May 15, 1962 K. HANLEY 3,034,295

HYDRAULIC JET PROPULSION UNIT FOR WATERCRAFT

Filed Oct. 24, 1960 6 Sheets-Sheet 1

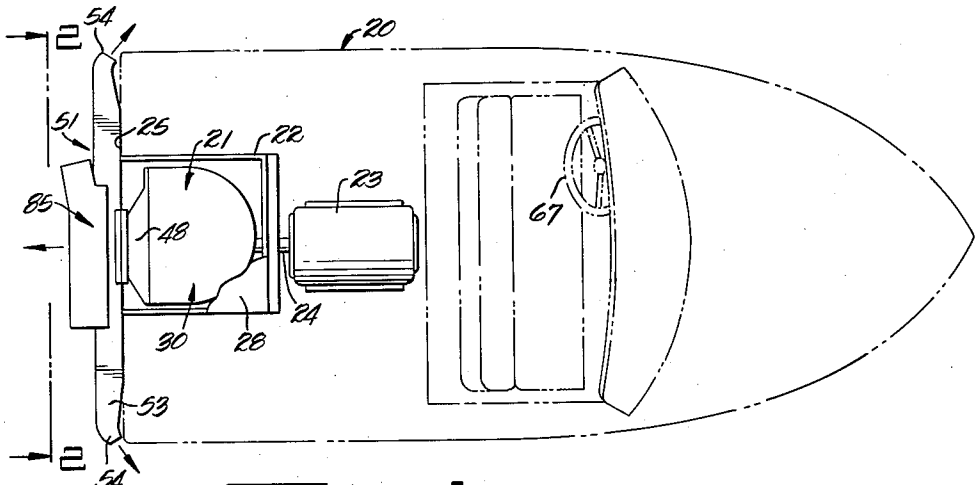


Fig. 1

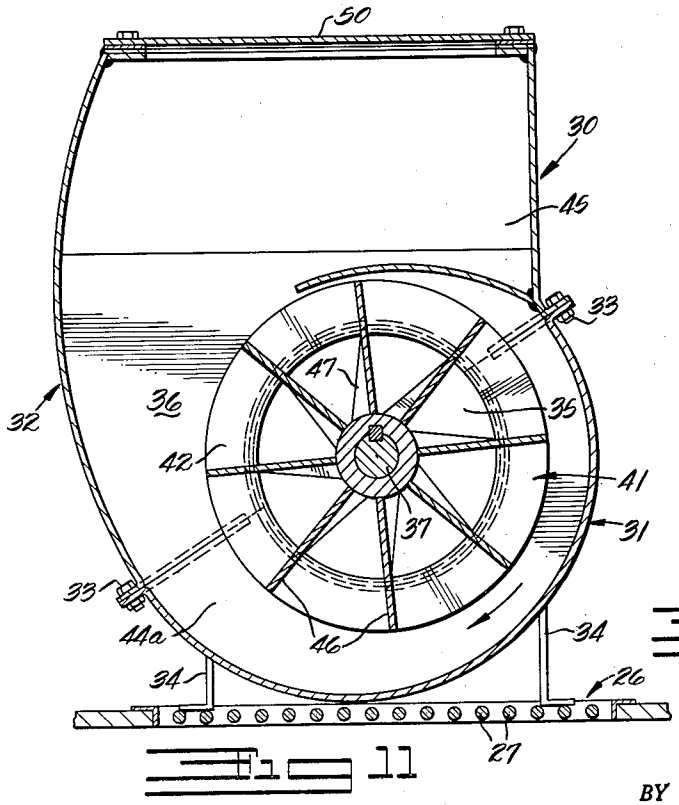


Fig. 11

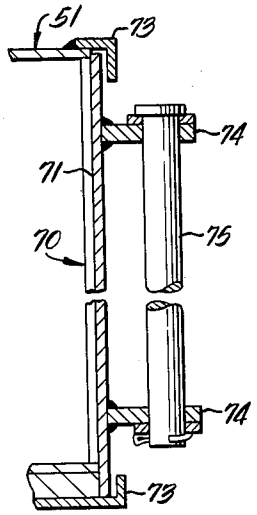


Fig. 8

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HYDRAULIC JET PROPULSION UNIT FOR WATERCRAFT

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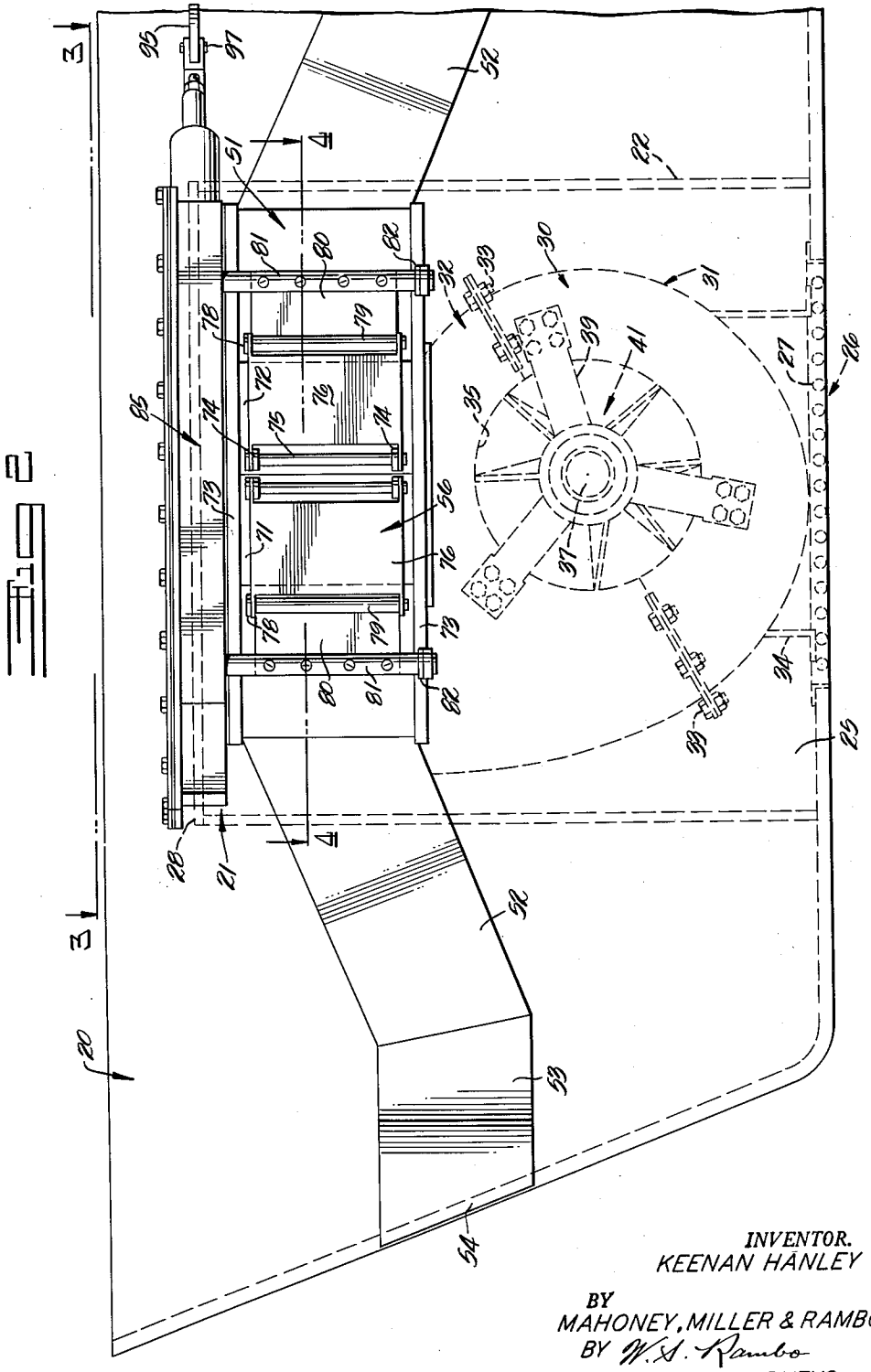


Fig. 2

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HYDRAULIC JET PROPULSION UNIT FOR WATERCRAFT

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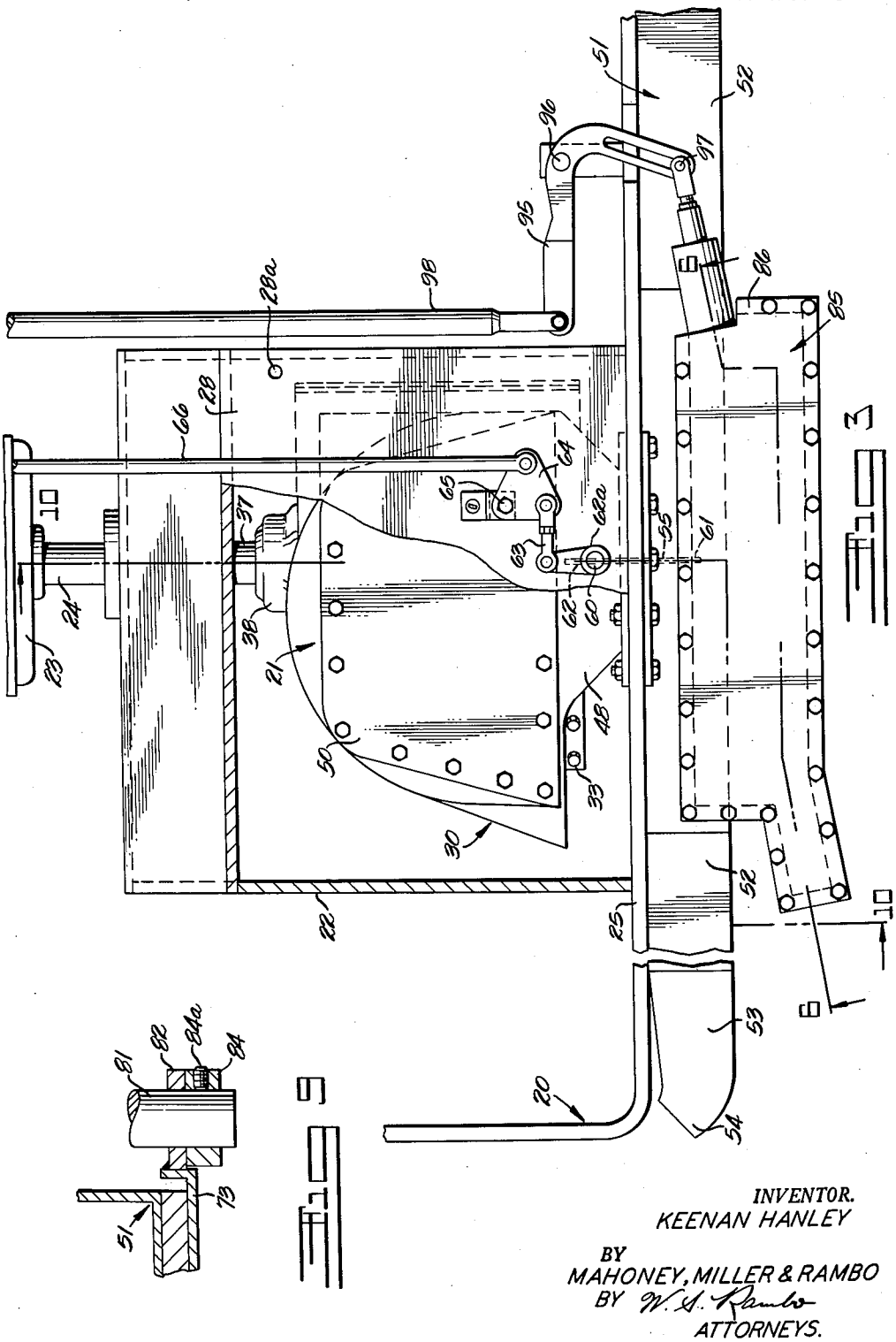


FIG. 3

FIG. 5

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HYDRAULIC JET PROPULSION UNIT FOR WATERCRAFT

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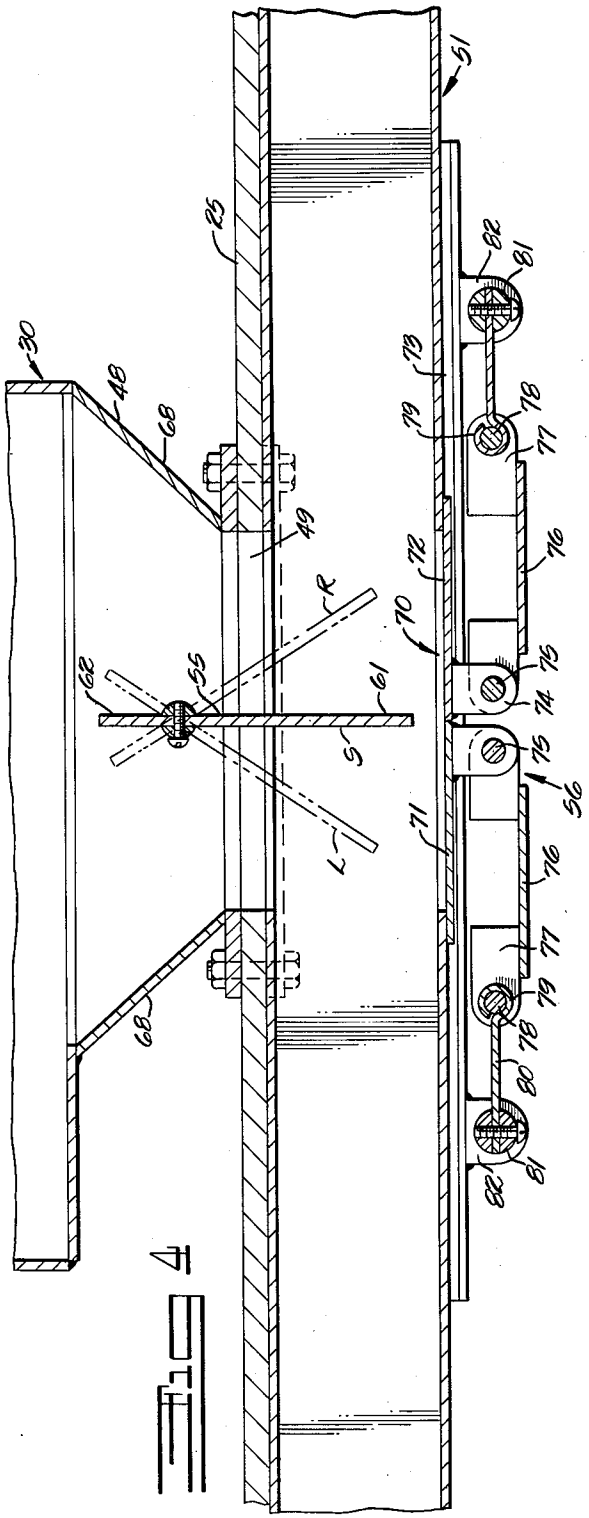


FIG. 4

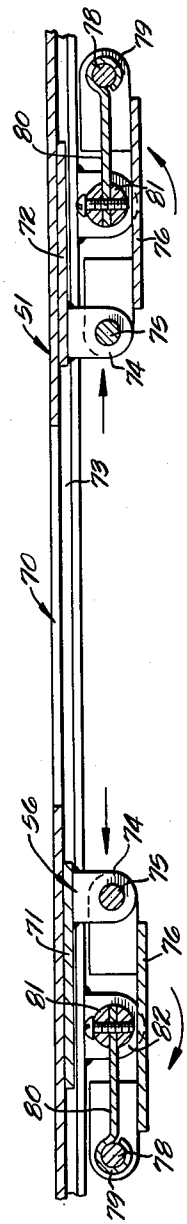


FIG. 5

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HYDRAULIC JET PROPULSION UNIT FOR WATERCRAFT

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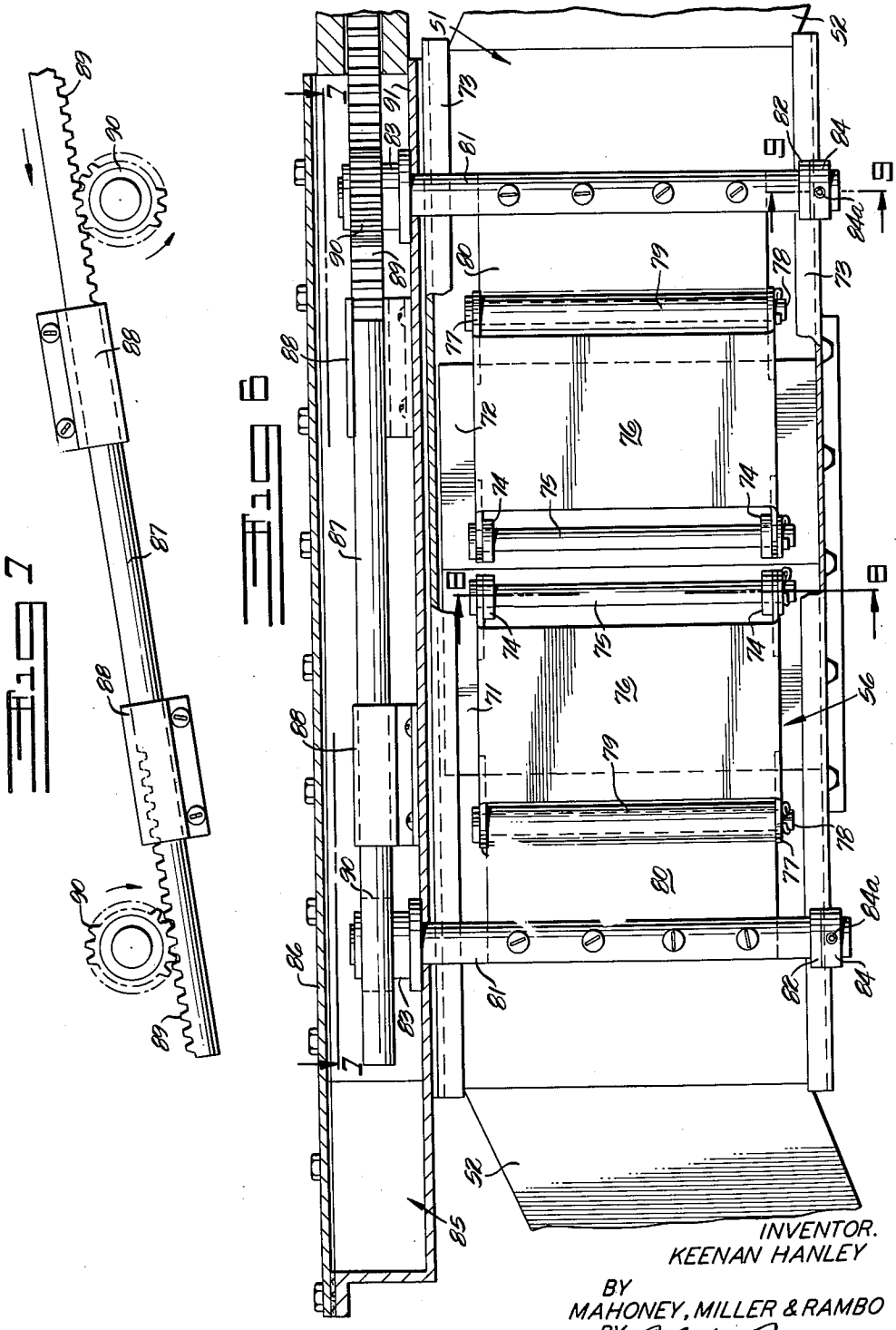


FIG. 7

FIG. 6

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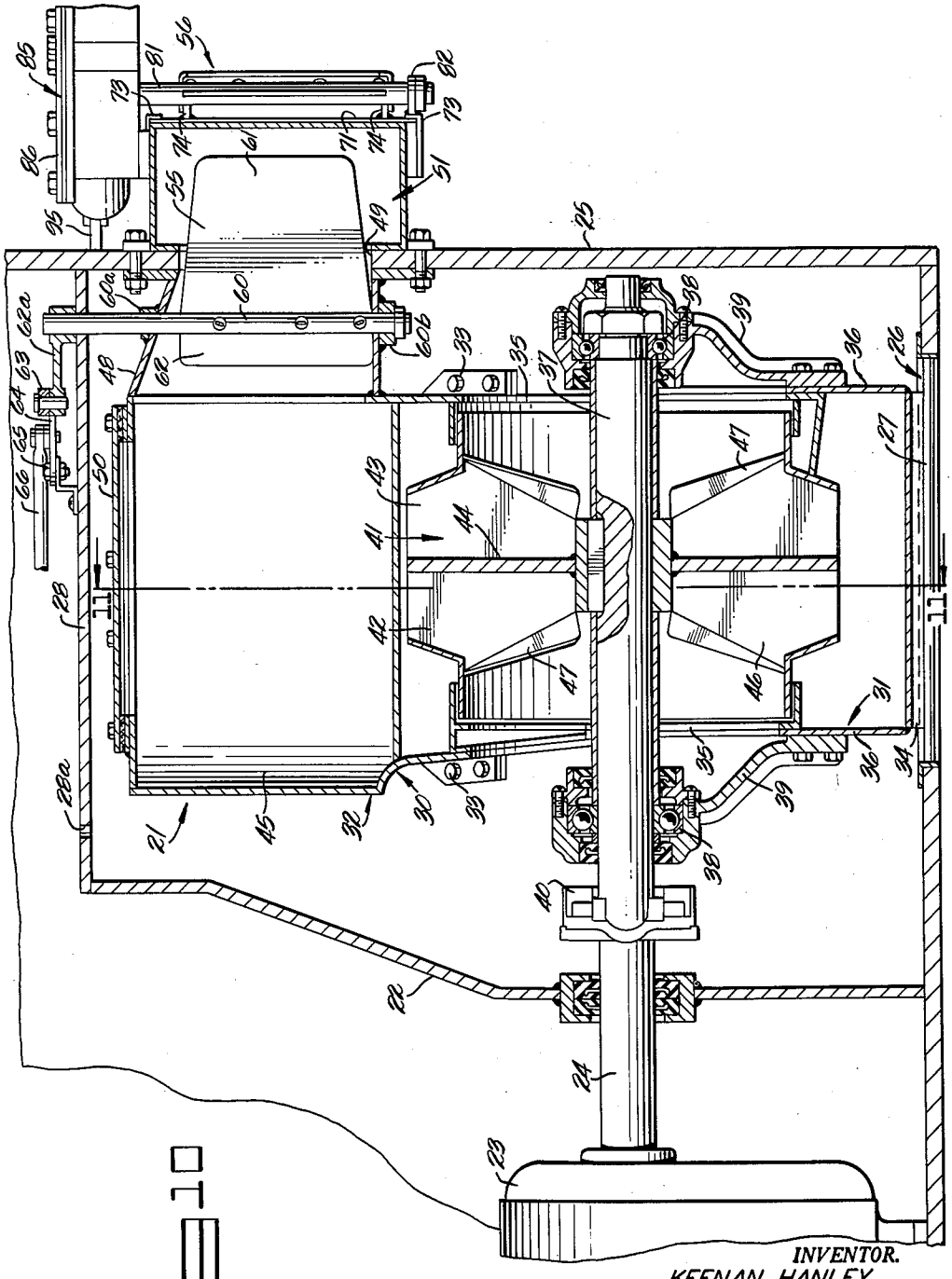


Fig. 10

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United States Patent Office 3,034,295 Patented May 15, 1962

3,034,295

HYDRAULIC JET PROPULSION UNIT FOR WATERCRAFT

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Filed Oct. 24, 1960, Ser. No. 64,495
7 Claims. (Cl. 60—35.54)

My invention relates to a hydraulic jet propulsion unit for watercraft.

My invention has to do, more particularly, with a jet propulsion unit which can be mounted in any suitable watercraft and which will function to discharge a jet stream or streams of water under pressure from the watercraft in selected directions, either generally rearwardly or generally forwardly, to thereby propel and steer the boat in a forward or rearward direction. The discharge of the jet stream or streams may be either into the ambient atmosphere or into the body of water in which the watercraft is disposed and in either instance the watercraft will be propelled by the reactive thrust set up by the discharge into the atmosphere or body of water.

The unit of this invention is provided with a novel pump arrangement for producing the jet or jets for propelling the watercraft. It is provided with a novel control arrangement for selectively directing the jet or jets in a generally rearward direction to propel the watercraft forwardly or in a generally forward direction to propel the watercraft in a reverse direction. It is further provided with a novel steering control arrangement whereby the direction of the jet or jets is controlled to steer the watercraft at all times regardless of whether it is being propelled forwardly or rearwardly. The controls are simple and efficient and are so designed and arranged to selectively and properly direct the jet or jets readily even though the jets discharge under considerable pressure. Thus, the entire unit is so designed and constructed that the operator of the watercraft has it under control at all times in regard to steering whether the craft is moving forwardly or rearwardly and in regard to selecting the direction of movement of the boat either forwardly or rearwardly. The combination of controls is such that the watercraft can be quickly and easily started or stopped, changed between forward and reverse direction of movement, and turned in either direction whether it is moving forward or rearwardly.

Although in the attached drawings I have illustrated my invention applied to a pleasure craft and refer to such a craft in the following description, it will be understood that it is equally applicable to other types of watercraft such as barges, landing craft, etc.

The accompanying drawings illustrate the preferred embodiment of my invention but it is to be understood that specific details may be varied without departing from basic principles of my invention.

In these drawings:

FIGURE 1 is a diagrammatic view illustrating a boat of the pleasure craft type to which the unit of my invention is applied.

FIGURE 2 is an enlarged fragmentary view taken substantially along the line 2—2 of FIGURE 1 at the rear or stern of the boat and illustrating my unit positioned in the boat.

FIGURE 3 is a top plan view of the structure shown in FIGURE 2, partly broken away, taken substantially along line 3—3 of FIGURE 2.

FIGURE 4 is an enlarged transverse horizontal sectional view taken substantially along line 4—4 of FIGURE 2, showing the jet directing control valve and gates.

FIGURE 5 is a horizontal sectional view of the gates

illustrated in FIGURE 4 but showing them in fully opened position.

FIGURE 6 is a transverse vertical sectional view taken along line 6—6 of FIGURE 3 through the gate control rack mechanism and showing it associated with the gates.

FIGURE 7 is a horizontal sectional view taken along line 7—7 of FIGURE 6 showing the rack mechanism.

FIGURE 8 is a detail in vertical section taken along line 8—8 of FIGURE 6 through one of the gate structures.

FIGURE 9 is a detail in vertical section of one of the gate structures taken along line 9—9 of FIGURE 6.

FIGURE 10 is a vertical longitudinal sectional view through the propulsion unit taken substantially along line 10—10 of FIGURE 3.

FIGURE 11 is a transverse vertical sectional view taken along line 11—11 of FIGURE 10.

With reference to the drawings, in FIGURE 1 I have illustrated the general arrangement of my hydraulic jet propulsion unit in a boat of the pleasure craft type. The hull of the boat is indicated by the numeral 20 and my propulsion unit is indicated by the numeral 21 and it will be noted that this unit 21 is located at the stern of the boat, along the longitudinal center line thereof. The unit 21 is located mainly within a sea chest or compartment 22 and is driven by a suitable driving motor or engine 23 which is preferably of the internal combustion type. The motor 23 is coupled to the unit 21 by means including a drive shaft 24. The sea chest or compartment 22 extends upwardly from the bottom of the boat and may be of any suitable shape in plan but it is illustrated as being of substantially square outline. The rear wall of the chest is formed by the transom 25 at the stern of the boat as indicated best in FIGURES 3 and 10. The bottom of the chest 22 opens to the water through a large opening 26 which is shown best in FIGURES 2, 10 and 11 and this opening is protected by a grating or grill 27 to prevent the entrance of foreign objects of any considerable size into the chest 22 and therefore into the unit 21. The chest 22 may be closed at its top by means of a lid 28 (FIGURE 3) although this is not necessary. If closed, preferably one or more vent openings 28*a* are provided to prevent the build-up in pressure in the upper end thereof as water rises therein through the inlet opening 26.

The unit 21 includes means for taking in water through the bottom inlet opening 26, and then forcibly discharging it in the form of a jet or jets. The unit 21 preferably comprises a centrifugal pump of a double impeller volute type, shown best in FIGURES 10 and 11, although other types of pumps may be employed. The pump casing is indicated at 30 and is of the usual volute form but is preferably composed of detachable sections 31 and 32 to facilitate manufacture and assembly, the sections being bolted together at 33. The pump casing 30 is disposed upright and transversely over the opening 26 within the chest or compartment 22 and is in spaced relationship to the walls thereof, as indicated in FIGURES 1, 3 and 10, and it may be suitably supported over the opening 26 as by the legs or supports 34. The pump casing 30 is provided with opposite, axially arranged inlets 35 formed in the upstanding flat vertical side walls 36 of the casing. An impeller drive shaft 37 extends axially through the inlet openings 35 (FIGURES 2, 10 and 11) and is supported by suitable antifriction bearings 38 carried by radially disposed spider supports 39 secured to the exterior of each wall 36. The shaft 27 is connected to the drive shaft 24 of the motor 23 by a suitable universal joint or coupling 40.

Keyed on the shaft 37 within the casing 30 is a double

impeller 41. This impeller 41 comprises identical pump sections 42 and 43 located on opposite sides of a centrally disposed, circular divider wall or plate 44. Each section 42 and 43 is provided with a set of radially directed blades 46, each having curved or angularly formed side edges 47 facing toward the associated inlet 35 and pitched so as to draw water inwardly through its associated inlet. Water is displaced by the blades of the impeller 41 through the volute passage 44*a* (FIGURE 11) into an upper manifold chamber 45 where the water changes direction for discharge rearwardly in a course generally parallel to the axis of the impeller. This manifold chamber 45 has a tapered jet-forming spout 48 extending rearwardly therefrom and terminating at an opening 49 formed in the transom 25 of the boat. The top of the pump casing may be provided with a removable cover plate 50 over the manifold chamber 45 to permit access to the chamber.

The spout 48 communicates with a transversely extending conduit 51 (FIGURES 3, 4 and 10) which is shown as being of substantially rectangular cross section, but which may be of other cross sectional shape. This conduit 51 is attached to the rear or outer surface of the transom 25 and extends in both directions laterally from the spout 48. Each lateral part of the conduit 51 preferably includes a downwardly and outwardly extending angular section 52 (FIGURE 2) and an outwardly extending horizontal section 53. Each section 53 terminates in a discharge nozzle 54 located adjacent one of the aft corners of the hull 20. The nozzles 54 open in a generally forward direction, but preferably do not extend directly forwardly, in order to preclude the entrance of substantial amounts of water thereinto when the boat is moving forwardly through the water. Within the rearwardly directed spout 48 I provide a jet deflecting vane or valve 55 which extends through the opening 49 and into the conduit 51. Directly opposite the opening 49, at the upstanding rear wall of the conduit 51, I provide a jet-reversing shutter or gate assembly 56.

The jet deflecting valve 55 is best shown in FIGURES 4 and 10, and comprises a plate or vane which is disposed in an upright position, being clamped within a vertical pivot shaft 60. The vane is so disposed relative to the shaft 60 as to provide a relatively long outwardly extending jet-directing section 61, and a relatively shorter inwardly extending balancing section 62. The vertically disposed shaft 60 is rotatably mounted in aligning bearings 60*a* and 60*b* carried by the upper and lower walls of the spout 48. The shaft 60 is arranged to be oscillated by means of a lever 62*a* which is keyed to the upper end of the shaft, and which is pivoted (FIGURE 3) to a rod 63. The rod 63 is pivotally connected to a bell crank plate 64 which is pivoted at 65 to the wall 28. A push-pull steering rod 66 is pivoted to the bell crank plate 64. Thus, by actuating the rod 66, the valve 55 may be oscillated about a vertical axis within the spout 48. The rod 66 may be connected to the steering wheel 67 of the boat by any suitable linkage means (not shown), so that when the wheel is turned to the right, for example, the valve 55 will be swung in a direction to deflect the stream of water being discharged from the spout 48 rightwardly at an angle with respect to the central axis of the opening 49. In other words, the valve 55 is operated similar to a rudder and when the wheel 67 is rotated clockwise, the valve is rotated counterclockwise and vice versa.

The action of the valve 55 is illustrated best diagrammatically in FIGURE 4 where the neutral or straight-ahead position is indicated in full lines at S, a left position is indicated in dotted lines at L, and a right position at R. It will be noted that the side walls 68 of the spout 48 taper inwardly from the manifold chamber 45 and toward the opening 49. With the valve 55 rotated clockwise to the position L, the greater portion of the stream of water passing through the spout 48 will be discharged through the passage created by the valve 55 and the left-hand side wall 68 and will be directed rearwardly to the left. The passage defined between the other side of the valve 55 and the right-hand side wall 68 is also directed generally leftwardly. Conversely, by turning the steering wheel in an opposite direction, the valve 55 will move to the position indicated at R and the stream or jet of water will be deflected generally rightwardly upon discharge from the spout 48. Although a steering wheel 67 is referred to above, it will be understood that steering may be accomplished by other suitable means, such as with a steering lever.

While the forwardly extending section 62 of the valve 55 has a smaller area than the section 61, the same, nevertheless, provides means for partially balancing the section 61 against the pressure of the stream of water, and will, therefore, reduce the force necessary to turn the shaft 60.

The jet-reversing shutter or gate assembly 56 is best shown in FIGURES 2, 3, 4, 5, 8 and 10. It comprises a pair of oppositely sliding gates 71 and 72 which are mounted for lateral sliding movement relative to an opening 70 in the rear wall of the conduit 51 which is located opposite the opening 49 for the spout 48. The gate opening 70 is preferably slightly wider than the opening 49. Each gate 71 or 72 has its upper and lower edges slidably mounted in transversely extending upper and lower guideways 73 which extend along the exterior surface of the conduit 51 above and below the opening 70. The guideways 73 are of sufficient length so that the gates 71 and 72 may move to a closed position, with their inner edges in contact, where the gates cover the opening 70, as shown in FIGURE 4, or to an open position where they completely expose the opening 70, as shown in FIGURE 5.

Suitable toggle linkage is provided for moving the slidable gates 71 and 72 simultaneously toward or away from each other. The linkage connected to each gate is identical with the linkage connected to the other gate and a description of one will suffice. Thus, each gate is provided with a pair of outwardly extending vertically spaced hinge lugs or ears 74 which are connected by a pivot pin 75 with a toggle plate 76. The plate 76 at its opposite edge carries a pair of vertically spaced pivot lugs 77. These lugs 77 receive a second pivot pin 78 which passes through a sleeve 79 formed on the outer end of a plate-like link 80. This link 80 is clamped within a split shaft 81 for rotation therewith. The lower end of the shaft 81 is rotatably mounted in a bearing 82 (FIGURES 6 and 9) carried by the lower guideway 73 and its upper end is mounted in a bearing and spacer 83 supported by the lower wall 91 of a rack and pinion housing 85. For preventing upward movement of the shaft 81, a collar 84 is provided below the bearing 82 and fixed to the shaft 81 by a set screw 84*a*. Thus, when the shafts 81 are turned 180° from the positions shown in FIGURE 4, the toggle linkage is folded outwardly to the positions shown in FIGURE 5 and the associated gates are pulled apart to expose the opening 70.

Suitable gear and rack mechanism is provided for oscillating both shafts 80 simultaneously to thus fully open or fully close the gates 71 and 72. The gate control gear and rack mechanism is best shown in FIGURES 6 and 7. This mechanism is disposed in a housing 85 which is shown in FIGURES 2, 3, 6, and 10. This housing is mounted on the conduit 51 directly above the location of the gate assembly 56 and extends transversely above the gate opening 70. The housing 85 is provided with a removable cover 86 to permit access to the gear and rack mechanism. This mechanism comprises a rack bar 87 which is mounted for longitudinal reciprocation in a pair of relatively spaced guide brackets 88. At its opposite ends and on opposite edges, the rack bar 87 is formed with rack gear segments 89. Each of the rack segments 89 meshes with an associated pinion or gear 90 which is

keyed on the upper end of one of the shafts **81**. It will be noted that the shaft **81** extends upwardly through the bottom wall **91** of the housing **85** in which it is rotatably mounted and that the brackets **88** are rigidly secured to this wall. Thus, it will be apparent that when the rack bar **87** is reciprocated, the gears **90** are rotated in opposite directions to rotate the shafts **81** in opposite directions and, consequently, to move the gates **71** and **72** toward or away from each other. The rack bar **87** is adapted to be reciprocated by means of bell crank lever **95** (FIGURE 3) which is pivoted at **96** to a support carried by the boat transom **25**. The outer end of the rack bar is connected to the bell crank **95** by a pin and slot connection **97**. The bell crank **95** may be oscillated about the fulcrum pivot **96** by means of a push-pull control rod **98** which is pivotally connected with the opposite end of the beli crank **95**, and which extends to a suitable position so that it can be conveniently operated by the operator of the boat.

From the above description, it will be apparent that to propel the boat in a forward direction with my unit the gate assembly **56** is completely opened to expose the jet discharge opening **70**. The pump is started to discharge a stream of water through the opening **49** of the spout **48** and the stream will then be discharged through the opening **70** to create a forward thrust on the boat. If it is desired to travel straight ahead, the valve **55** is set at the centered position S so that the stream of water will be discharged in a rearward path parallel to the center line of the boat. The thrust created by the stream or jet is governed by the speed of rotation of the impeller **41** which will be determined by the setting of a throttle control (not shown) for the engine **23**. If it is desired to turn the boat during forward movement thereof, the valve **55** is moved either leftwardly or rightwardly from its centered position to turn the boat to the left or right, respectively. Whenever it is desired to propel the boat rearwardly, the gates **71** and **72** are fully closed. Then, assuming the valve **55** to be centered, the jet stream will be divided equally by the valve **55** and diverted laterally outwardly through the opposite branches **52** of the conduit **51** and finally a pair of equal volume jets will be discharged from the nozzles **54** which are directed in a generally forward direction. With the valve **55** set in position S, the jet stream from the spout **48** will be divided equally into two jets of equal volume which will be directed from the opposed nozzles **54**. Consequently, the thrust forces created at the nozzles **54** will be equal and will reverse the boat along a straight course. If, during astern movement it is desired to steer either left or right, the valve **55** may be shifted by the steering wheel so as to divert a larger volume of the jet stream toward the discharge nozzle **54** disposed on the side of the boat opposite the desired direction of turn. Assuming that the valve **55** is shifted to the position L, the greater volume of fluid will then be discharged through the left branch of the conduit **51** (FIGURE 4) and issued from the nozzle **54** at the left. The reactive thrust set up thereby will be greater than the thrust set up by the jet issuing from the right hand nozzle **54** and will, therefore, swing the stern of the boat to the right. If the valve **55** is shifted toward the opposite position R, the stern of the boat will shift to the left in a similar manner. Thus, in reversing, the steering wheel **67** is normally turned in the opposite direction to that employed in steering ahead.

It will be apparent from the above description that I have provided an improved hydraulic jet propulsion unit for watercraft which includes means for creating and selectively directing a jet stream of water under pressure in one of several different directions so as to steer, as well as to propel an associated watercraft in both forward and rearward movement. For straight forward movement of the boat, the stream is discharged directly rearwardly of the boat through the open gate assembly **56**. To steer during the forward movement of the boat, the stream is diverted at a suitable angle with respect to the center line of the boat by shifting the control valve **55** either rightwardly or leftwardly. To reverse movement of the boat, the gate assembly is closed to divert the stream of water laterally into the reversing conduit **51**. With the control valve **55** centered, the stream or jet of water is divided into two equal volume streams and discharged with equal thrust from the two reversing nozzles **54**. With the gate assembly **56** closed, the valve **55** may be shifted in either direction from its centered position to divet a larger volume of the jet stream to one or the other of the reversing nozzles **54**, thus causing the boat to swing in the opposite direction.

The present hydraulic jet propulsion system can be built as a unit for ready attachment to standard makes of boats or other watercraft or vehicles without requiring extensive modification thereto.

According to the provisions of the patent statutes, the principles of this invention have been explained and have been illustrated and described in what is now considered to represent the best embodiment. However, it is to be understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

Having thus described my invention, what I claim is:

1. In a hydraulic jet propulsion system for a watercraft; means for displacing water under pressure including a main discharge nozzle for discharging the water under pressure in a jet stream in one direction; jet-directing means associated with said main discharge nozzle and operable to angle the direction of flow of the jet stream being discharged from said main nozzle either rightwardly or leftwardly relative to said one direction; a reversing conduit arranged directly behind and in surrounding relation to said main discharge nozzle and including two opposite, laterally and remotely extending branches each terminating in a reversing nozzle which opens in a direction generally opposite said one direction, said reversing conduit also including a jet-discharging opening disposed in axially spaced alignment with said main discharge nozzle; and gate means connected with said reversing conduit for sliding movement between positions opening and closing the jet-discharging opening of said reversing conduit, said gate means, when occupying a closed position, being operable to divert a jet stream of water discharged from said main discharge nozzle into the branches of said reversing conduit.

2. A hydraulic jet propulsion system as defined in claim 1, wherein said gate means comprises a pair of sliding gates carried by said reversing conduit and movable into and out of registry with the jet-discharging opening of said reversing conduit.

3. A hydraulic jet propulsion system as defined in claim 1, wherein said jet-directing means comprises a partially balanced vane-type valve pivotally mounted in said main discharge nozzle for lateral swinging movement therein.

4. A hydraulic jet propulsion unit mounted in a watercraft comprising a pump unit for taking in water and discharging it under pressure, a main nozzle through which the pump discharge is directed generally rearwardly of the watercraft for creating a jet stream, a deflector disposed in said nozzle and movable from a central position laterally in either direction, a conduit directly behind the nozzle and having portions extending transversely to the right and left of the craft and terminaitng in oppositely disposed reversing nozzles opening generally forwardly of the craft, said conduit having a main jet discharge opening arranged in axially spaced relation to said main nozzle and opening rearwardly of said watercraft, and manually operable gates slidably carried by said conduit and operable to open or close the main jet discharge opening of said conduit.

5. A hydraulic jet propulsion unit according to claim 4 in which the deflector is a vane disposed for lateral swinging movement about a vertical pivot axis in said main nozzle, said vane having a balancing portion forwardly

of said axis and a deflecting portion extending rearwardly of said axis, and manually operable control means for swinging said vane about its pivot axis.

6. A hydraulic jet propulsion unit according to claim 5 in which said deflecting portion extends rearwardly from the main nozzle into said conduit.

7. A hydraulic jet propulsion unit according to claim 6 in which said main nozzle has angularly disposed, rearwardly convergent side walls.

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