

[54] **HYDRAULIC JET STERN STEERING CONTROL**

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[56] **References Cited**

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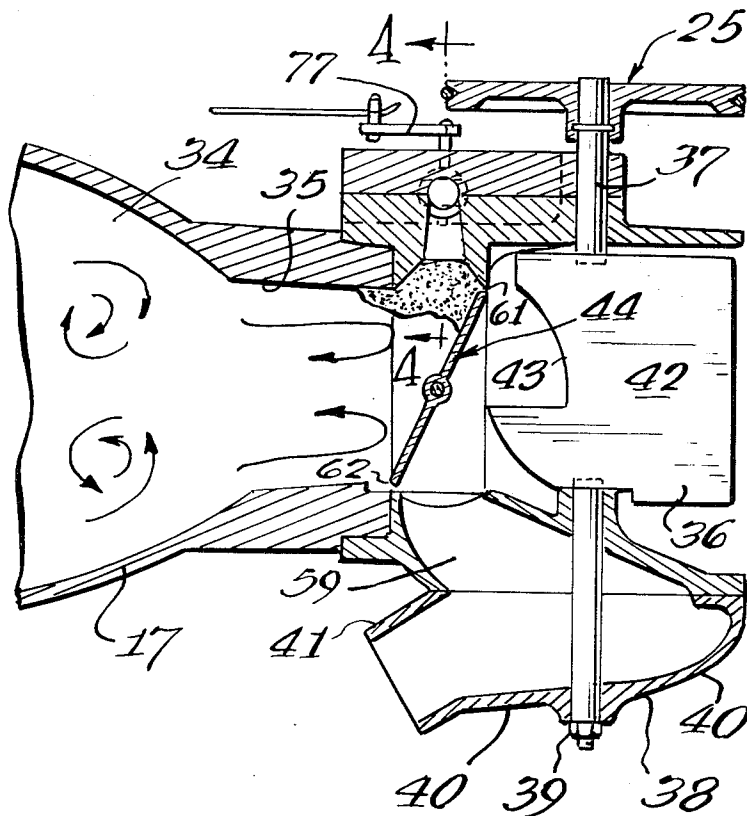
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Primary Examiner—Trygve M. Blix
Assistant Examiner—Charles E. Frankfort

[57] **ABSTRACT**

In a hydraulic jet turbine having a Venturi section, a main propulsion opening in the Venturi section and a shutoff valve for closing the main propulsion section, a secondary valve is provided to remove mud, gravel and other bottom material which may become wedged against the main shutoff valve. Various modifications of control units for attachment to hydraulic jet turbines have side thrust nozzles to provide direct stern steering for vessels. A single ball valve in a control unit for a hydraulic jet turbine is rotated about one axes for selectively closing a main propulsion opening or a reversing nozzle or both of them and is rotated about another axis to selectively close opposed side thrust nozzles or both of them.

17 Claims, 17 Drawing Figures



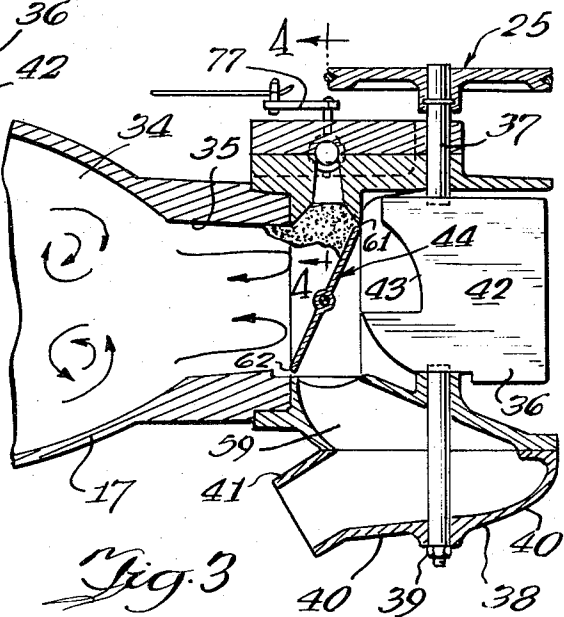
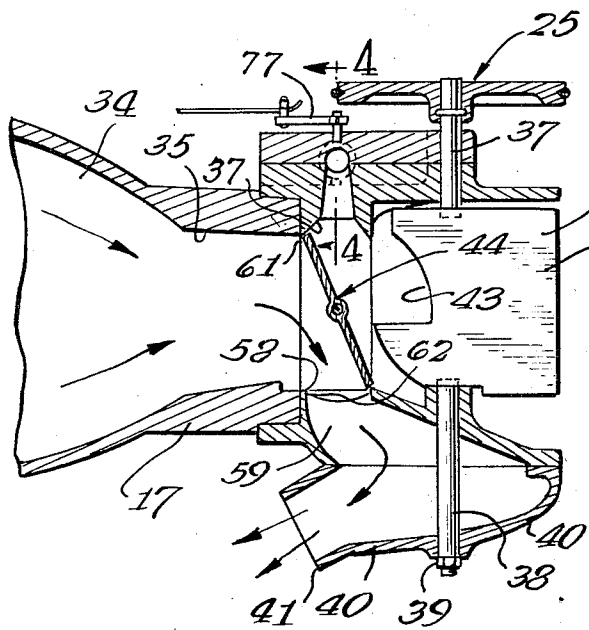
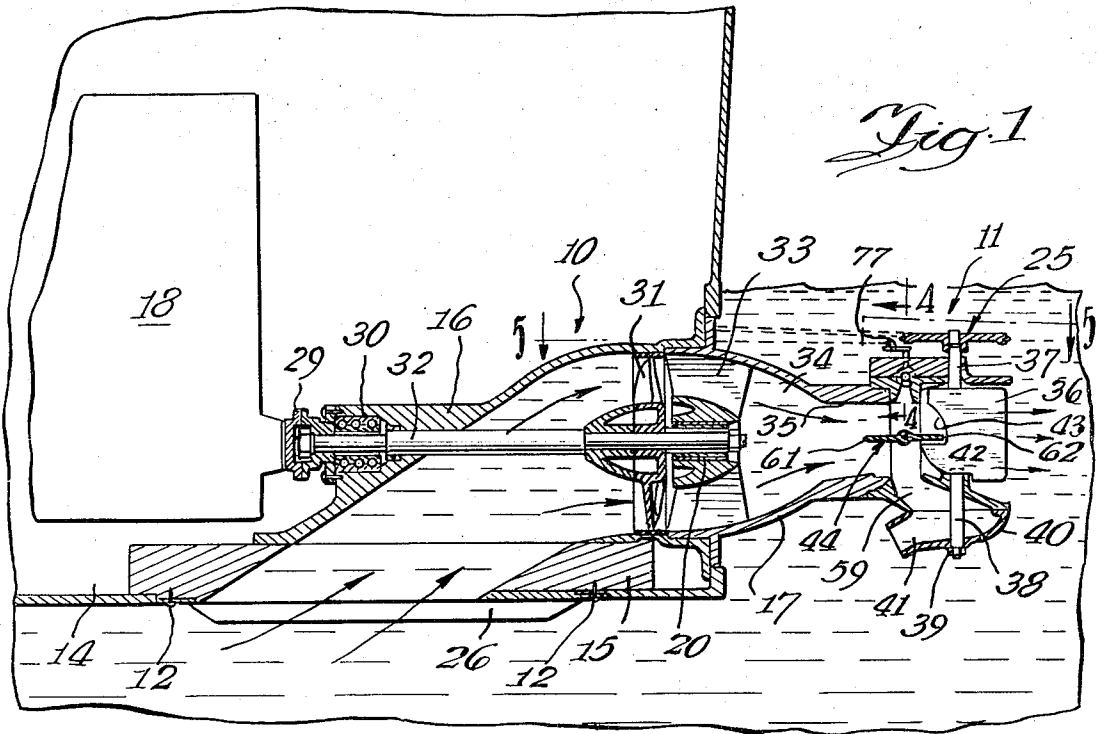
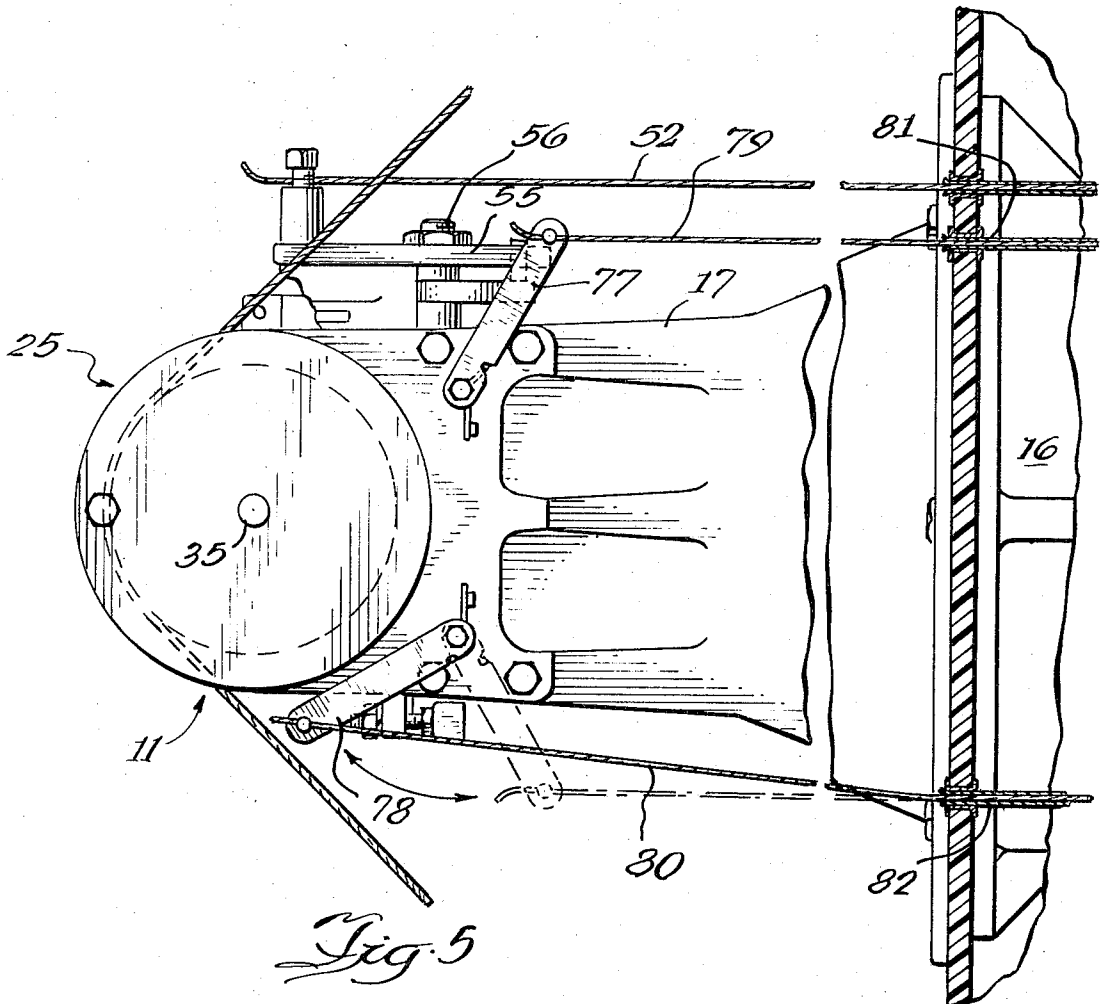
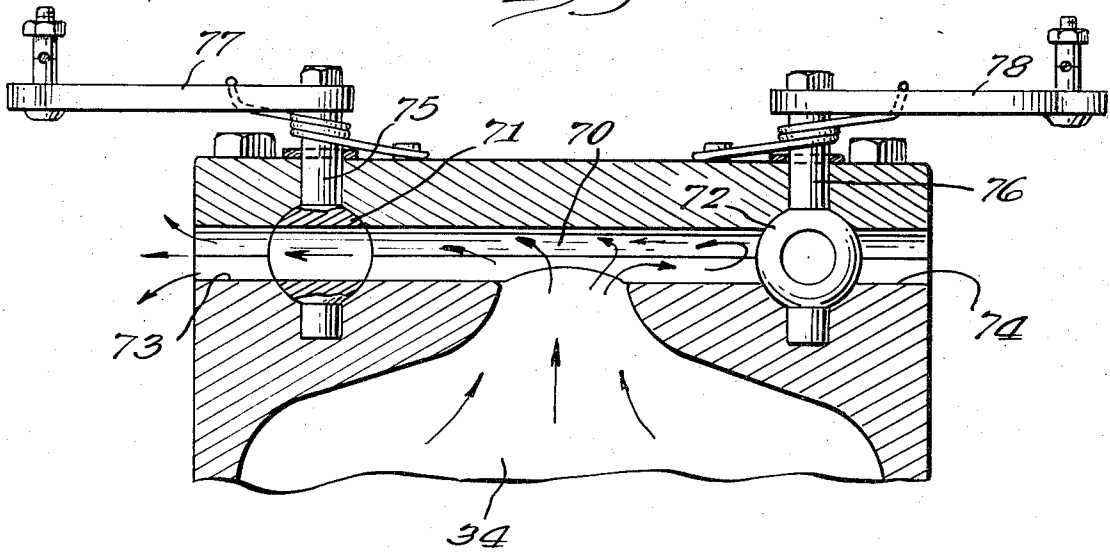
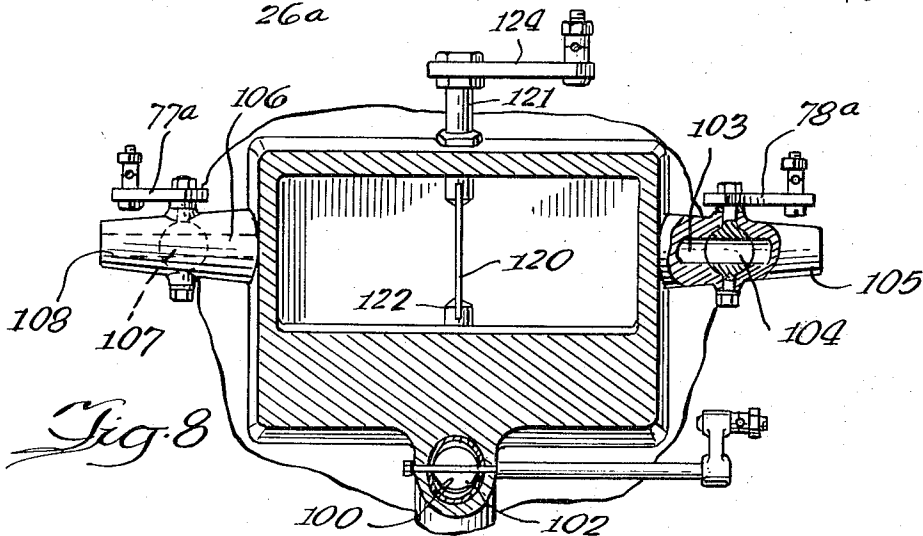
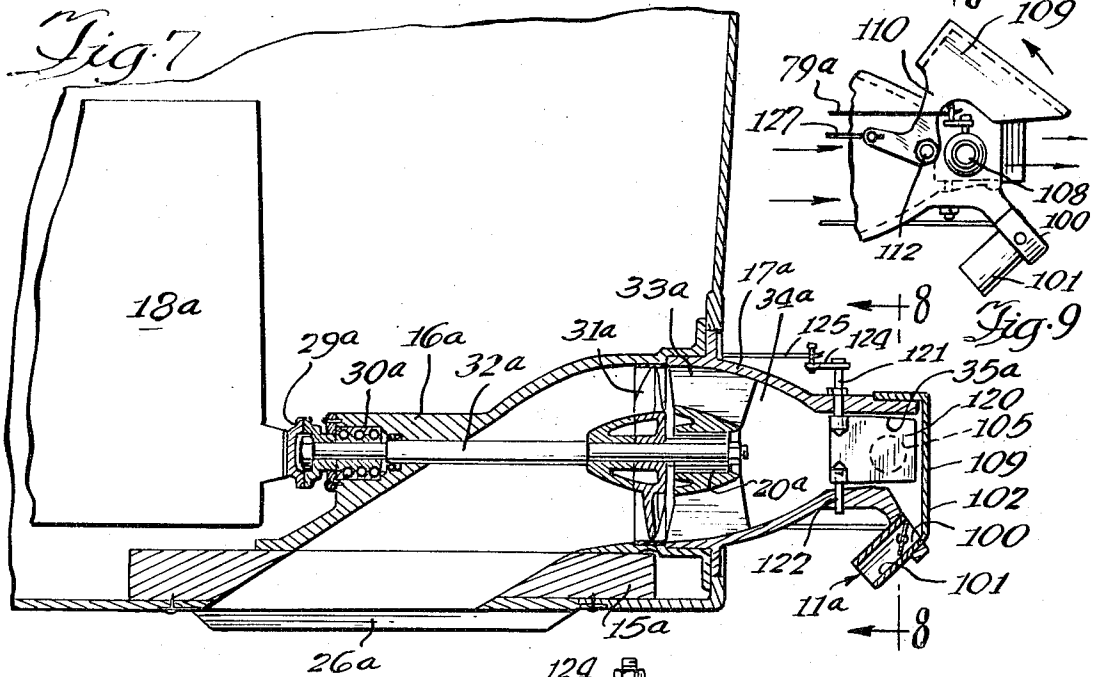
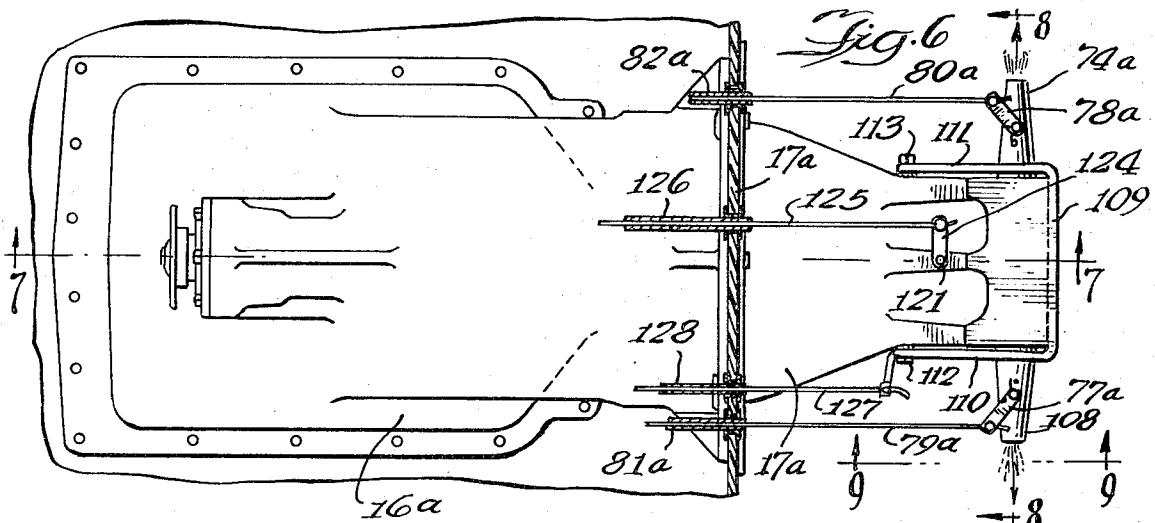


Fig. 4





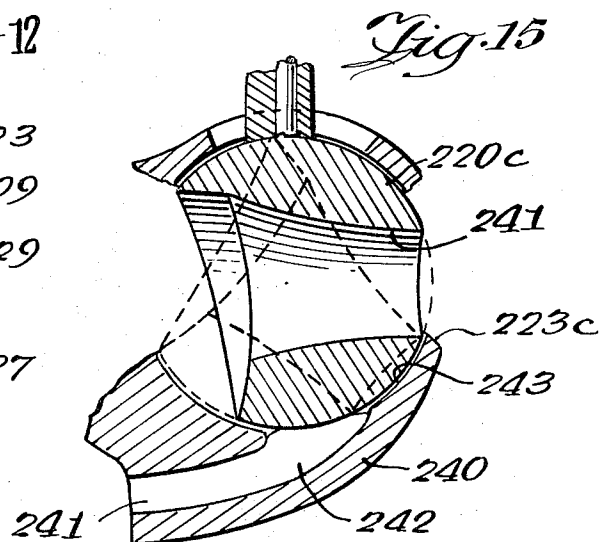
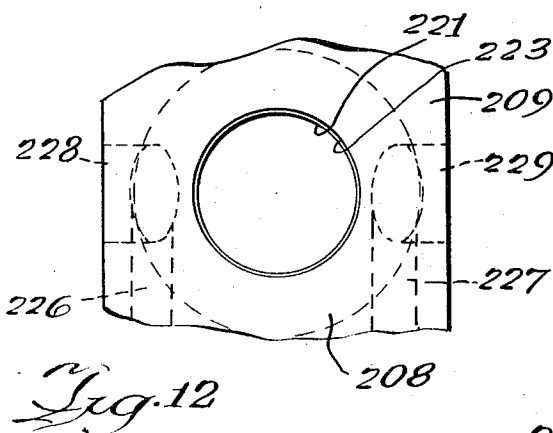
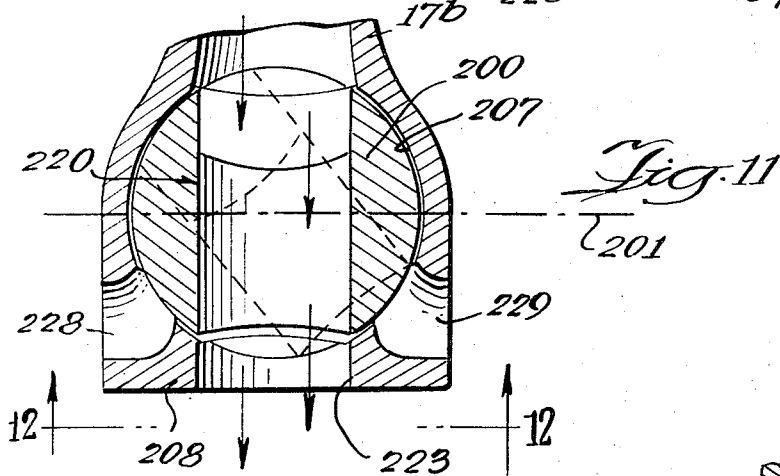
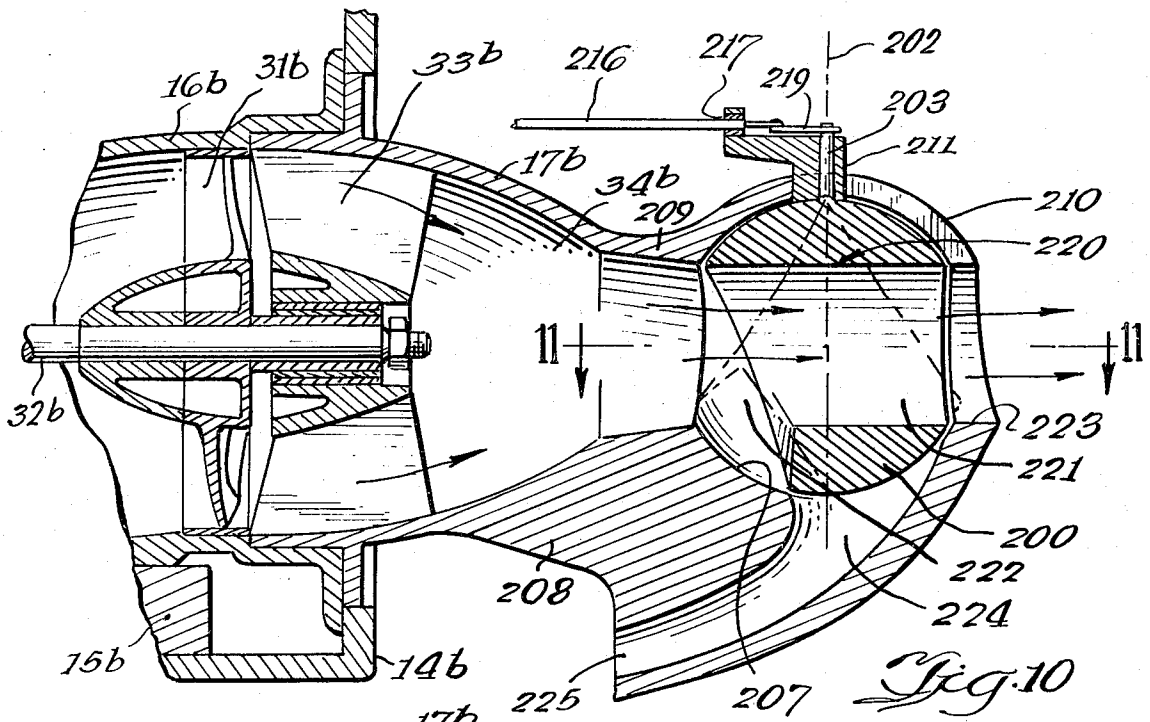


Fig. 13

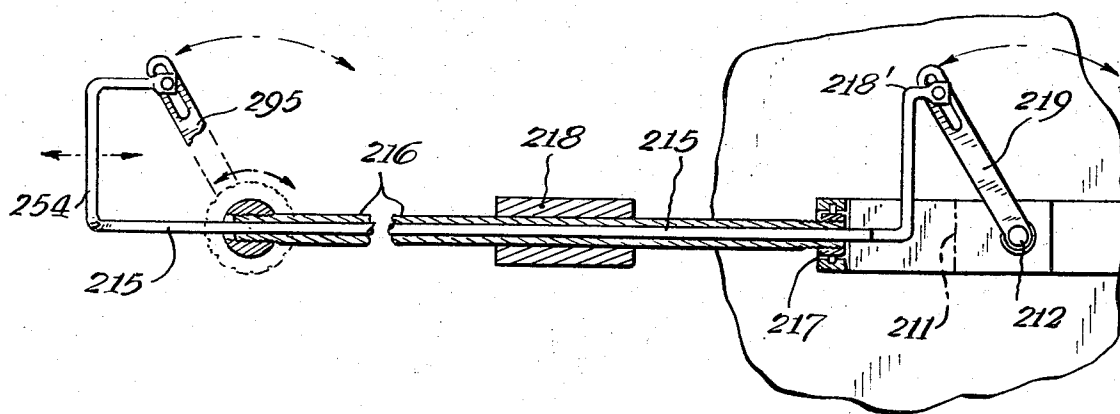
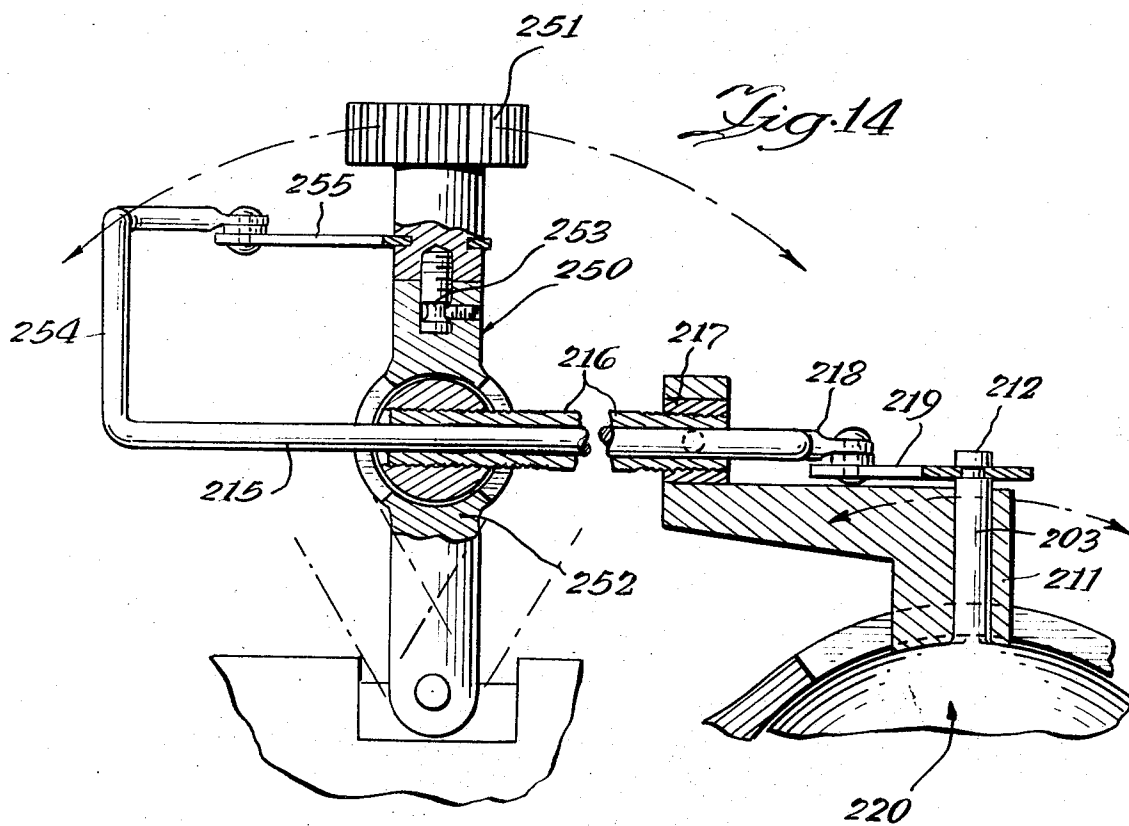
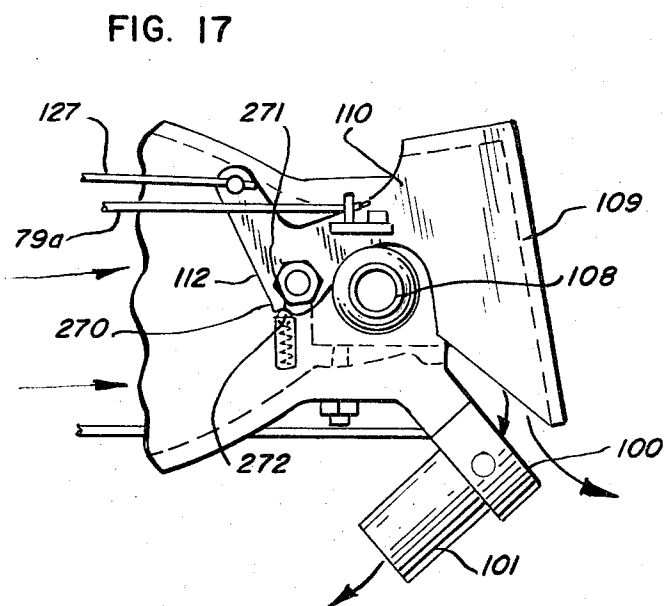
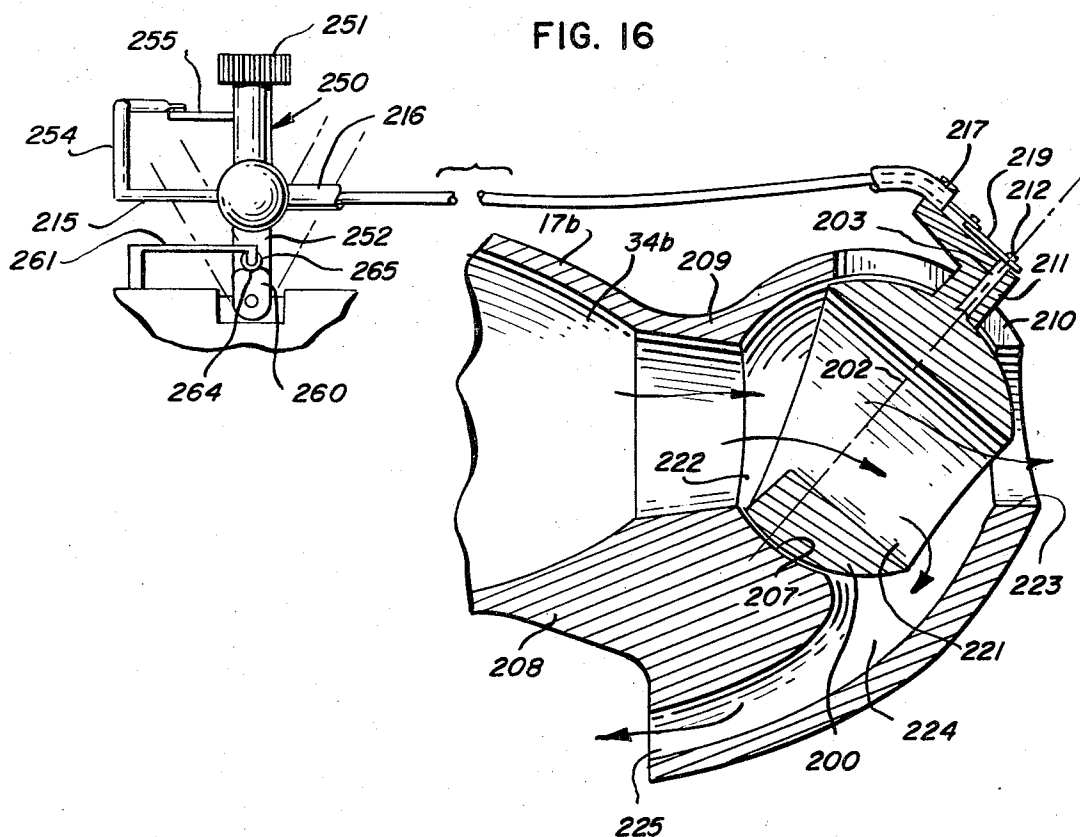


Fig. 14





HYDRAULIC JET STERN STEERING CONTROL

The present invention relates to steering devices for hydraulic jet vessels and particularly to such steering devices which can purge themselves of bottom material such as sand and mud.

U.S. Pat. No. 3,185,124 issued May 25, 1965 for a stern steering for hydraulic jet boat, disclosed a steering system for a hydraulic turbine pump utilized for propulsion of marine vessels which has been particularly successful. It discloses a butterfly valve which provides a complete shutoff of the main propulsion opening and a reverse nozzle, thereby providing a completely safe neutral position of the propulsion system. Occasionally, when an operator places a vessel equipped with such a propulsion system substantially on the bottom of the body of water in which the vessel is operating and then increases the pump pressure radically while the butterfly valve is still in the neutral position, large amounts of bottom material such as sand and mud become packed behind the butterfly valve making it difficult to move it to either the forward or the reverse positions. The present invention overcomes this difficulty by providing a method of purging such bottom material from the valve. It also provides alternative control structures for additional directional steering.

It is an object of the present invention to provide new and improved steering devices to be utilized with hydraulic jet turbines and similar high capacity pumps.

An additional object is to provide a steering device for vessels utilizing hydraulic jets which will provide a positive neutral and at the same time provide a method of purging such a device of bottom material.

An additional object is to provide in conjunction with present steering devices for hydraulic jets, a system of lateral thrusting nozzles to increase steering maneuverability at low speeds.

Yet another object of the present invention is to provide a steering device for vessels equipped with hydraulic jets that will create a direct lateral movement of the stern of such vessels.

Further objects and advantages will become apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a cross sectional view taken along the centerline of a preferred embodiment of the invention with a shutoff valve in position for forward thrust;

FIG. 2 is an enlarged fragmentary view of FIG. 1 showing the stern steering device with the shutoff valve in position for reverse thrust;

FIG. 3 is an enlarged fragmentary view of FIG. 1 showing the stern steering device with the shutoff valve in a neutral shutoff position;

FIG. 4 is a fragmentary cross sectional view of the embodiment of the invention illustrated in FIGS. 1-3 taken along lines 4-4;

FIG. 5 is a top elevational view and partial sectional view of the embodiment of the invention illustrated in FIG. 1 taken along lines 5-5;

FIG. 6 is a top elevational and partial sectional view of a modified version of the embodiment of the invention illustrated in FIGS. 1-5;

FIG. 7 is a sectional view of the embodiment of the invention illustrated in FIG. 6 taken along lines 7-7;

FIG. 8 is a sectional view of the embodiment of the invention illustrated in FIGS. 6 and 7 taken along lines 8-8;

FIG. 9 is a fragmentary elevational view of the embodiment of the invention illustrated in FIG. 6 taken along the lines 9-9;

FIG. 10 is a cross sectional view of yet another modification of the embodiments illustrated in FIGS. 1-9;

FIG. 11 is a fragmentary cross sectional view of the embodiment of the invention illustrated in FIG. 10 taken along the lines 11-11;

FIG. 12 is a fragmentary elevational view of the embodiment of the invention illustrated in FIG. 11 taken along the lines 12-12;

FIG. 13 is a fragmentary top partial sectional view of the controls for the modification of the invention illustrated in FIGS. 10-12;

FIG. 14 is a fragmentary cross section view of the controls illustrated in FIG. 13;

FIG. 15 is a fragmentary view of an alternate structural arrangement of the ball control portion illustrated in FIG. 10, and

FIG. 16 is a partial fragmentary elevational view of a modification of the invention illustrated in FIG. 10 and FIG. 14; and

FIG. 17 is an elevational view of a modification of the invention illustrated in FIG. 9.

While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail, embodiments of the invention with the understanding that the present disclosures are to be considered as exemplifications of the principles of the invention and are not intended to limit the invention to the embodiments illustrated. The scope of the invention will be pointed out in the appended claims.

FIGS. 1-3 show the cross-section of a jet turbine 10 of the general type disclosed in U.S. Pat. No. 3,185,124 and a stern directional steering control unit 11. A series of grate bars 26 are secured by bolts 12 to a hull 14 and a mounting adapter 15. The jet turbine 10 has a forward intake housing 16 and an aft discharge housing 17. The forward intake housing 16 is secured to mounting adapter 15 to receive intake water through the grate bars 26 and the mounting adapter 15. An engine generally indicated at 18 has an output drive shaft connected to a turbine drive shaft 32 by a coupling 29. The drive shaft 32 is supported for rotation in forward triple ball thrust bearing 30 and an aft water bearing 20. A number of turbine blades 31 are rigidly secured to the drive shaft 32, and a number of stator blades 33 are rigidly secured in the aft discharge housing 17 supporting water bearing 20.

The water will be taken in from the area adjacent to the keel through the grate bars 26 and be forced by the turbine past the stator blades 33 where it will converge in a nozzle section and pass through the directional control unit 11 which incorporates a rudder 36 being secured as by welding to a vertical pivot member 37 and secured at the lower end by means of a further vertical pivot which is the extension of the upper pivot 38 and fastened by suitable means with a threaded fastener 39 securing at the same time a reversing nozzle housing 40, having a nozzle section 41. The rudder blade 42 may be moved through a suitable arc to direct the stream of water from the boat. There is a cut-out section in the shape of a quarter of a circle 43 to permit

the movement of the principal shutoff valve for the turbine 44 and a portion of this in the full open position is seen at 45 which swings through an arc clockwise to form a cut-out portion of the rudder. The main shutoff valve is horizontally pivoted and is adapted to move through an arc of 105 degrees from a substantially horizontal position 75 degrees counterclockwise to a full closed position as seen in FIG. 3 and 25 to 30 degrees further counterclockwise as seen in FIG. 2 to provide fluid into the reversing nozzle. The full-open position is shown in FIG. 1; the neutral shutoff position is shown in FIG. 3; the reversing position is shown in FIG. 2.

Details of this will be described more completely in that control means which is indicated generally at 25 will operate the rudder pivot 37 and 38 in moving the rudder 36 and its blade portion 42 through the limited arc. This permits the rudder to be moved through a limited angular movement to steer. Further it will be seen that movement of the rudder assembly 36 and the rudder blade 42 generally will not interfere with the butterfly shutoff valve because of the cut-out section 43. This shutoff valve 44 pivoted about its horizontal axis or shaft is free to move through its arc somewhat larger than 90° from the reverse position through the closed position to the full-open position and still permit the rudder blade 42 to rotate through its arc from starboard to port.

Further, it will be seen that the reverse nozzle housing shown generally at 40 with the nozzle outlet projected downwardly and forwardly at 41 consisting of an angular cavity around the pivot point 38 so that when the valve 44, which is to be described in greater detail, goes into the reverse position, a flow of water under high pressure is directed downwardly through a passage 59 into the reversing cavity and nozzle so that it projects forwardly and downwardly under the boat. It will be seen that at the same time, the turbine may then be directed into reverse and it will reverse along the identical path that the rudder is steering the boat, i.e., there will not be any side thrust from a quick-shift of the control valve on the turbine to the reverse position. If this were not the case, there might be an accidental movement into reverse, in which event, the boat would give a sharp thrust to starboard or port and upset the occupants.

Further, in connection with this assembly, the shutoff valve is particularly important. FIGS. 1-3 show three different positions. The push-pull cable 52 is connected through rotating link 55, rotating arm 56 is secured to a shaft 63 on which is secured shutoff valve 44.

The blade itself is shown at 44 and it has a number of positions fitting in a generally angular cavity formed by arcuate top walls 57 and arcuate bottom walls 58. The valve itself would be perhaps in one size four inches square and would permit the passage of roughly 16 sq. inches of water at any one time. However, only about a quarter of this would be able to go down to passageway 59 to the reversing cavity 40 and nozzle 41.

The three positions of this are shown in FIGS. 1-3 and they are the full-open position, which is shown in FIG. 1 where a leading edge of the blade is forward as at 61, a trailing edge of the blade as at 62 is in line with the flow of fluid through the turbine and provides the least resistance to the flow and permits the maximum flow therethrough. As this valve is rotated from this position counterclockwise, the flow would be restricted and at the position which is shown in FIG. 2 the valve

will be closed, i.e. no fluid may pass through the turbine.

At the same time, from the fully closed position which is neutral since the forward motion of the boat would be arrested and it would be only going on momentum, if any, the nozzle might be rotated counterclockwise into an angle of somewhat less than 45 degrees to the position shown in FIG. 3, where the reversing nozzle is in a full-open position and water from the jet turbine passes through the nozzle downwardly under the pressure directed by the vane 44 into passageway 59 and into the enlarged reversing cavity 40 and out through nozzle 41. This provides a jet stream of water under the boat, partially lifting the boat and directing the boat to the rear. This is a simple way of providing reverse control for the boat, to retard the boat and to direct the boat rearwardly through at slower speed than forwardly, of course.

Further, it will be seen that this control nozzle can be partial or total and is dependent upon the speed of the turbine and other factors. It will also be seen that the rudder blade 44 of the control valve will generally be a fairly tight fit in the cavity and will prevent excessive loss of fluid around the edges of the blade.

It will further be obvious from a careful study of FIGS. 1-3 that the boat can go from full forward back through neutral to full reverse and will not interfere with the rudder and at the same time, will not cause any change in the operational characteristics of the engine and the turbine, i.e., it may go from full forward into reverse at full throttle. Of course, pressure would be building up in the engine at this time and this might not be the most desirable manner of operating the boat, but there is no absolute obstruction to movement of the main control valve in the manner indicated.

A Venturi section 34 has a Venturi nozzle 35 which is formed in the aft discharge housing 17 for the ejection of water into the control unit 11.

The description thus far follows that disclosed in U.S. Pat. No. 3,185,124. However, in the present invention a passageway 70 connects the Venturi section to a pair of ball valves 71 and 72 which in turn are connected to side thrust nozzles 73 and 74 as may be best seen in FIG. 4. Nozzle 73 directs water laterally to port and side thrust nozzle 74 directs water to starboard when the respective ball valves 71 and 72 are opened. Suitable linkage connects the control stem 75 and 76 of the respective ball valves 71 and 72 to controls at the control station of a vessel. These controls are conventional and may be of any type well known to those skilled in the art. In the embodiment illustrated in FIGS. 4 and 5 lever arms 77 and 78 are connected to stems 75 and 76 respectively and are connected to control cables 79 and 80 which are operated from a control station of a vessel through respective cable housings 81 and 82. The cable housings have one end secured to the flange portion of forward intake housing 16. The ball valve 71 and 72 may be opened independently of each other, both may be closed or both may be opened simultaneously.

By opening both ball valves 71 and 72 simultaneously water will be directed through the passageway 70 and forced out both to port and starboard through nozzles 73 and 74 thereby neutralizing the side thrust when both valves are opened. This action clears out, as may be more readily seen in FIG. 4, any bottom material such as sand, gravel or mud which has piled up behind

the plate 44 when the plate 44 is in the neutral position shown in FIG. 3. Thus the area in front of the plate 44 may be purged of such material and the plate may then be rotated freely again.

With the plate of the butterfly valve 44 in a neutral position as shown in FIG. 3, only one valve such as 71 may be opened to produce immediate side steering thrust. As the valve is opened a greater thrust to the side will be exerted and therefore the amount of side thrust can be thus controlled. This side thrust would be equivalent to turning nozzle 41 to one side. However, in order to get immediate side thrust the butterfly control valve can be put in the neutral position and side thrust to either side can be produced without the necessity of turning the main steering wheel which controls the angle of the nozzle 41 fully from one end of its travel to the other end of its travel. Thus thrust to the side at the stern of the vessel may be produced and shifted from side to side much more quickly than when it was necessary to turn the main steering wheel from one end of its travel to the other end of its travel.

Instead of utilizing two separate ball valves such as 71 and 72 to shut off water flow from the passage 70 to the respective nozzle 73 and 74, a single two-way three position valve could be placed in the passage 70 to select either a shutoff position for both nozzles or alternatively open positions for each of the respective nozzles. Such a modification is intended to be within the scope of the appended claims.

Turning now to FIGS. 6-9 a turbine similar to the turbine illustrated in FIGS. 1-5 is shown, but the control unit for the turbine differs greatly. The butterfly plate 44, the steering rudder 42 and the reversing nozzle 41 have been eliminated and replaced by a smaller number of moving parts. The parts of the hydraulic turbine which correspond to those illustrated in FIGS. 1-5 bear similar identification numbers with the subscript "a." A passageway 100 leads to a reversing nozzle 101. A valve 102 in the passage 100 shuts off the flow of water to nozzle 101.

Referring to FIGS. 6 and 8, a passage 103 has a ball valve 104 in it, which, when open, passes water to a port side thrust nozzle 105. A similar passage 106 has a ball valve 107 in it and it directs water to a starboard side thrust nozzle 108 when the valve is open. A closure plate 109 is mounted on arms 110 and 111. The arms are pivoted on shafts 112 and 113 which are secured to the main housing 17a.

For the purposes of high speed operation a separate rudder is provided. For purposes of reversing the boat, the plate 109 is pivoted down over the main propulsion opening or nozzle 35a thereby increasing the water pressure within the Venturi section 34a. If then one of the valves is opened, immediate port or starboard or reverse thrust is produced. If valve 102 is open and a side thrust valve is open, reverse thrust is produced at the same time either port or starboard thrust is being produced in order to turn the boat at the same time it moves rearwardly.

A steering vein 120 is connected to shafts 121 and 122 for rotation in the nozzle 35a. A lever 124 is secured to the shaft 121 at one end and to a push-pull cable 125 which has a cable housing 126 which is secured to the flange portion of the forward intake housing 16a. The plate 109 is connected, for rotation about shafts 112 and 113, to a push-pull cable 127. The cable

127 runs in a cable housing 128 which is secured to the flange portion of forward intake housing 16a.

An alternate form of the modification illustrated in FIGS. 6-9 would be to attach a single three-way four position valve in place of valve 102 with connections not only to reversing nozzle 101 but with connections to two opposed side thrust nozzles located on either side of nozzle 102. In such a modification the three-way four position valve could be shut off or direct a flow of water to either the reversing nozzle, a port side thrust nozzle or a starboard side thrust nozzle. The construction of such a three-way four position valve such as ball and cylinder valves are well known to those skilled in the art. Such modifications of the invention are intended to be within the scope of the appended claims.

Turning now to FIGS. 10-12 another modified version of the invention is illustrated. The pump section is essentially identical to the hydrostatic jet illustrated in FIGS. 1-5 and similar elements bear the same identification number with a subscript "b." Only the steering control unit differs in construction from the embodiments of the invention previously described. A ball 200 is rotatably mounted about a first axis 201 and about a second axis 202 which is perpendicular to the axis 201. To accomplish rotation about these axes a shaft 203 is secured to the ball 200. The ball 200 rests in a circular cavity 207 formed by the housing sections 208 and 209. Section 208 is an integral portion of aft discharge housing 17b and section 209 is secured to section 208 by suitable bolts. A slot 210 in the housing 209 receives a rectangular slide 211 which slides in the slot 210 and rotationally supports shaft 203 as the ball turns about the axes 201 and 202, but its rectangular shape restrains it from turning about the axis 202. In order to rotate the shaft 203 about the axis 202, a lever arm 214 has one end secured to the shaft 203 and the other end secured to a push-pull cable 215. The cable 215 slides in a cable housing 216 which has its end secured to the slide member 211 at the securing lip 217. The cable housing 216 slides in an outer housing 218 which has one end secured to intake housing 16b.

The ball 200 has a passageway generally indicated at 220 which has a cylindrical aft portion 221 and a scoop type forward section 222. Cylindrical section 221 is the main propulsion nozzle. When it is aligned with an opening 223 in the housings 208 and 209 water from the Venturi section 34b passes through the scoop section 222 and is ejected through the nozzle 221 to propel the vessel forward. A passageway 224 connects the ball 200 with a reversing nozzle 225. When the ball is in the position shown in FIG. 10 a solid portion of the ball closes off the passageway 224 so that no water flows to the reversing nozzle 225. However, when the ball 200 is rotated about the axis 201 by operation of the push-pull cable housing 216, the ball is rotated to the position shown in dashed lines in FIG. 10. The main propulsion opening 223 is closed off and the nozzle 221 is aligned with the passageway 224. The scoop section 222 of the ball 200 still receives water from the Venturi section 34b of the turbine pump. This water is forced through the ball and into the passageway 224 to be ejected from the reversing nozzle 225. The rotation of the ball between these two positions provides for either a forward thrust on the vessel by the virtue of water passing out the main propulsion opening 223 or a reversing thrust on the vessel by virtue of the water being

ejected through the nozzle 225. A pair of side thrust passageways 226 and 227 connect the ball to the port side thrust nozzle 228 and the starboard side thrust nozzle 229 respectively. When the nozzle 221 is in a horizontal position to provide forward thrust to the vessel and aligned with the opening 223 the solid portions of the ball prevent any water from being transferred to the passageways 226 and 227. When it is desired to turn the vessel to port the ball is rotated counterclockwise as viewed from the top. This directs water to starboard as the clockwise rotation is commenced. As it continues the nozzle 221 overlaps a portion of the passageway 227 and water is directed through the passageway 227 and out the side thrust nozzle 229. This increases the side thrust effect on the control head housing sections 208 and 209 and thereby transfers a side thrust to the stern of the vessel. As the ball is continuously turned it will reach the position shown in dashed lines in FIG. 11. In this position the main propulsion opening 223 and the nozzle 221 are directing water only through the passageway 227 and the side thrust nozzle 229. Rotation is accomplished by the movement of the push-pull cable 215 from a suitable control lever 250 at the control station of the vessel. Movement of the control cable in the opposite direction will rotate the ball clockwise as viewed from the top and nozzle 221 will produce side thrust to port in the same manner.

When the ball is rotated to its reversing position it may still be rotated as aforementioned about the axis 202. If it is rotated in a counterclockwise position as viewed from the top looking down on the axis 202, nozzle 221 will overlap passageway 227 to provide a side thrust to port through nozzle 229, while at the same time providing part of the flow to the reversing nozzle 225 as the clockwise rotation continues, all the water from nozzle 221 will be passing through passageway 227 and the nozzle 229. Similarly clockwise rotation of the ball while in the reverse position about axis 202 will provide port flow through passageway 226 and port thrust through nozzle 228 to force the stern of the vessel toward starboard and thereby turn the bow to port. Therefore combinations of direct forward thrust, reversing thrust and either port or starboard side thrust can be produced by a nozzle formed in a single ball which is capable of connecting the proper nozzles and openings as required for their various described operations.

The end of the push-pull cable 215 is connected to an arm 218 which is connected to an arm 219. This arm has its other end rigidly secured to the shaft 203. The shaft 203 is rotatively mounted in the slide 211 and has its other end secured to the ball 200. Movement of the shaft 203 in the slot 210 rotates the ball about axis 201, and rotation of the shaft rotates the ball about axis 202 making it possible to rotate the ball 200 about both axes by the appropriate movements of the slide 211 and the shaft 203.

A single control lever generally indicated at 250 has a tee type handle 251 which is rotationally connected to a main shaft 252 by an internal shaft 253. The lower end of the shaft 252 is rotatively secured to the stationary structure of the vessel. The push-pull cable housing 216 is connected to the lever 252 so that forward and backward motion of the handle 251 will produce a forward and backward motion of the slide 211. The push-pull cable 215 is connected to an arm 254 which, in

turn, is connected to an arm 255. The arm 255 is rigidly connected to the handle 251 so that rotation of the handle about the shaft 253 moves the cable 251 in and out of the cable housing 216. Rotation of the handle 251 rotates the lever 219. Thus it may be seen that the forward and reverse position of the handle 251 rotates the ball about axis 201 and rotation of the handle 251 controls the rotation of the ball around axis 202. Moving the handle forward places the ball in the forward thrust position, and moving the handle backward places the ball 200 in the reverse thrust position. In any of these positions the handle may be rotated to turn the nozzle 221 of the ball to either the port side nozzle 228 or the starboard side nozzle 229. Thus the single handle both shifts thrust between forward and reverse and steers the vessel.

If it is desirable to split the flow between main propulsion thrust and reverse thrust when the driving engine is idling and therefore the pump is idling, this can be accomplished by having an intermediate position of the ball as it rotates about axis 201 which divides the flow between the opening 223 and the passageway 224. This minimizes the difference between forward and reverse thrust and will tend to keep the vessel from idling forward or idling rearwardly under the force of the water being ejected under idling conditions.

A pair of bow thruster nozzles and valve control means as is more fully described in U.S. Pat. No. 3,185,124 may be installed in the bow of the vessel and connected to the Venturi section of any of the hydraulic jet turbine pumps herein described. Thus when such a bow steering system is combined with the stern side thruster nozzles as has been fully described, a vessel may easily move either its bow or stern to port and starboard or may easily push the vessel sideways by adjusting the thrust between bow and stern side thrust nozzles on the same side of the vessel. This is done without the utilization of a reverse nozzle as is required in the disclosure of the U.S. Pat. No. 3,185,124. Such modifications and alterations are intended to be within the scope of the appended claims.

If the central ball valve 200 as shown in FIG. 10 is turned so as to split the flow of water between the opening 223 and the reverse nozzle passage 224, the thrust tending to push the boat forward may be made to approximately equal the thrust being generated to push the vessel backward. Thus a position could be found which would neutralize the forward versus reverse thrust on the boat when the turbine is idling or running at low speed. A detent can be provided in the control lever for the ball which will allow an operator to find such an equalizing flow point illustrated in FIG. 16. A cam plate 260 with a depression 264 is rigidly secured to the lever 252. A resilient lever arm 261 is contacted by the cam plate 260 through a roller 265 rotatable mounted in the end of the arm 261 when the lever 252 is in a vertical position. Pressure of the roller 265 in the cam depression 264 maintains the ball valve 200 in a neutral position with the forward thrust offsetting the reverse thrust. Similarly the closure plate 109 in the modification of the invention illustrated in FIGS. 6-9 may have an intermediate point wherein flow from an idling or slowly revolving turbine will strike the plate and approximately equalize its forward thrust against reverse thrust from water passing through the reversing nozzle so that the differential between forward versus reverse thrust is minimized as illustrated in FIG. 17. A

cam 270 is formed in the closure plate arm 110 with a depression 271. A spring loaded ball 272 is mounted on the housing to enter the depression 271 when the closure plate 109 is at the intermediate point with the forward thrust offsetting the reverse thrust.

A further alternate construction of the modification of the invention shown in FIGS. 6-9 is the placement of a valve between the Venturi section and the closure plate 109. This valve can be of any type well known to those skilled in the art and is utilized to shut off all flow which might produce either a forward or reverse thrust from being discharged from the Venturi section. Similarly a modification of the invention shown in FIGS. 10-14 is a valve between the Venturi section and the ball 200 which is shut off to similarly provide a complete neutral with no water being discharged from the Venturi section through the ball 200.

A further aperture connected to side thrusters may be placed forward of the aforementioned valves placed between the Venturi sections and the plate 109 and the ball 200 respectively. Thus a positive shutoff is provided for bow thrusters and other side thrusters such as illustrated in FIGS. 6-9. All such modifications are intended to be within the scope of the appended claims.

A further modification of the invention is to attach the Venturi section of a pump as illustrated in FIGS. 1-14 to a conduit which leads to a valve to provide either a positive shutoff or alternatively a flow of water to a forward facing nozzle and a rearwardly facing nozzle. Suitable conduits connect the valve to the two nozzles. The pump intake is placed at a convenient point in the hull of a sailing vessel below the waterline. Thus the forward and rearwardly facing nozzles will provide alternatively rearwardly or forward thrust to a vessel. If the nozzles are placed above the waterline they will not interfere with the smooth flow of water over the hull of a sailing craft while it is being propelled by wind and not by power.

However, a positive neutral position is provided in the modification of the embodiment shown in FIGS. 9-12 by the alternate structure shown in FIG. 15. Similar elements have the same identification numerals with the subscript "c." A housing 240 is provided in place of the housing 208. The ball 220c is similar to the ball 220 shown in FIGS. 10-12 except that it has a narrower nozzle 241. The housing 240 has a reverse nozzle 241 joined to the ball by a passageway 242, and a flat land 243 situated between a main propulsion opening 223c and the opening of the passageway 242. Whenever the nozzle 241 becomes aligned with the land area 243, the nozzle 241 is blocked off. This position is shown in dashed lines in FIG. 15. This is the positive shutoff neutral position where no water reaches any of the output openings, passages or nozzles. Sideways rotation about the axis 202 will bring the nozzle 241 into alignments with either port 226 or port 227. Thus operation of the steering controls while the ball is in the neutral position can bring about port and starboard thrust without first shifting to either a forward or a reverse position of the ball about axis 201.

Further rotation of the ball 220c brings the nozzle 241 into alignment with the reverse passage 242 thereby providing reverse thrust in the same manner as described for the embodiment of the invention illustrated in FIGS. 10-12.

A detent can be provided with the control lever 250 so that the ball 220c may be positioned with its nozzle 221c aligned with the land 243. Thus the single handle control can easily provide a forward-neutral-reverse position when it is connected to a ball valve structure as shown in FIG. 15.

I claim:

1. A directional control means for a hydraulic jet turbine having a Venturi section, a main propulsion opening in said Venturi section, a main shutoff valve closing said main propulsion opening, said valve being able to close the Venturi nozzle to stop flow of water through the Venturi section wherein the improvement comprises another opening in said Venturi section contiguous to said main shutoff valve to evacuate material forming against said main shutoff valve when it is closed and said hydraulic jet turbine is in operation and a secondary shutoff valve means closing said another opening.

2. A directional control means as specified in claim 1 wherein said secondary shutoff valve means comprises a pair of side thrust openings in said Venturi section, a pair of opposed side thrust nozzles, a passageway connecting each nozzle to one of said openings, a shutoff valve closing off each of said opposing side thrust nozzles.

3. A directional control means for a hydraulic jet turbine having a Venturi section, a main propulsion opening in said Venturi section, a main shutoff valve closing said main propulsion opening, a reversing nozzle, a passageway into said reversing nozzle from said Venturi section, said valve being able to close the Venturi nozzle selectively either to stop flow of water through the Venturi section or to direct water into the reversing nozzle wherein the improvement comprises another opening in said Venturi section contiguous to said main shutoff valve to evacuate material forming against said main shutoff valve when it is closed and said hydraulic jet turbine is in operation and a secondary shutoff valve means closing said another opening.

4. A direction control means as specified in claim 3 wherein said main shutoff valve closing said main propulsion opening comprises a horizontally pivoted member.

5. A directional control means as specified in claim 3 wherein said secondary shutoff valve means comprises a pair of side thrust openings in said Venturi section, a pair of opposed side thrust nozzles, a passageway connecting each nozzle to one of said openings, a shutoff valve closing off each of said opposing side thrust nozzles.

6. A directional control means for a hydraulic jet turbine having a Venturi section and a main propulsion opening in said Venturi section comprising,
a main shutoff valve closing said main propulsion opening,
a reversing nozzle,
a pair of opposed side thrust nozzles adjacent to said Venturi section,
passageways connecting said reversing and side thrust nozzles to openings in said Venturi section, adjacent to said main shutoff valve, and
secondary shutoff valve means adjacent to said Venturi section and closing said reversing nozzle and said opposed side thrust nozzles.

7. In combination with the directional control means for a hydraulic jet turbine as specified in claim 6,

another pair of opposed side thrust nozzles mounted forward of the center of buoyancy of said vessel and connected by a passageway into said Venturi section upstream of said main shutoff valve, and valve means selectively opening each of another pair of opposed side thrust nozzles while maintaining the other closed or maintaining both closed.

8. A directional control means for a hydraulic jet turbine as specified in claim 6 wherein the secondary shutoff valve means comprises a three-way valve connected into said Venturi section by a passageway and having output ports connected to said reversing and opposing side thrust nozzles to selectively open each of said reversing and opposed side thrust nozzles or close all said reversing and opposed side thrust nozzles.

9. A directional control means for a hydraulic jet turbine as specified in claim 6 wherein the secondary shutoff valve means comprises a reversing valve connected into said Venturi section by a passageway and having an output port connected to said reversing nozzle and a two-way valve connected into said Venturi section by a passageway and having output ports connected to each of said opposing side thrust nozzles to selectively open each of said opposed side thrust valves or close both opposed side thrust valves independently of said reversing valve.

10. A directional control means for a hydraulic jet turbine as specified in claim 6 wherein the secondary shutoff valve means comprises three separate valves, each connecting one of said reversing and opposed side thrust valves into said Venturi section.

11. In combination with the directional control means for a hydraulic jet turbine as specified in claim 6, a remote control means connected to control both of the valves closing said opposing side thrust valves to selectively open them or close both of them.

12. A directional control means for a hydraulic jet turbine mounted in a vessel and having a Venturi section and a main propulsion opening in said Venturi section comprising,

a reversing nozzle,

a pair of opposed side thrust nozzles aft of the center of buoyancy of the vessel, and

a sole combination shutoff valve connected to said main propulsion opening and having output ports connected by passageways to said reversing nozzle and said opposed side thrust nozzles selectively closing said main propulsion opening and said reversing nozzle and selectively closing said opposed side thrust nozzles or closing both of them.

13. A directional control means for a hydraulic jet turbine as specified in claim 12 wherein said main shutoff valve means comprise a ball valve having a central

ball with an aperture therethrough mounted in said main propulsion opening of said Venturi section.

14. A directional control means for a hydraulic jet turbine as specified in claim 13 wherein said ball is rotated about two axes, said rotation about one of said axes selectively closing said main propulsion opening or said reversing nozzle or both of them and said rotation about the other of said axis selectively closing said opposed side thrust nozzles or closing both of them.

15. A directional control means for a hydraulic jet turbine having a Venturi section, a main propulsion opening in said Venturi section ejecting a stream of water, means for reversing the flow of water from the main propulsion opening by blocking said stream of water, wherein the improvement comprises means for positioning and detent means for securing said reversing means in a position partially reversing said stream of water to minimize the difference between forward and reverse thrust produced by the reaction of the flow of water.

16. A control means for a hydraulic jet turbine having a Venturi section and a sole propulsion opening in said Venturi section comprising,

means mounted adjacent said main propulsion opening for selectively reversing the direction of said stream of water by blocking said stream,

another opening in said Venturi section adjacent to said blocking means,

a shutoff valve means connected to said main propulsion opening to selectively prevent water flow from reaching said reversing means, and

a secondary shutoff valve means closing said another opening.

17. A control means for a hydraulic jet turbine having a Venturi section and a main propulsion opening in said Venturi section ejecting a stream of water comprising,

means mounted adjacent said main propulsion opening for selectively reversing the direction of said stream of water by blocking said stream,

a shutoff valve means connected to said main propulsion opening to selectively prevent water flow from reaching said reversing means,

side thrust nozzles mounted on said Venturi section,

another propulsion opening in said Venturi section contiguous to said main shutoff valve to evacuate material forming against said main shutoff valve when it is closed and said hydraulic jet turbine is in operation, and

conduit connecting said another propulsion opening to said side thrust nozzles.

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