RETRACTABLE RUDDER FOR A BARGE


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6 Claims. (Cl. 114—162)

This invention relates to a retractable rudder utilized in the directional control and maneuverability of both propelled and non-propelled vehicles through a fluid medium.

In the past a great deal of merchandise and material has been transported by barges since such barges are relatively inexpensive to manufacture and can be left in one place during the loading or discharging of cargo and thereafter one or a plurality of barges can be moved from one place to place by a towboat, tugboat, work boat or the like. When a plurality of barges are to be moved to the same general area, they can be connected together into a flotilla or tow so that a single towboat can move a plurality of barges simultaneously.

Normally when the barges are moving through an inland waterway it is advantageous to connect the barges in a sluting relation and locate a towboat at the rear which will push the barges, and when the barges are to be moved through open water such barges are normally connected together in spaced relation to each other by means of a hawser or cable and the towboat is located in front in order to pull the barges. With the increased horsepower of modern towboats the number of barges which make up a barge flotilla has been increased to the point where it is not unusual to have a barge flotilla 1,000 feet long. Due to the extreme length of the barge flotilla it has become increasingly difficult to maintain directional control because of inertia, the increased effects of wind and current, changes in direction of travel, and other reasons.

As an example, when a long barge flotilla approaches a river, the pilot of the boat knows by experience that if he continues ahead and tries to steer the tow or flotilla around the bend, the current of the river will sweep the barges onto the river bank before the rudders of the boat have turned the head of the flotilla around the bend. The standard procedure is to slow down or stop the flotilla by backing the engine of the boat, and while backing, the desired attitude of the boat relative to the current is maintained by use of flanking rudders. As the lead barge slowly enters the bend it receives a lateral thrust from the current because the direction of the current is changed to conform to the bend of the river. The pilot will continue to back until the current has turned the flotilla sufficiently to allow him to push ahead and steer out of the bend. This maneuvering operation might consume several hours depending upon the degree or angle of turn, the length of the flotilla, the skill of the pilot, the strength of the current, the force of the wind, as well as several other factors, including the condition of the barges, that is, whether they are empty or full.

An additional consideration when the barges are empty is that a great deal of freeboard is exposed to the wind and since the bottoms of the barges are usually relatively flat, the wind will act as a lateral force to move the barges off of the intended track. Due to the flat bottoms of the barges such barges will have a tendency to slide or continue in the original direction of travel while being turned. Barges which are towed by a towboat or the like in open water must be spaced apart because of wave action and since they are connected only by hawser or cables such barges will not follow in the track of the boat but will yaw from side to side following a zigzag course. This greatly reduces the speed of the flotilla in the direction of desired travel, as well as produces an unmanageable steering situation for the boat when maneuvering under bridges or between boats and piers.

It is an object of the invention to provide a retractable rudder and rudder housing which can be installed on a non-propelled barge and controlled from a remote position such as the pilot house of the propelling vessel and such rudder will substantially increase the directional control of the barge.

Another object of the invention is to provide a rudder which is extendable from and retractable into a housing exteriorly of the barge, and such housing will function as a skeg to reduce the effect of cross-wind, as well as the amount of slide when turning.

A further object of the invention is to provide a retractable rudder having interlocking means to prevent the rudder from being turned while retracted and to prevent retraction of the rudder unless the rudder is aligned with the housing.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a bottom perspective of the front of a barge illustrating one application of the invention;
FIG. 2, an enlarged top plan view of the upper deck of the barge and illustrating the steering mechanism;
FIG. 3, a fragmentary section on the line 3—3 of FIG. 2;
FIG. 4, a longitudinal section on the line 4—4 of FIG. 2;
FIG. 5, a section on the line 5—5 of FIG. 4;
FIG. 6, a section on the line 6—6 of FIG. 4;
FIG. 7, a fragmentary enlarged section illustrating the rudder in retracted position;
FIG. 8, a view similar to FIG. 2 illustrating a modified form of steering control;
FIG. 9, a side elevation thereof; and,
FIG. 10, a schematic diagram of the control mechanism.

With continued reference to the drawings, a barge 10 is provided. Such barges normally are rectangular in plan view having a generally square bow and stern, and with the bow having a longitudinal curve or rake 11 extending from the bottom to the deck. A conventional barge normally lacks means for propulsion, as well as means for controlling maneuverability, and the present invention includes a housing or well 12 extending from a position above the main deck downwardly through the bow of the barge and through the rake portion 11 and terminating above the bottom of the barge. Preferably the housing 12 is substantially water-tight throughout its entire length so that the use of packing glands is greatly reduced or eliminated. A rudder stock or post 13 is located within the housing 12 and is supported for rotational as well as axial movement by upper and lower bearings 14 and 15, respectively. A rudder 16 which may be of any desired configuration is fixed to the lower end of the stock 13 so that when the rudder stock is rotated the rudder 16 likewise will be rotated. The upper bearing 14 is accessible for maintenance from the upper deck, while the lower bearing 15 is accessible for maintenance through water-tight hatches 17 in the sides of the housing 12.

In order to rotate the rudder stock 13 to control the position of the rudder 16, a hub 18 is fastened to the rudder stock adjacent the upper end. To facilitate mounting the hub on the rudder stock, such hub may be in two or more pieces connected together by fasteners 19, and in the lowest position of the rudder such hub will rotatably engage a thrust washer 20. The upper end of the rudder
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A quadrant or steering lever 23 is mounted on the forward portion of the hub 18 and such quadrant has a pair of outwardly extending lugs 24 one on each side of such quadrant. A pair of wire ropes 25 and 26 are provided with one end of such ropes being connected to the lugs 24. The wire ropes 25 and 26 extend around sheaves 27 and 28 and the opposite ends thereof are connected to the pivot rod 29 of a double acting fluid cylinder 30. The sheaves 27 and 28 are supported above the deck of the barge by pivot pins 31 and 32 carried by U-shaped support members 33 and 34 which in turn are connected by shackles 35 and 36 to anchor plates 37 and 38 welded or otherwise attached to the deck of the barge. The fluid cylinder 30 is mounted by fasteners 39 on a support block 40 fixed to the upper portion of the housing 12. It will be noted that although two wire ropes have been illustrated and described, a single wire rope could be utilized and adapted to extend from one end of the piston rod around the quadrant and back to the other end of the piston rod, it being necessary only to connect the rope to the quadrant in some well known manner. Also it will be noted that any other conventional method of rotating the rudder stock such as a rack and pinion, electric or fluid motor, or the like could be used.

It is desirable to raise the rudder stock to retract the rudder 16 into the housing 12 to protect the rudder, or to lower the rudder stock a distance sufficient that the rudder is entirely removed from the housing when in use. Preferably the rudder does not extend downwardly below the base line of the barge so that the rudder can be used in relatively shallow water as long as the barge has draft clearance. In order to control the vertical position of the rudder stock a pair of fluid cylinders 41 are provided with one of such cylinders being located beneath each end of the crosshead 21. Each of the cylinders 41 has a piston rod 42, the free ends of which are pivotally connected by pins 43 to lugs 44 carried by crosshead 21. When the crosshead is moved upwardly by the cylinders 41 it will retract the rudder into the housing 12 until the crosshead engages the collar 22 which acts as a stop.

A clean-out plate 45 is provided with an opening 46 freely received about the rudder stock 13 adjacent to the rudder stock and such clean-out plate is adapted to close the opening in the bottom of the housing when the rudder is extended. In the extended position of the rudder the clean-out plate will be retained by an inwardly extending lip 47 carried by each side of the housing 12 to prevent debris from entering the housing. When the rudder is retracted the rudder stock will move upwardly through the opening 46 until the rudder engages the clean-out plate 45 and thereafter continued upward movement of the rudder will raise the clean-out plate and permit the rudder to enter the housing.

With reference to FIGS. 8 and 9 a modified form of steering control mechanism is provided in which the hub 18 is slidable mounted on the rudder stock 13' to permit up and down movement of the rudder stock without corresponding movement of the hub. The rudder stock is provided with a pair of keys 48 slidably mounted in key ways 49 formed in the hub, so that when the hub is rotated the rudder stock likewise will be rotated. In order to rotate the hub, a tiller 50 is secured to the hub 18' and such tiller is connected by a pivot pin 51 to a pivot rod 52 carried by a fluid cylinder 53. The opposite end of the cylinder is connected to a foundation on the deck of the barge by a pivot pin 54.

With reference to FIG. 10 an electric and hydraulic system for controlling the rudder 16 is diagrammatically illustrated. The hydraulic system includes a pump 58 which drives a pump 59 which is connected by a fluid line 60 to a reservoir 61. A strainer 62 is disposed in the line 60 to remove any impurities from the fluid. The pump forces fluid under pressure through a line 63 to the first open-center distributor valve 64, then through a line 65 to a second open-center distributor valve 66, and thereafter through a line 67 back to the reservoir 61.

In order to move the rudder 16 to either the right or the left, the first distributor valve 64 is controlled by a pair of solenoids 68 and 69 which can be energized, in a manner to be described later, to direct fluid under pressure from the line 63 into a line 70 which is connected to one end of a double-acting fluid cylinder 30 or through a line 71 to the opposite end of such double-acting cylinder. The valve 64 is arranged so that when pressure is applied to one of the lines 70 or 71, the other line will be connected to the line 65 to permit fluid within the cylinder 30 to be discharged.

The second distributor valve 66 receives fluid from the first valve 64 through the line 65 and such second valve is adapted to be operated by solenoids 72 and 73 to direct fluid under pressure into the fluid cylinders 41 through lines 74 connected to one end of each cylinder or lines 75 connected to opposite ends of the cylinders 41. When one of the lines 74 or 75 is under pressure, the other line will be connected to the discharge line 67 to return fluid to the reservoir. The fluid line 75 is provided with a pilot-operated check-holding valve 76 which provides that the rudder can only be lowered by applying pressure to the "down" side of cylinders 41.

If desired the pump 59 may be provided with a pressure compensating device 77 of conventional construction which modulates the regular flow in direct relation with the pressure. At a preset pressure the pump flow will stop but will maintain the preset pressure on the cylinders. This functions as a safety device and also gives control of the rates of rudder movement.

In the electrical system, power is supplied by the generators (not shown) located in the propelling vessel or if desired a diesel-driven generator could be provided on one or more barges to furnish power. An on-off switch 80 controls the flow of electrical energy to operate the motor 58 and to supply electrical energy to a pair of switches 81 and 82. The switch 81 is a double-pole double-throw switch which energizes either solenoid 72 or 73 which will move the second distributor valve 66 to one side or the other and introduce fluid into the cylinders 41 to either raise or lower the rudder. The switch 82 is a double-pole double-throw switch adapted to energize either solenoid 68 or 69 to introduce fluid under pressure into either end of the cylinder 30 to move the rudder either to the right or to the left.

An interlock switch 83 is closed mechanically when the rudder is in the "down" position and functions as a safety feature which prevents the rudder from being turned when disposed within the rudder housing 12. An interlock switch 84 is closed mechanically when the rudder is amidships. This is a safety feature to prevent raising the rudder into the housing unless the rudder is amidships and aligned with the opening in the bottom of the housing.

If desired a rudder angle indicator 85 can be located in the pilothouse and such indicator is connected either electrically or mechanically to a rudder transducer 86 which is located adjacent to the rudder and connected thereto by a simple bar linkage (not shown).

In the operation of the device one or more barges are adapted to be moved from place to place by a propelling vessel, such as a towboat of the like. In order to control the maneuverability of the barges, at least the lead barge will have an extendable and retractable rudder which can be raised or retracted within a housing when not in use and can be extended from a remote position and thereafter rotated to assist in controlling the movement of the barge. The electric and hydraulic system providing a steering mechanism including a double-acting fluid cylinder connected to the rudder stock or post 13 and controlled by a first distribut-
tor valve 64 energized by solenoids 68 or 69 from the pilot house of the propelling vehicle. As long as the rudder is in the lowermost position the rudder can be operated to maneuver the barge either to the right or to the left. In order to protect the rudder when not in use, such rudder is adapted to be retracted within the housing 12 by a second distributor valve 66 controlled by solenoids 72 and 73 to raise and lower the rudder under the influence of fluid cylinders 41. As long as the rudder is disposed amidships such rudder can be raised and lowered freely; however, raising of the rudder is prevented by limit switch 81 when the rudder is in any position other than amidships.

It will be obvious to one skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof and therefore the invention is not limited by that which is illustrated in the drawings and described in the specification, but only as indicated in the accompanying claims.

What is claimed is:

1. A retractable rudder for a non-propelled vessel comprising a housing having one end extending upwardly into said vessel and terminating above the water line and the other end extending outwardly of the vessel to act as a keel to reduce lateral movement of the vessel, said housing being open at the bottom and having watertight sides, a rudder stock rotatably and slidably mounted within said housing, said rudder stock having a rudder at one end, a steering mechanism carried by said vessel and slidably connected to said rudder stock adjacent to the other end thereof and adapted to turn said stock, means for raising and lowering said rudder stock to move said rudder into and out of said housing, said steering mechanism and said means for raising and lowering said stock being operated from a remote position, whereby said rudder can be selectively raised and lowered and when the rudder is in lowered position it can be turned to control the direction of travel of the vessel.

2. The structure of claim 1 in which said steering mechanism includes a quadrant fixed to said rudder stock, cable means connected at one end to said quadrant, and fluid cylinder means connected to the opposite end of said cable means.

3. The structure of claim 1 in which said steering mechanism includes a hub keyed to said rudder stock and slideable relative thereto in a generally vertical direction, a tiller bar mounted on said hub, and fluid cylinder means for rotating said hub and said rudder stock.

4. The structure of claim 1 in which said means for raising and lowering said rudder stock includes at least one fluid cylinder.

5. The structure of claim 1 including automatic means to permit rotation of said rudder only when in lowered position.

6. The structure of claim 1 including automatic means to permit said rudder to be raised only when said rudder is in alignment with said housing.

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