern of the barge. Towboat 1 makes continuous pushing contact with barge 2 at its centerline by means of a shock-absorbing pusher knee 4 rigidly mounted on the bow of the towboat. Knee 4 essentially comprises a cylindrical casing 5 affixed to the towboat and a plunger 6 which is reciprocable within the casing. In addition, plunger 6 bears against a shock absorbing coil spring 7 seated within casing 5. The forward end of plunger 6 carries a button 8 that engages a curved pusher bar 9 rigidly mounted on the barge stern headlog at its centerline. Bar 9 has a vertically elongated and curved cavity 10 facing astern which receives the button 8. If desired, the pusher knee may be provided with means for retracting it aft when not in use.

During push-towing, button 8 and cavity 10 of bar 9 are maintained in pushing engagement, and the propeller thrust of the towboat is transmitted to the barge through the pusher knee and the socket to propel the assembly of vessels. Orientation of towboat and barge in FIG. 1 shows them in axial alignment; however, as will hereinafter be described, the stern of the towboat can be shifted to port or starboard in order to make its propeller thrust available for steering the barge. The mating curved surfaces of the pusher button 8 and pusher socket cavity 10 accommodate changes in orientation between the towboat and barge.

While in push-towing service the tiller lines are tensioned so that the towboat and barge are continuously and firmly lashed into contact with one another. Towline tensions in the order of three times the astern power of the towboat are used. The spring 7 in the pusher knee is designed so that under such loading it is compressed to approximately half of its fully extended length for two purposes, first to absorb any shock loading between barge and towboat which might occur and second to store energy developed by tension in the tiller lines so that upon detachment of those lines, the spring through plunger 6 and button 8 immediately pushes the towboat and barge apart. This provides a positive separation when casting off.

Tiller lines 3*a*, 3*b* connect through resilient spring means 11*a* and 11*b*, respectively, to the barge at adjustable tiller connectors 12*a*, 12*b* mounted on the port and starboard sides of the barge respectively. As shown more clearly in FIG. 2, each connector comprises a housing 13 mounted on the barge headlog which defines a vertical channel 14 in which is carried an adjustable carrier 15 suspended by a positioning chain loop 16 training over an upper sprocket 17 and a lower sprocket 18 mounted at the ends of channel 14. To the stern side of the carrier is attached lashing eye 19 to which the spring means 11*a*, 11*b* on the end of the tiller lines are pinned. Vertical elevation of the eye and its carrier can be varied by rotation of the chain sprockets, manually for example before lashing, so that the points of connection of the spring means to the barge, the connections of the tiller lines to the stern of the towboat and the point of contact between the pusher knee button and the socket cavity lie in substantially the same horizontal plane. A locking pin 20 passing through the positioning chain loop secures the carrier at any predetermined elevation.

Tiller lines 3*a*, 3*b* are anchored at the stern of the towboat, each to a grooved wire rope drum 31*a*, 31*b* rotatably mounted

on the towboat deck. The end of each tiller line has a slip fitting that, when the tiller line wound on the drum is fully paid out, automatically detaches from the drum. The tiller line drops overboard and tiller line buoys 32*a*, 32*b*, respectively, float the end of the tiller lines so that they can be easily recovered. Also mounted on the stern of the towboat is a pair of cylinders or tension means 33*a*, 33*b* by means of which drums 31*a*, 31*b* respectively can be rotated to wind the tiller lines onto the drums and tension them. Each tension means may be selectively operated as to lash towboat and barge together or to pay out the tiller lines until they automatically detach from the drums and are dropped.

As is more clearly illustrated in FIGS. 3, 4 and 5, the port and starboard tiller line drums 31*a*, 31*b* are rotatably mounted on the main deck of the towboat. In the embodiment shown, each tiller line is wound on the lower grooves of the drum with the end of each line secured to the drum by a slip fitting 34*b* which bears against a retainer 35*b* on the drum, this being shown in FIG. 5. It will be readily seen that rotation of the drums as to pay out the tiller lines will eventually release the fittings and drop the tiller lines.

As indicated above, each of the tiller line drums is rotated by one of the tension means 33*a*, 33*b*, each tension means comprising an hydraulic cylinder 36*a*, 36*b* carrying a piston 37*a*, 37*b* mounted on the end of a piston rod 38*a*, 38*b*. The rods carry a sheave block 39*a*, 39*b* at their free ends, and each block takes a multiple purchase on a drum 31*a*, 31*b*, by means of a tensioning cable 40*a*, 40*b* wound on the top of a drum. In the three-part purchase shown, one end of the tensioning cable is fixed to a block 39*a*, 39*b*, and each cable is entrained over a deck-mounted fixed block 41*a*, 41*b*, then around the sheave on the end of a piston rod 38*a*, 38*b* and onto the top of a tiller line drum 31*a*, 31*b*. Accordingly, retraction of either piston rod 38*a*, 38*b* takes up and/or tensions the associated tiller line whereas extension of either rod pays out the tiller line, and both rods may be extended to a point that the tiller lines 3*a* and 3*b* are disconnected and dropped.

FIG. 6 schematically shows one form of hydraulic tiller line control useful in actuating the port and starboard tiller line tension means 33*a*, 33*b*. The hydraulic control comprises a source of hydraulic pressure 50 which communicates through block valve 51 with the rod side of cylinder 36*a* and through block valve 52 with the rod side of cylinder 36*b*. The blind sides of cylinders 36*a*, 36*b* communicate with each other and also with an elevated reservoir 54 through a block valve 53. Three-way valve 55 through associated conduits connects the rod sides of both cylinders together and to both cylinder blind sides. Throttle valves 56 and 57 also communicate the rod side of cylinders 36*a* and 36*b*, respectively, to its blind side and to that of the other cylinder.

The system is at equilibrium with block valves 51, 52 closed. To connect the tiller lines to the barge, block valve 51, and/or 52, is opened and three-way valve 55 is opened while block valve 53 and both throttle valves 56, 57 remain closed. The resulting differential pressure across the pistons in cylinders 36*a* and 36*b* causes the piston rods to extend, enabling the tiller lines, pinned to the lashing eye on the barge, to be attached to their respective drums.

The port side tiller line may then be taken up by opening block valves 53 and 51 and closing the remainder of valves 52, 55, 56 and 57. The high pressure on the rod side of cylinder 36*a* retracts piston rod 38*a* to a predetermined position or pressure setting which may be read on a port side pressure gage 58. This gage may be calibrated in terms of pressure but it is also desirable to provide a scale for reaching the corresponding value of tiller line tension. Excess oil from the blind side of cylinder 36*a* flows to reservoir 54.

Starboard tiller line 36 may be taken up in similar fashion by opening block valves 53 and 52 and closing all other valves, the high pressure admitted to the rod side retracting piston 37*b* to a predetermined position or pressure setting on pressure gage 59.

While under way, the stern of the towboat may be maneuvered to port by retracting port side piston rod 38*a* and extending that on the starboard side. This is done by opening block valves 51 and 53, closing valves 52, 55 and 56, and opening throttle valve 57. In this manner the pressure source is open to the rod side of the takeup cylinder 36*a*, hydraulic fluid bleeds from the rod side on the other cylinder through the throttle valve 57 to the lower pressure level of reservoir 54. The takeup cylinder retracts while the other extends, and the stern of the vessel swings in response to the stroking cylinders. In a similar manner, the stern of the towboat may be maneuvered to starboard by retracting the starboard piston rod and extending the port rod by opening block valves 53 and 52 and throttle valve 56 while closing block valve 51, three-way valve 55 and throttle valve 57.

The hydraulic control system may be operated to disconnect both tiller lines from drums 31*a* and 31*b* by moving both pistons in cylinders 36*a* and 36*b* from retracted to extended positions. This is accomplished by opening block valve 51 (and/or block valve 52) and three-way valve 55, and by closing block valve 53 and both of the throttle valves 56 and 57. The differential pressure across the pistons causes the cylinder rods to extend.

It is also contemplated that the tiller lines may be disconnected without aid of hydraulic pressure by opening all valves but the throttle valves and by putting the towboat in reverse. The movement of the towboat (which produces tension in the tiller lines) will cause drums 31*a* and 31*b* to rotate while forcing hydraulic fluid from the rod side of cylinders 36*a*, 36*b*. Makeup fluid to the blind side of the cylinders is drawn from reservoir 54.

Thus, with the foregoing hydraulic system the tiller lines can be tensioned the amount necessary for lashing towboat and barge under extreme weather conditions and for simultaneously developing potential energy in the pusher knee requisite to quickly separate the vessels upon casting them off. In addition, the stern of the towboat may be easily maneuvered while under way to steer the barge. As an important safety feature, the tiller line tension may be ascertained at all times by reading the pressure on gages 58, 59.

Referring to FIGS. 7 and 8, a spring means suitable for use at the forward end of each tiller line comprises a plurality of resilient cushion pads 60 compressed within the bight of a loop formed in the end of the tiller line and a U-shaped frame 61. As shown, the end of tiller line 3*a* is clamped in a loop by a wire rope clamp 62, and frame 61 is made from a steel rod bent into a generally U shape and oriented 90° relative to the loop. The closed or bent end of the rod supports a pair of washers 63 which are welded thereto to form the stop for a compression plate 64 and define an attachment eye 65 that may be pinned to the tiller lashing eye 19 on the barge. Compression plate 64 is slidably mounted upon the two frame legs and within the end loop of the tiller line, a groove being formed in the compression plate for receiving the end loop. A plurality of cushion pad spacers 66, each having semicircular cutouts which fit the legs of the frame 61, are also disposed within the loop of the tiller line, a pair of cushion pads 60 (which are substantially donut shaped and made of a resilient hard rubber) being disposed between each pair of spacers. A keeper plate 67 (within the tiller line loop but also slidable on the legs of frame 61) bear against the end most spacer. This keeper plate is held in place by nuts 68 threaded on the free ends of frame 61.

Compression plate 64, cushion pad spacers 66, and cushion pads 60 (as well as keeper plate 67) are each slidable along the legs of frame 61 within the end loop of the tiller line. With no tension on the tiller line they may occupy the positions illustrated in FIG. 3, the cushion pads being slightly prestressed by tightening nuts 68. As tension is thereafter applied to the tiller lines, the cushion pads are compressed. The degree of compression is dependent upon the tension applied and this changes to accommodate relative pitching, rolling, and other motions between the towboat and barge.

One of the important features of the present invention is the immediate ability to convert from push-towing to pull-towing in the event that extremely rough water makes it dangerous to continue a push-towing relationship between towboat and barge. In FIG. 9 towboat 1 is in pushing relationship to the load carrying vessel 2 and pusher knee 4 is in contact with bar 9 on its stern centerline. Tiller lines 3*a*, 3*b* securely lash boat 1 to barge 2. The centerline of the towboat may be aligned with the centerline of the barge or it may have an angular relationship with respect to the barge centerline so that tug thrust is available for steering the barge. Both conditions are illustrated in FIG. 9. The distance R, as shown, represents the moment arm that is available for turning the barge with propeller thrust, the resultant turning couple being in addition to the usual turning couple developed by rudder action.

Simultaneously with the foregoing push-tow lashing a normally nonoperational deep sea towline 70, connected to the bow of the barge and triced to the port side of the barge and to the starboard side of the tug, is wound on a winch or towing engine 71 mounted on the towboat. If, for example, the towboat captain decides that pull-towing is safer for the weather conditions which have arisen, he may rapidly switch to pull-towing by following the simple procedures illustrated in FIGS. 10 and 11. First, the combination of towboat and barge is brought about to a steady course generally into the weather and the towboat is put into full reverse. The tiller lines are then quickly cast off as hereinbefore described and the energy stored in the pusher knee spring assists in positive separation of the two vessels in spite of such uncontrollable variables as stern power, wind, weather and sail area of the two vessels. The two tiller lines detach from their drums and are dropped into the sea. Their free ends remain accessible for later pickup by buoys 32*a*, 32*b*. The towboat rapidly separates from the barge and the danger which otherwise would be associated with casting off from a heavy and massive free floating barge is eliminated. The towboat is then positioned, as shown in FIGS. 10 and 11, in pull-towing relationship to the barge, towline 70 now being used to pull the barge until the heavy seas subside. At that time the deep sea towline can be stowed and the towboat can reassume push-towing relationship by picking up the tiller lines 3*a*, 3*b* which trail behind the barge attached to buoys 32*a*, 32*b*. If desired, an auxiliary towline 72 may be triced to the starboard side of the barge with a trailing buoy at its end as at 83.

FIGS. 12 and 13 illustrate a preferred embodiment in a shock absorbing pusher knee 4*a* that includes a ball-and-socket joint. This knee construction provides a superior contact with the barge and tolerates various combinations of movement between tug and barge including simultaneous pitching and rolling. Pusher knee 4*a* is also useful in dampening vertical motion between barge and pusher tug. Such motion is caused primarily by the pitching of the two vessels, but it may also be attributed to surge. Since the magnitude of these forces is generally too great to restrain completely, it is essential that there be some vertical "give" between the barge and pusher tug. On the other hand, too much "give" or freedom of movement between the vessels makes the pushing operation difficult, and if there is too much relative movement, the tug may have to resort to a towing operation.

Pusher knee 4*a* essentially comprises a hollow ball member 80 attached to one end of a sleeve 81 reciprocally movable in a housing 82. The housing is adapted to be mounted in the bow of a pusher tug in lieu of the cylindrical casing 5 of knee 4. Ball 80 supports a brakeshoe comprising a socket plate 83 and a pair of ring plates 84 and 85. Plate 84 is peripherally welded to the face of plate 85 which is in turn connected to socket plate 83 by a plurality of bolts 86. Thus, the brakeshoe is mounted to ball 80 for universal movement as is customary with a standard ball-and-socket connection.

Socket plate 83 is especially formed with top and bottom extensions 83*a* and 83*b*, respectively, these extensions being provided to facilitate and maintain engagement of the shoe with bar 9 mounted on the barge stern headlog. The cross section of the bar is illustrated generally by the broken lines in FIG. 12, said bar comprising a pair of parallel contact rails 9*a* and 9*b* and having a cavity 10 that receives extensions 83*a*, 83*b*.

Socket plate 83 further supports a pair of brake linings 87, each lining being bonded or attached to a support plate 88 which is in turn mounted to plates 83 and 85 by a plurality of bolt connections 89. In operation, brake linings 87 make contact with the pair of rails 9*a*, 9*b* for pushing the barge; and, although friction forces inhibit relative movement between the linings and rails, such forces will be overcome and the brake shoe may move vertically along the rails as the vessels pitch in opposite directions while navigating rough water.

Linings 87 may be made of various materials, such as cast iron or steel as well as more conventional brake lining materials. The particular material to be used should be selected for its coefficient of friction, thereby controlling one of the two variables which affect relative movement between the linings and rails 9*a*, 9*b*. The second variable is the contact pressure between the linings and rails and this may be regulated by adjusting tiller line tension. This tension may be varied to suit weather or other operating conditions, so long as the minimum tension is high enough to prevent a separation between linings 87 and rails 9*a*, 9*b*.

Sleeve 81 is adapted to be moved into housing 82 against the resilient bias imposed by a plurality of cushion pads 90 housed within sleeve 81 between a stop plate 91 and the interior wall 81*a* of sleeve 81. Plate 91 is mounted to the vertical centerline plate 91*a* that forms a structural part of the bow section of the pusher tug. As shown, plate 91 is also lodged within sleeve 81, the peripheral edges of the plate being engaged by one end of a keeper sleeve, 92, also disposed within the end of sleeve 81 and secured thereto by bolt connections 93. Keeper sleeve 92 is bolted to sleeve 81 while cushion pads 90 are slightly compressed between stop plate 91 and interior wall 81*a*. Thus, pads 90 are preloaded and tend to maintain the end of keeper sleeve 92 against the back surface of plate 91 until pushing contact is made between the brakeshoe and the bar 9 on the barge.

In operation, a movement of sleeve 81 toward the left compresses cushion pads 90 which then impose a resilient bias urging sleeve 81 to the right.

Means is further provided for supplying a constant supply of lubricant between the surfaces of ball 80 and socket plate 83. For this purpose, ball 80 is formed with a hollow recess and a plurality of openings which communicate that recess with the spherical concave surface of socket plate 83. A continuous supply of lubricant may then be fed into the hollow recess of the ball through a conduit 94 connected to a main reservoir stored on the pusher tug.

FIGS. 14–16 illustrate a second embodiment in a quick release device for disconnecting tiller lines 3*a* and 3*b* from pusher tug 1. This embodiment dispenses with the need of a winding drum and a multiple part purchase as used with the first described apparatus. However, the same hydraulic circuitry illustrated in FIG. 6 may also be used with this second embodiment.

Referring to FIG. 14 in particular, each tiller line is entrained around a deck sheave 95 mounted near the stern of tug 1. The end of each tiller line is provided with a bulbous fitting 96 which may be engaged and held between a pair of jaws 97*a* and 97*b* forming a part of a "clamshell" fitting 97. This fitting is attached to the end of a piston rod 98 which may be reciprocated and forming a part of hydraulic cylinder 99. This cylinder may be identical to cylinders 33*a*, 33*b* used in connection with the first described quick release apparatus.

Jaws 97*a* and 97*b* are each pivoted on parallel axes, and each jaw is pivoted to an open position when forced against a splitter 100. In the form illustrated, splitter 100 comprises two parts 100*a* and 100*b*, one part being spaced from the other a distance greater than the width of fitting 96 but a distance less than the width of clamshell fitting 97. In addition, each part of splitter 100 is formed with convergent surfaces that define

camming edges 100c for wedging jaws 97a and 97b apart and into open position as piston rod 98 drives the clamshell fitting 97 into contact therewith. This operation and position of elements is most clearly apparent in view of FIG. 16.

Means is further provided for clamping jaws 97a and 97b onto fitting 96 and then maintaining such engagement until such time that the fitting is to be released. This means essentially comprises two pairs of upper and lower rails 101 and 102, respectively, each rail having an out-turned end 101a, 102a in the vicinity of splitter 100. Rails 101 and 102 extend parallel to piston rod 98 and are so positioned relative to jaws 97a and 97b that the jaws can open only when they are positioned adjacent the splitter. It will be further apparent that a retraction of piston rod 98 will bring jaws 97a and 97b into contact with the end of rails 101 and 102, causing the jaws to be pivoted to a closed position and allowing the "clamshell" to be withdrawn between the rails. This is a condition or position as shown in FIGS. 14 and 15.

Although one particular system and several embodiments of the invention have been illustrated and described, it is to be understood that various modifications and changes may be made without department from the spirit of the invention or the scope of the attached claims, and each of such modifications and changes is contemplated. For example, hydraulic motors may replace the hydraulic cylinders which are described for applying tiller line tension and various types of resilient means may be used as a substitute for tiller line springs and knee cushions.

What is claimed is:

1. A method for rough-water towing of a load carrying vessel by a towboat comprising propelling said vessel by pushing contact with said towboat at the stern centerline of said vessel; detachably lashing said towboat and vessel together; and tensioning the lashing with a force sufficient to prevent separation of said vessel and towboat and concomitantly developing by said force potential energy including a rearwardly directed major component substantially instantaneously variable as a function of the tension in said lashing for quickly pushing said vessel and towboat apart upon detachment of said lashing.

2. A method according to claim 1 including the step of resiliently lashing said towboat and vessel together to accommodate differential rolling or pitching between vessel and towboat.

3. A method of switching from push to pull towing of a load carrying vessel by a towboat comprising normally maintaining slack tow means interconnected between the bow of said vessel and said towboat; normally propelling said vessel by pushing contact with said towboat at the stern centerline of said vessel; detachably lashing said towboat and vessel together with a force sufficient to prevent separation of said vessel and towboat; developing by said force potential energy for quickly pushing said vessel and towboat apart upon detachment of said lashing; quickly unlashing said towboat and vessel thereby releasing said potential energy to push said vessel and towboat apart while simultaneously reversing said towboat; maneuvering said towboat forwardly of said vessel; and then tensioning said tow means for pulling said vessel with said towboat.

4. A system for rough-water towing of a load carrying vessel with a towboat comprising pusher means on said towboat normally in pushing contact with said vessel at its stern; a pair of resilient tension means, one connecting the stern of said towboat with the port side of the stern of said vessel and the other connecting the stern of said towboat with the starboard side of the stern of said vessel; means for tensioning said tension means; means for quickly detaching each of said tension means from said towboat; and means associated with said pusher means for storing energy including a rearwardly directed major component substantially instantaneously variable as a function of the tension in said tension means tending to separate said towboat and vessel for pushing said towboat and vessel apart upon detachment of said tension means.

5. The system of claim 4, the points of connection of said resilient tension means to said vessel and to said towboat and the contact of said pusher means with said vessel being in substantially the same horizontal plane.

6. The system of claim 4, said towboat and vessel being relatively rotatable about a longitudinal axis through the point of said pushing contact, said resilient tension means being lengthened and shortened to accommodate such rotation.

7. The system of claim 4, said pusher means comprising a reciprocable plunger and means resiliently urging said plunger in a forward direction; said pair of tension means comprising a pair of tiller lines and a pair of resilient means connected in series with each tiller line, respectively, for extending and retracting the effective line length; and means for separately tensioning each tension means as to take up or pay out each tiller line.

8. The system of claim 4, said pusher means comprising a reciprocable plunger, means resiliently urging said plunger in a forward direction, and a contact shoe mounted for universal movement on the forward end of said plunger.

9. The system of claim 4, said pusher means comprising a contact shoe, said shoe having a pair of laterally spaced and parallel contact surfaces engageable with complementary spaced and parallel contacts mounted on the stern end of said vessel.

10. The system of claim 4, said pusher means comprising a reciprocable plunger, means resiliently urging said plunger in a forward direction, and a contact shoe mounted to the forward end of said plunger, said shoe having an extension projecting in a forward direction and a pair of laterally spaced and parallel contacts disposed on opposite sides of said extension; whereby said extension is adapted to be engaged with a recess provided on the stern end of said vessel to maintain said laterally spaced and parallel contacts in engagement with complementary contacts mounted on said vessel.

11. The system of claim 4, said means for quickly detaching said tension means comprising a tiller line and a slip fitting secured to one end of said tiller line, a rotatable drum mounted at the stern end of said tug for taking up and paying out said tiller line, a retainer mounted to said drum and engageable with said slip fitting for selectively anchoring said tiller line to the drum or allowing said slip fitting to fall away from the drum when said tiller line is fully unwound from the drum, and power means for rotating and latching said drum.

12. The system of claim 4, and further comprising means for selectively securing one end of each tension means at a predetermined elevation to said load carrying vessel to direct the force of said tension means in substantially horizontal planes.

13. The system of claim 4, and further comprising hydraulic controls including a pair of fluid operated cylinders releasably connectable with said pair of tension means, respectively, each of said cylinders having a throw sufficient to lengthen or shorten the associated tension means to create an angularity between the centerlines of said vessel and said towboat for steering.

14. A system for rough-water towing of a load carrying vessel with a towboat comprising pusher means on said towboat normally in pushing contact with said vessel at its stern; a pair of resilient tension means, one connecting the stern of said towboat with the port side of the stern of said vessel and the other connecting the stern of said towboat with the starboard side of the stern of said vessel; means for tensioning said tension means; and means for quickly detaching each of said tension means from said towboat comprising a first fitting secured to one end of said tension means, a clamshell fitting having pivoted jaws for engaging said first fitting, power means for reciprocally moving said clamshell fitting, and a splitter disposed in the path of movement for said clamshell fitting and adapted to be engaged by said fitting for separating said jaws to release said first fitting.

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