

[54] **WATER JET BOAT THRUST TRIMMER**

[75] Inventor: **Patrick W. Breslin**, Watsonville, Calif.

[73] Assignee: **Custom Speed Marine, Inc.**, San Jose, Calif.

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[58] Field of Search **115/12 R, 14, 15, 115/11; 114/151; 239/265.35; 60/232**

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Primary Examiner—M. Henson Wood, Jr.

Assistant Examiner—John J. Love

Attorney—Stephen S. Townsend, Thomas F. Smegal, Jr. et al.

[57] **ABSTRACT**

In a water jet boat thrust source of the type comprising a water pump for generating a water jet, a steering conduit forming an exit nozzle through which the water is emitted, the steering conduit exit nozzle adjustable left and right in a horizontal plane for steering, and a steering lever arm system coupled to the exit nozzle for adjusting said exit nozzle left and right, the improvement including an adjustable trimming conduit interposed between the water pump and exit nozzle for adjusting the direction of thrust from the water jet in a vertical plane for trimming the boat, a second or trimming lever arm system coupled to the adjustable conduit for adjusting the conduit in a vertical plane upon actuation of the trimming lever arm system, and a friction coupling between the adjustable trimming conduit and the steering lever arm system so that upon adjustment of the trimming conduit in a vertical plane the steering lever arm system and exit nozzle move with the conduit maintaining the steering direction of the exit nozzle substantially constant during trimming. Alternatively, the trimming conduit is coupled downstream from the steering conduit so that the trimming conduit forms the exit nozzle.

9 Claims, 5 Drawing Figures

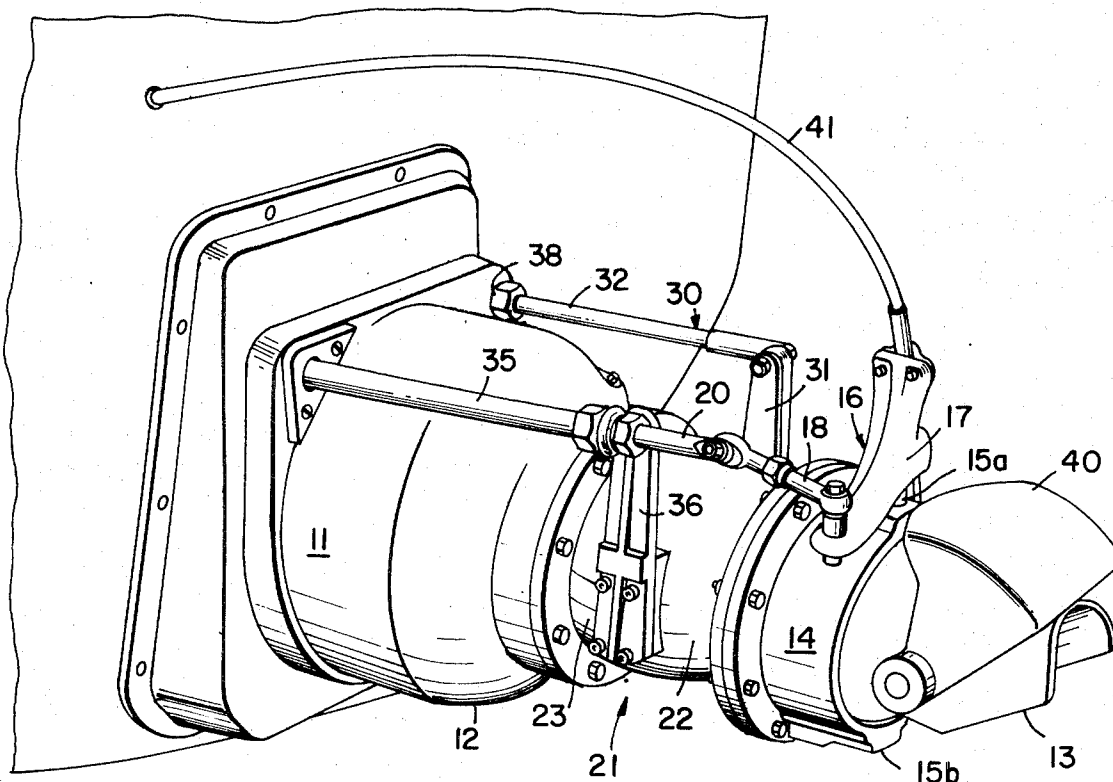


FIG_1

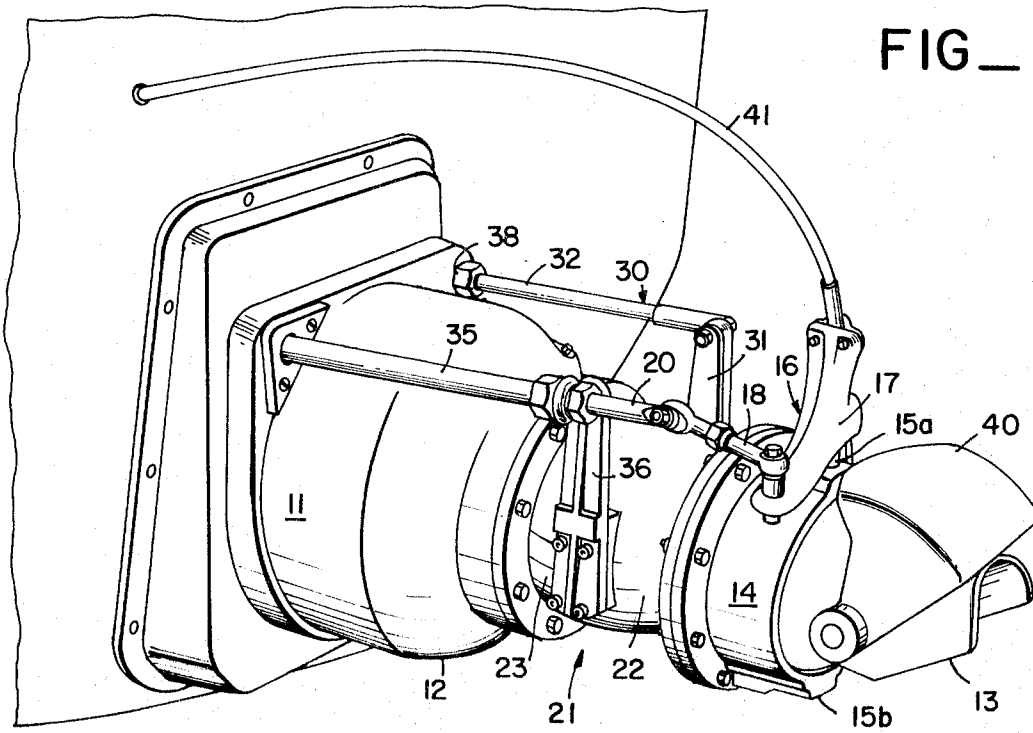
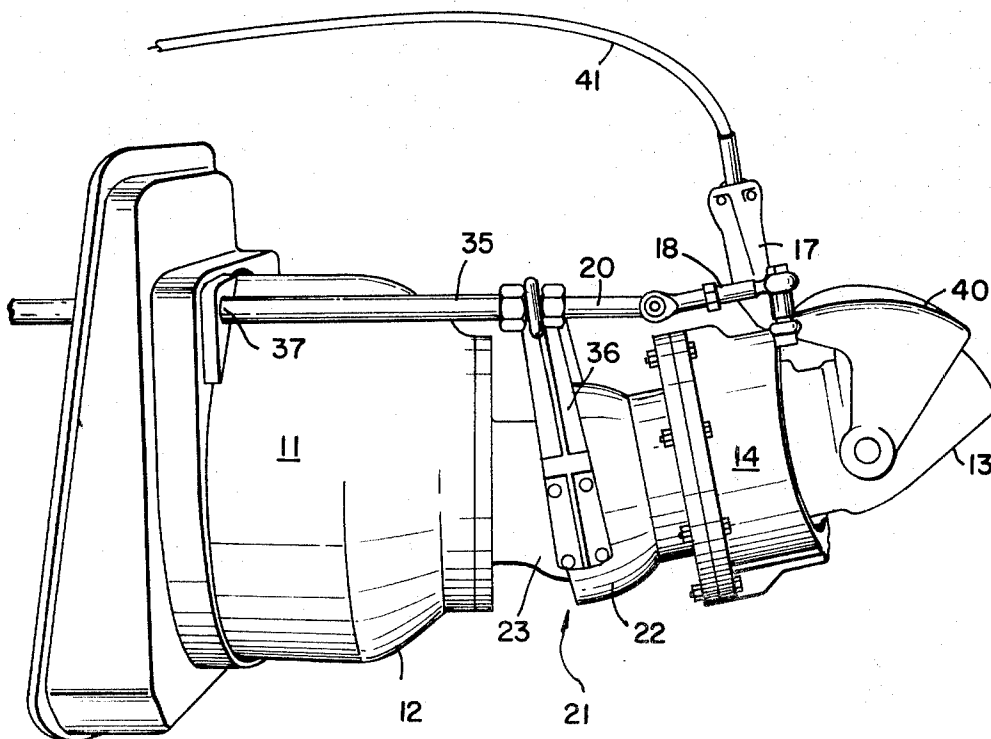


FIG_2

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FIG_3

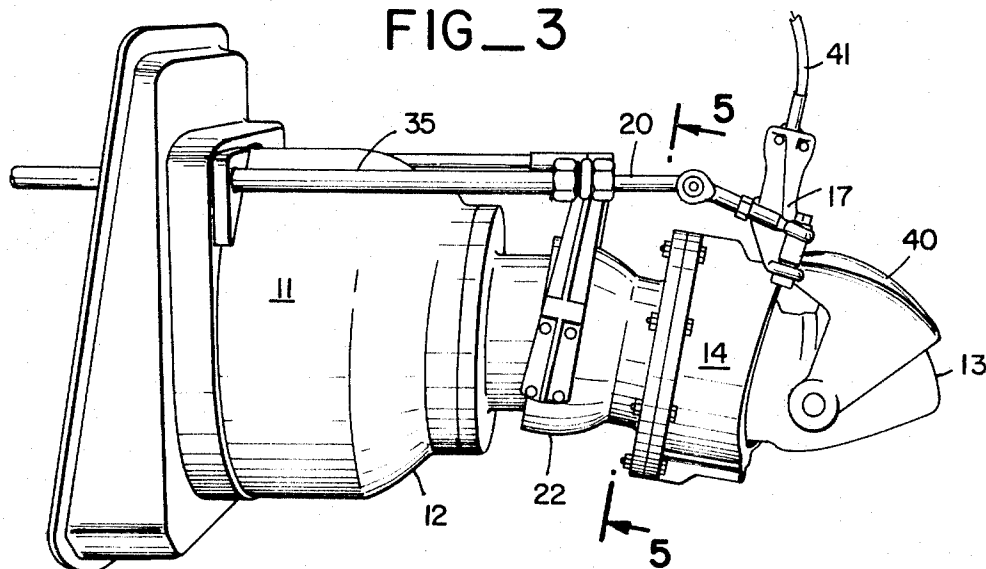
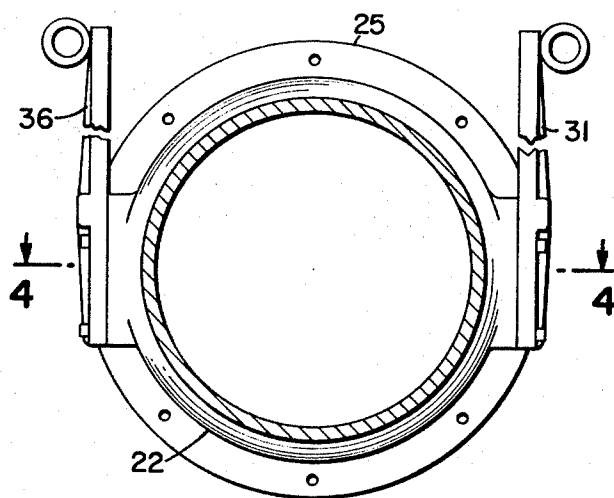


FIG_5

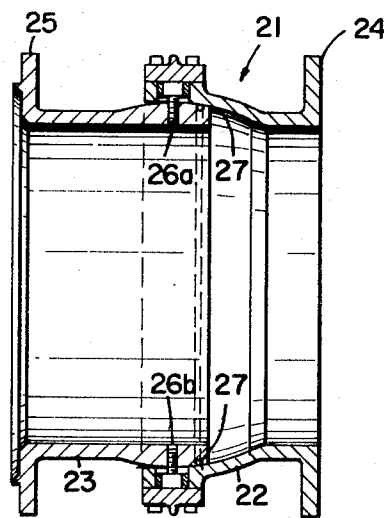


FIG_4

WATER JET BOAT THRUST TRIMMER

This invention relates to a new and improved water jet boat thrust source and in particular to a system arrangement for adjusting the drive source or thrust of a water jet boat in a vertical plane and to a method for trimming water jet boats.

The standard water jet boat drive source includes a pump such as an impeller pump and pump motor for generating a jet of water providing thrust and an exit nozzle through which the jet of water is emitted. The exit nozzle is formed by a conduit adjustable left and right in a horizontal plane and a lever arm system is provided which upon actuation adjusts the exit nozzle left and right for steering.

A principal object of the present invention is to provide a variety of adjustable trimming conduit arrangements interposed and coupled between the water jet pump and the steering conduit exit nozzle for adjusting the attitude of the water jet up and down in a vertical plane thereby adjusting the direction of thrust in the vertical plane for trimming the boat. Alternatively, the trimming conduit is coupled downstream from the steering conduit, itself forming an exit nozzle.

The capability of adjusting the water jet boat thrust in a vertical plane and of trimming the boat contemplated by the present invention offers a variety of features and advantages. The top speed range of the boat is increased because the wetted surface can be lessened with the exit nozzle and thrust adjusted in an upward direction to counteract low pressure generated under the boat at high speeds which otherwise retains a greater wetted surface against the water. On the other hand planing can be achieved at lower speeds in the lower speed range by adjusting the exit nozzle downwardly lifting the back up and out of the water and again reducing the wetted surface. With the thrust properly adjusted in a vertical plane acceleration can be increased and resulting acceleration time decreased. Similarly, when towing objects and transporting loads of different weight and at different speeds the handling characteristics of the boat can be optimized by proper adjustment of the vertical attitude of the thrust of the water jet exhaust. Adverse weather conditions can be overcome in operation of the boat by adjustment of the thrust up and down and safety of the boat in rough water is generally increased.

In order to accomplish these results the present invention generally contemplates interposing and coupling between the water jet pump and the steering exit nozzle of a water jet boat, means such as an adjustable conduit for adjusting the attitude of the exit nozzle up and down in a vertical plane for trimming the boat. In one embodiment the adjustable trimming conduit is coupled to the pump outlet by means of a pair of pins forming a horizontal axis about which the adjustable trimming conduit rotates in a vertical plane. The exit nozzle generally comprises a second conduit coupled from the output of the first conduit by means of a pair of pins forming a vertical axis about which the second conduit rotates in a substantially horizontal plane. Alternatively the steering conduit and trimming conduit can be transposed so that the trimming conduit is coupled downstream from the steering conduit forming a trimming exit nozzle.

The invention further contemplates providing a trimming lever arm system coupled to the adjustable trim-

ming conduit and means for actuating the lever arm system for rotating the conduit about its horizontal axis in a vertical plane. A steering lever arm system available as in the standard water jet boat is coupled with the exit nozzle conduit for adjusting the exit nozzle in a horizontal plane about its vertical axis upon actuation of the steering lever arm system.

According to another aspect of the invention proper steering geometry is maintained during vertical adjustment or trimming of the water jet boat thrust for the configuration in which the trimming conduit is coupled upstream from the steering conduit exit nozzle. Thus, an arrangement is provided so that upon adjustment of the trimming conduit in a vertical plane for adjusting the thrust up or down to trim the boat, the steering lever arm system coupled to the exit nozzle or steering conduit moves in fixed relationship with the adjustable trimming conduit to maintain a constant steering direction of the exit nozzle in the horizontal plane. In order to accomplish this result the steering lever arm system is frictionally coupled with the adjustable trimming conduit.

In one embodiment the frictional coupling is provided by a tubular or cylindrical housing frictionally engaging and enclosing at least one lever arm on the steering lever arm system. The cylindrical or tubular housing is fixed in stationary relationship to the adjustable trimming conduit so that upon adjustment of the trimming conduit in a vertical plane the steering lever arm system and exit nozzle to which it is coupled move with the cylindrical housing and the steering direction of the exit nozzle in the horizontal plane remains substantially constant during trimming.

In the preferred embodiment, the adjustable trimming conduit means is interposed between the water pump and exit nozzle for adjusting the direction of thrust from the water jet in the vertical plane for trimming the boat and comprises a ball joint having internal and external sides coupled by pins forming a horizontal axis. The internal side of the ball joint is fixedly coupled to the outlet of the water pump for receiving the water jet and the external side of the ball joint is coupled at the horizontal axis for rotation relative to the internal side of the ball joint in a vertical plane. This movably mounted external side of the ball joint is coupled at its output side to the exit nozzle. A trimming lever arm system is coupled to the external side of the ball joint for rotating the downstream side of the ball joint in the vertical plane upon actuation of the trimming lever arm system. Finally, the steering lever arm system which is actuated for adjusting the exit nozzle left and right in a horizontal plane for steering is frictionally coupled to the external or downstream side of the ball joint so that upon rotation of the ball joint in a vertical plane the steering lever arm system coupled with the exit nozzle moves with the ball joint so that the direction of the exit nozzle in a horizontal plane, i.e., the steering geometry, remains constant during trimming.

Other objects features and advantages of the present invention will become apparent in the following specification and accompanying drawings.

FIG. 1 is a perspective view of a water jet boat thrust source in accordance with the present invention.

FIG. 2 is a side view of the water jet boat thrust source with the trimming conduit and exit nozzle adjusted to direct the thrust at an angle above the horizontal.

FIG. 3 is a side view of the water jet boat drive source with the trimming conduit and exit nozzle adjusted to direct the thrust downward at an angle below the horizontal.

FIG. 4 is a side cross-sectional view of the ball joint coupling for adjusting the direction of thrust up and down in a vertical plane.

FIG. 5 is an end cross-sectional view of the ball joint coupling.

Referring to the example illustrated in FIGS. 1 through 5 there is illustrated the rear portion of a water jet boat showing the thrust source including an impeller pump 11 contained within bowl 12 for developing a jet of water. The pump is driven by a marine engine or converted automobile engine as is well known in the water jet boat art, housed within the hull of the boat. The water jet developed by pump 11 is emitted through an exit nozzle 13 also of conventional design. The exit nozzle 13 is coupled inside an intermediate conduit 14 by means of a pair of vertical pins 15a and 15b which form a vertical axis about which the exit nozzle 13 can rotate left and right in a substantially horizontal plane. The exit nozzle 13 is of smaller diameter than the intermediate conduit 14 so that there is leeway for rotation left and right about the axis formed by pins 15a and 15b. The exit nozzle 13 is thus used for left and right steering as is conventionally known and steering is accomplished by means of a lever arm system 16 including lever arm 17 coupled to the exit nozzle 13 through pin 15a and additional lever arms 18 and 20 pivotally coupled in sequence. Lever arm 20 is actuated by a conventional steering cable housed inside the boat and extending to the driver's seat for control by the driver. In accordance with the present invention the intermediate conduit 14 is coupled at its upstream side to the outlet of water pump 11 through a ball joint 21. In particular, the intermediate conduit 14 terminates at its upstream side in the external or outer side 22 of ball joint 21. The outlet from water pump 11 on the other hand terminates in the internal or inner side 23 of ball joint 21. In the illustrated example, the external outer side 22 of ball joint 21 is rigidly fixed to and forms a portion of the intermediate conduit 14 while the internal coupling 23 of ball joint 21 is rigidly fixed to the output of pump 11 and forms the pump outlet at the upstream side of the ball joint.

As shown in more detail in the cross-sectional views of FIGS. 4 and 5, the external side 22 of the ball joint terminates in a flange 24 which is bolted to the intermediate conduit 14 forming an integral part thereof. The internal side 23 of ball joint 21 on the upstream side terminates in flange 25 bolted to the outlet of bowl 12 and pump 11 forming an integral part thereof. The relatively moving upstream and downstream sides 23 and 22 respectively of ball joint 21 are coupled through a pair of horizontal pins 26a and 26b forming a horizontal axis about which the intermediate conduit 14 can rotate relative to the outlet of water pump 11 up and down in a vertical plane. By placing the internal side 23 of ball joint 21 upstream from the external side 22, frictional impedance or obstruction of the water jet flow generated by pump 11 is minimized and the obtainable thrust maximized.

Up and down motion of the intermediate conduit 14 to which exit nozzle 13 is coupled as previously described is controlled by means of the lever arm system 30 including lever arm 31 coupled to the external side

22 of ball joint 21 at pin 26a and lever arm 32 which passes through an O-ring sealed hole 38 in the transom of the water jet boat and which is controlled by a conventional cable control system housed within the boat and extending to the driver's seat for control by the driver. Lever arm 31 is pivotally coupled to lever arm 32. The lever arm system 30 is actuated by the cable control to rotate the intermediate conduit 14 to which the exit nozzle 13 is coupled up and down in a vertical plane under control of the operator.

It is thus seen that the thrust source illustrated in the example of FIGS. 1 through 5 includes three relatively moving parts. Thus, the thrust source includes a water pump 11 in bowl 12 which generates a water jet exhaust through outlet 23; a first or intermediate trimming conduit 14 coupled to the water pump outlet 23 by means of a pair of horizontal pins forming a horizontal axis about which the first or intermediate trimming conduit 14 rotates up and down in a vertical plane; and a second conduit or exit nozzle 13 coupled to the intermediate conduit 14 by means of a pair of vertical pins forming a vertical axis about which the exit nozzle can rotate left and right in a substantially horizontal plane. The rotation of the first and second conduits in substantially vertical and horizontal planes respectively is controlled by means of separate first and second lever arm systems 30 and 16 respectively, in turn actuated by separate cable controls under the control of the driver or operator.

Appropriate frictional resistance is built in to the system at various coupling joints by, for example, O-ring seals such as O-ring seal 27 within ball joint 21 as illustrated in FIG. 4.

The illustrated water jet boat thrust source includes the conventional reversing attachment 40 for reversing the direction of thrust and a control cable 41 for lowering and raising the reversing attachment.

In operating the water jet boat thrust source described above it is apparent that if the operator of the boat actuates lever arm system 30 for rotating the intermediate conduit 14 up and down in a vertical plane thereby adjusting the thrust in a vertical plane for trimming the boat, the second lever arm system 16 used for steering the boat would normally be effected because the relative distance between the exit nozzle and the transom of the boat will change placing stress on the steering lever arm system 16 having the effect of turning the exit nozzle 13 left or right in one direction or the other changing the steering direction or course of the boat. At high speeds such unintended effects on the steering can be dangerous and simultaneous adjustment of the trimming lever arm system 30 and steering lever arm system 16 by the driver would be difficult at best. Therefore, in accordance with the present invention a novel coupling is provided in the steering lever arm system in order to compensate for relative changes in the steering lever arm system which are otherwise inevitable while trimming the boat.

To this end the lever arm 20 of steering lever arm 16 is enclosed within a tubular housing 35 which is pivotally coupled through arm 36 to the intermediate conduit 14 and in particular the external or downstream side 22 of ball joint 21. The tubular housing 35 extends through an O-ring sealed hole 37 in the transom of the water boat for sliding back and forth through the hole 37 when the operator is trimming the boat. Thus upon actuation of lever arm 30 and rotation of intermediate

conduit 14 up and down in a vertical plane the tubular housing 35 extends into and out of hole 37. The tubular housing 35 frictionally engages lever arm 20 of steering lever arm 16 so that the steering lever arm system is carried with the tubular housing 35 which slides relative to the transom of the boat through hole 37 during trimming of the boat. This motion of the steering lever arm system with the tubular housing 35 in which it is frictionally coupled, just compensates for the motion up and down of the exit nozzle 13 inevitably entailed during trimming of the boat so that the exit nozzle 13 retains a substantially constant direction in the horizontal plane as far as left or right motion and the steering direction remains constant.

It is thus seen that the steering lever arm system 16 which is actuated by a steering cable under the control of the driver for rotating the exit nozzle 13 left and right in a horizontal plane around the vertical axis formed by pins 15a and 15b, is frictionally coupled to the intermediate or trimming conduit 14 through the tubular housing 35 which encloses and frictionally engages the lever arm 20 of steering lever arm 16. The intermediate or trimming conduit 14 which rotates up and down in a vertical plane around a horizontal axis formed by pins 26a and 26b thus carries with it the exit nozzle 13 and the steering lever arm 16 without relative movement of the steering lever arm system which otherwise would effect the steering direction of the boat.

During the steering of the boat on the other hand the trimming conduit or intermediate conduit 14 under control of lever arm system 30 remains fixed, and the steering lever arm 20 upon actuation of the steering cable travels back and forth within the tubular housing 35 actuating the remainder of the lever arm system 16, turning the exit nozzle back and forth or left and right in a substantially horizontal plane for steering.

The tubular housing 35 extends through the transom of the boat a sufficient distance so that it always engages the rear transom through hole 37 through the entire range of travel of the trimming conduit in an up and down direction. The steering lever arm 20 which extends entirely through the tubular housing 35 is coupled on the inside of the boat to the steering cable in the conventional manner.

The ball joint 21 is designed to provide an optimum angular adjustment up and down of 10° above and below the horizontal direction, the optimum angular direction required for trimming the boat, but can be constructed to permit a travel of up to 15° above and below the horizontal.

While the coupling between the trimming or intermediate conduit 14 and the outlet of water pump 11 has been described in this example with reference to the preferred embodiment of a ball joint coupling, the coupling could also be provided simply in the same manner in which the exit nozzle 13 is coupled to the intermediate conduit 14. Thus, the intermediate conduit 14 would simply be coupled inside the outlets from pump 11 and bowl 12 by means of a pair of horizontal pins forming a horizontal axis. The diameter of the intermediate or trimming conduit 14 would in that case be smaller than the diameter of the outlet of pump 11 in bowl 12 to provide some leeway in the rotational direction within the outlet up and down in a vertical plane.

According to yet another embodiment the trimming conduit is coupled by means of a pair of horizontal pins forming a horizontal axis to the downstream end of the

steering conduit. In this arrangement the water jet exits finally through the trimming conduit, the steering conduit coupled between the water pump and trimming conduit. The latter is controlled by a separate flexible cable.

What is claimed is:

1. A water jet boat drive source comprising:

a water pump and means for driving said pump to generate a jet stream of water;

first conduit means coupled with the output from said water pump for guiding the water jet generated by said pump;

first lever arm system coupled to the first conduit means and means for actuating said lever arm for adjusting the attitude of said first conduit up and down in a vertical plane for varying the direction of thrust from said water jet in the vertical plane in order to trim the boat;

second conduit means coupled with the output of said first conduit means for guiding the water jet generated by said pump;

second lever arm system coupled to the second conduit and means for actuating said lever arm for varying said second conduit means right and left in a horizontal plane in order to vary the direction of thrust of the water jet for steering; and

means for frictionally engaging and enclosing at least one of the lever arms of the second lever arm system in a tubular housing for movement within and relative to the tubular housing during steering, said tubular housing being coupled in fixed relationship to the first conduit means so that upon adjustment of the first conduit means in the vertical plane, the second lever arm system moves in fixed relationship with the tubular housing to maintain a constant steering direction of the second conduit in a horizontal plane.

2. A water jet boat drive source as set forth in claim 1 wherein said first conduit is coupled to the pump outlet by means of a pair of pins forming a horizontal axis about which the first conduit rotates in a vertical plane and wherein the second conduit is coupled to the outlet of the first conduit by means of a pair of pins forming a vertical axis about which the second conduit rotates in a substantially horizontal plane.

3. A water jet boat drive source as set forth in claim 1 wherein the second lever arm system is frictionally coupled to the first conduit means so that upon adjustment of the first conduit means in the vertical plane, the second lever arm system moves in fixed relationship to maintain substantially constant steering direction in the horizontal plane.

4. A water jet boat drive source as set forth in claim 2 wherein said first conduit comprises a ball joint having internal and external sides coupled to the outlet of the water pump for receiving the water jet and the external side of the ball joint coupled around said horizontal axis for rotation relative to the internal side of the ball joint in a vertical plane for adjusting the direction of thrust from the water jet in a vertical plane for trimming the boat.

5. A water jet boat thrust source of the type comprising a water pump for generating a water jet and means for driving said pump, an exit nozzle through which the water jet is emitted, said exit nozzle adjustable left and right in a horizontal plane for steering the boat, and a first lever arm system coupled to said exit nozzle for ro-

tating said exit nozzle in a horizontal plane upon actuation of said lever arm system, the improvement comprising:

conduit means interposed and coupled between the water pump and exit nozzle for adjusting direction of thrust from the water jet in a vertical plane for trimming the boat;

second lever arm system means coupled to the conduit means for adjusting the attitude of said conduit means up and down in a vertical plane for varying the direction of thrust from the water jet in a vertical plane upon actuation of the second lever arm system;

and means frictionally coupling the first lever arm system to the conduit means so that upon adjustment of said conduit means in a vertical plane the first lever arm system and exit nozzle move with the conduit means and the steering direction of the exit nozzle in a horizontal plane remains substantially constant during trimming.

6. A water jet boat thrust source as set forth in claim 9 wherein the conduit means comprises a ball joint having internal and external sides coupled by hinge means forming a horizontal axis, the internal side of the ball joint fixedly coupled to the outlet of the water pump for receiving the water jet and the external side of the ball joint coupled around said horizontal axis for rotation relative to the internal side of the ball joint in a vertical plane, the external side of the ball joint coupled to the exit nozzle.

7. A water jet boat thrust source of the type comprising a water pump for generating a water jet and means for driving said pump, an exit nozzle through which the water jet is emitted, said exit nozzle adjustable left and right in a horizontal plane for steering, and a first lever arm system coupled to said exit nozzle for rotating said exit nozzle in a horizontal plane upon actuation of said lever arm system, the improvement comprising:

conduit means interposed between the water pump and exit nozzle for adjusting the direction of thrust from the water jet in a vertical plane for trimming the boat comprising a ball joint having internal and external sides coupled by pins forming a horizontal axis, the internal side of the ball joint fixedly coupled to the outlet of the water pump for receiving the water jet and the external side of the ball joint coupled around said horizontal axis for rotation

relative to the internal side of the ball joint in a vertical plane, the external side of the ball joint coupled to the exit nozzle;

a second lever arm system means coupled to the external side of the ball joint for rotating the downstream side of said ball joint up and down in the vertical plane upon actuation of said first lever arm system;

and a tubular housing fixed to the conduit means, said cylindrical housing frictionally engaging and enclosing at least one lever arm of the first lever arm system whereby upon adjustment of the conduit means in a vertical plane the second lever arm system and exit nozzle move with the cylindrical housing so that the steering direction of the exit nozzle in a horizontal plane remains substantially constant during trimming.

8. A water jet boat thrust source of the type comprising a water pump for generating a water jet and means for driving said pump, an exit nozzle through which the water jet is emitted, said exit nozzle adjustable left and right in a horizontal plane for steering the boat, and a first lever arm system coupled to said exit nozzle for rotating said exit nozzle in a horizontal plane upon actuation of said lever arm system, the improvement comprising:

conduit means adapted to cooperate with said water pump and exit nozzle for adjusting direction of water thrust from the water jet in a vertical plane for trimming the boat;

second lever arm system means coupled to the conduit means for adjusting the attitude of said conduit means up and down in a vertical plane for varying the direction of thrust from the water jet in a vertical plane upon actuation of the second lever arm system;

and means frictionally coupling the first lever arm system to the second lever arm system so that upon adjustment of said conduit means in a vertical plane the first lever arm system and exit nozzle move with the conduit means and the steering direction of the exit nozzle in a horizontal plane remains substantially constant during trimming.

9. A water jet boat thrust source in accordance with claim 8 wherein said conduit means is interposed and coupled between said water pump and exit nozzle.

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