Nov. 18, 1969 A. R. FOX 3,478,712

INBOARD JET PROPULSION UNIT

Original Filed Sept. 24, 1962 4 Sheets-Sheet 1

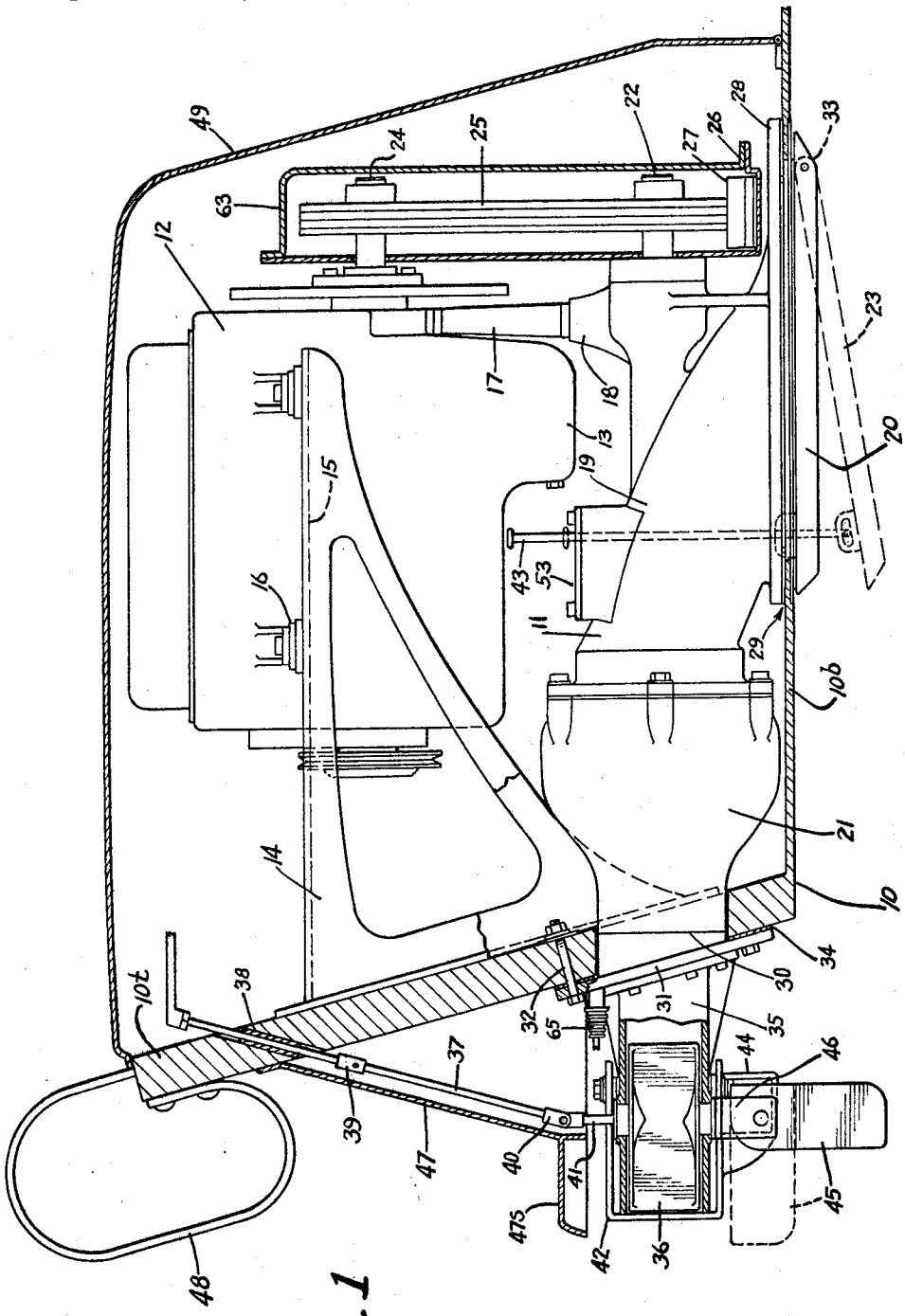


FIG. 1

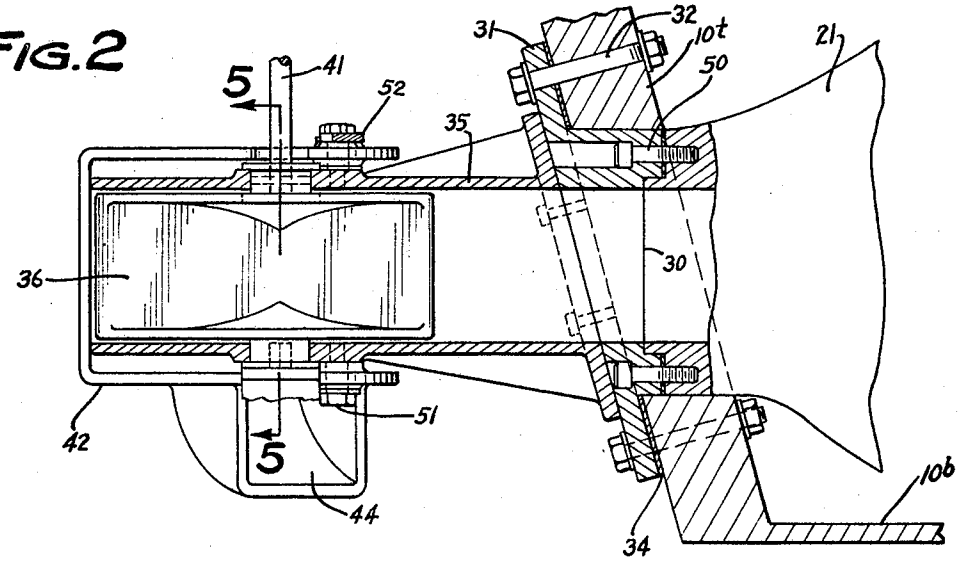
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FIG. 2



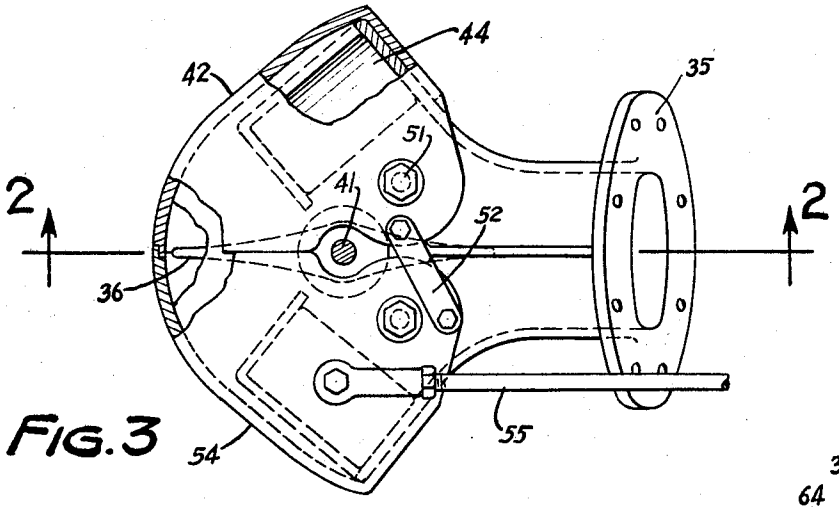


FIG. 3

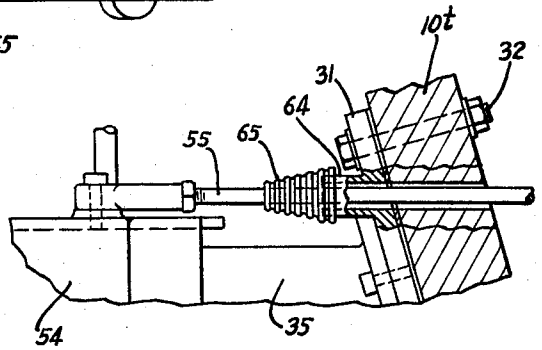


FIG. 6

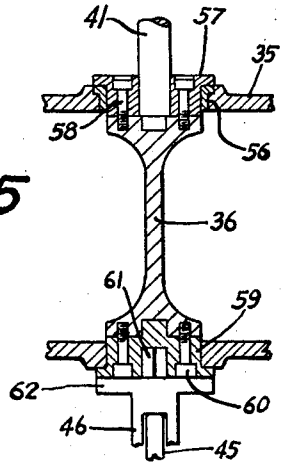


FIG. 5

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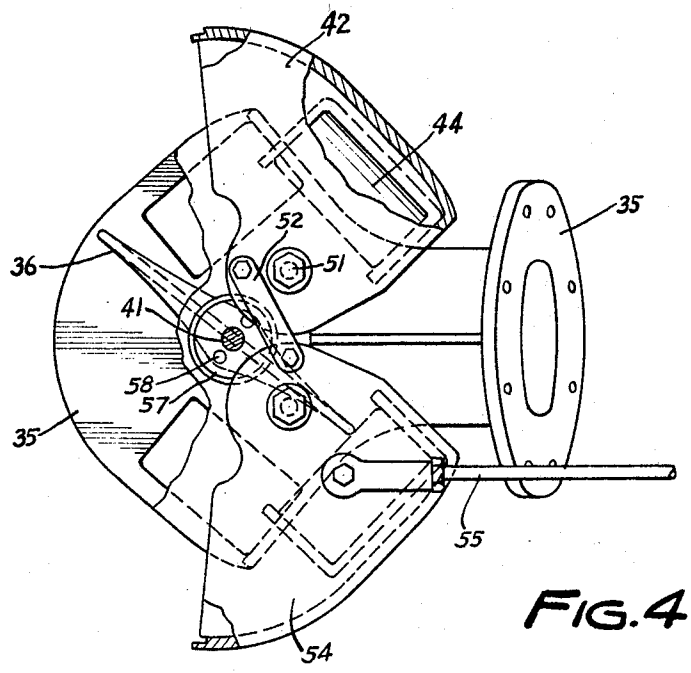


FIG. 4

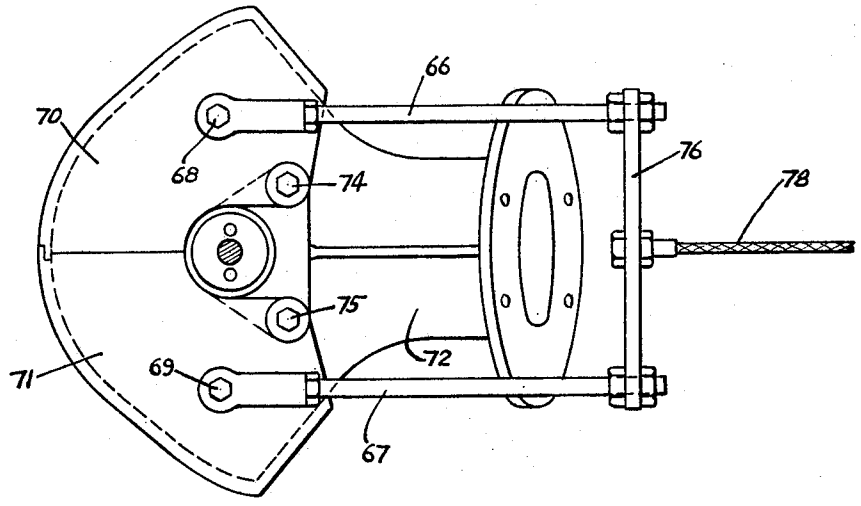


FIG. 7

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INBOARD JET PROPULSION UNIT

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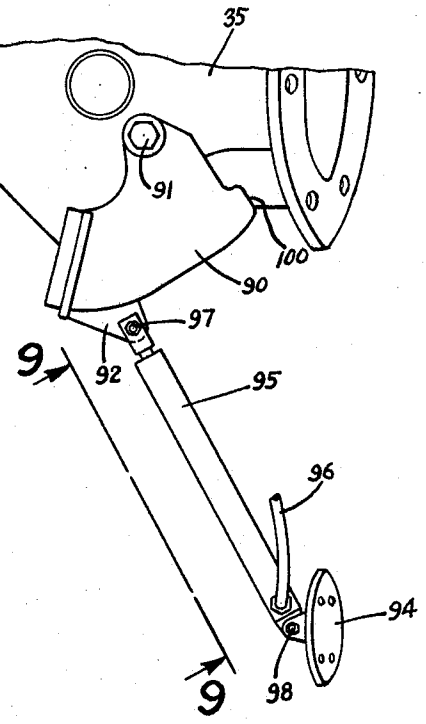


FIG. 8

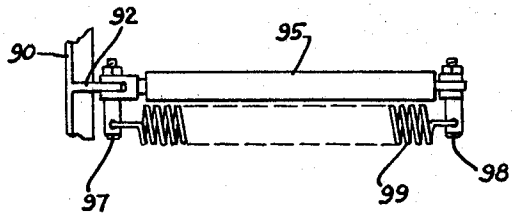


FIG. 9

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INBOARD JET PROPULSION UNIT

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Continuation of application Ser. No. 225,712, Sept. 24, 1962. This application Oct. 16, 1968, Ser. No. 768,967
Int. Cl. B63h *11/10, 25/42*
U.S. Cl. 115—12 10 Claims

ABSTRACT OF THE DISCLOSURE

A water craft propulsion system comprises an outlet nozzle formed generally in a fan shape as viewed from above with a jet-directing vane pivoted about a vertical axis within the fan-shaped nozzle at approximately its midpoint, the vane being directed by a control mechanism and direction being given to the jet with the aid of the vane and a door mechanism which is formed in two parts which are pivotally connected to the fan-shaped nozzle with ports formed in the door means at the bottom thereof so that when the door is closed, the jet is directed forwardly to produce a reverse flow of water and when the door mechanism is open, the vane directs the flow of water to control the direction of movement of the jet propulsion device.

This application is a continuation of application Ser. No. 225,712 filed Sept. 24, 1962, entitled "Inboard Jet Propulsion Unit," and now abandoned.

This invention is a novel jet propulsion unit for boats that is mounted inboard thereof with the exception of the directional nozzle. It is novel in part at least in having the driving engine for the jet propulsion unit mounted directly above it and supported by it in part and partially by the transom of the boat. The unit is also believed to be novel in its steering mechanism which includes an internal jet directing vane coupled with an external yielding rudder to provide directional control of the boat with which this unit is used under all power conditions. Specifically the rudder is pivoted to the same shaft which operates the directional vane in the jet nozzle so that the same controls actuate both the rudder and the jet directional nozzle under all conditions. The rudder is pivoted to the shaft, however, so that it will yield at high speed or upon striking an obstruction. The structure is also novel in having a pair of laterally moving doors which incorporate reversely directed openings so that the forward thrust of the propulsion unit may be changed into a reverse thrust by means of closing the doors and having the jet stream redirected in the opposite general direction. It is further novel in that the directional vane also operates with respect to the reversing doors so that a continuation of steering is obtained whether the reversing doors are open or closed. Included also in the structure is an access step into the rear of the boat which serves additionally to cover the propulsion unit as a splash deflecting shield. The unit is also novel in having the water intake unit extend downward to the bottom of the boat hull so that there is no point at the rear of the water access unit at which water can be driven between the plate of the water inlet and the interior of the hull.

Accordingly it is the principal object of this invention to provide a novel inboard jet propulsion unit.

It is a further object of this invention to provide a novel inboard jet propulsion unit incorporating an engine mount directly over the propulsion unit.

It is a further object of this invention to allow the propulsion unit to serve as a partial support for the driving engine.

It is a still further object of this invention to provide an inboard jet propulsion unit in which a major support for the engine is provided by brackets secured to the boat transom.

A still further object of this invention is to provide a jet propulsion unit having a directional vane pivoted on a vertical axis.

Yet another object of this invention is to provide a jet propulsion unit nozzle having swinging doors that close the jet propulsion nozzle in one direction and provide openings therefor in the opposite direction.

It is a further object of this invention to provide an inboard jet propulsion unit, the intake grille for which is easily cleaned.

It is yet another object of this invention to provide an inboard engine and jet propulsion unit that is very compact.

Still another object of this invention is to provide a jet propulsion inboard unit in which the seal between the water intake is especially resistant to water moving from front to rear past the unit.

Still another object of this invention is to provide a jet propulsion unit that incorporates steering mechanism operable at all speeds and directions of the jet drive.

Other and further objects of the invention are those inherent and apparent in the apparatus as described, pictured and claimed.

To the accomplishment of the foregoing and related ends, this invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principles of the invention may be employed.

The invention will be described with reference to the drawings in which corresponding numerals refer to the same parts and in which:

FIGURE 1 is a longitudinal section through a fragment of a boat with the inboard drive of this invention mounted therein, portions of the jet drive being broken away to illustrate the internal construction; broken lines illustrate hidden parts or adjusted positions thereof;

FIGURE 2 is a fragmentary enlargement of the propulsion unit showing greater detail of construction and the mounting means of the guide nozzle to the propulsion unit; hidden parts are shown with broken lines and portions of the structure are deleted for clarity in showing other portions; FIGURE 2 is taken on the line and in the direction of the arrows generally on the line 2—2 of FIGURE 3;

FIGURE 3 is a top plan view of the directional nozzle, portions broken away to illustrate construction and with broken lines illustrating hidden parts; it is drawn to the same scale as FIGURE 2;

FIGURE 4 is a view of the same structure as shown in FIGURE 3 taken in top plan but with the doors in open position for forward movement, portions of the device are broken away to illustrate construction fully and hidden parts are illustrated with broken lines;

FIGURE 5 is a fragmentary vertical section taken on the line and in the direction of the arrows 5—5 of FIGURE 2 but drawn to a substantially larger scale than that figure;

FIGURE 6 is a fragmentary view of reversing control rod as it passes through the boat transom with portions broken away to illustrate construction fully; it is drawn to the same scale as FIGURE 5;

FIGURE 7 is a view comparable to FIGURE 2 and drawn to that scale but showing a modified form of the reversing control mechanism;

FIGURE 8 is a fragmentary view in plan of the nozzle such as that shown in FIGURES 2, 3 and 4 but employing a modified form of control means; it is drawn to the same scale as those figures; and

FIGURE 9 is a fragmentary view of the power means and return spring mounted thereunder and taken on the line and in the direction of the arrows 9—9 of FIGURE 8.

Referring to the drawings and specifically first to FIGURE 1, the invention is seen mounted in a conventional boat hull **10** with its transom designated **10***t* and its hull bottom **10***b*. Just inside the hull at the rear center thereof, is shown the jet propulsion unit generally designated **11** and with the conventional engine **12** mounted directly above it. Unconventional is the engine oil pan which is arraged in such a manner that its deeper portion is over the thinner portion of the jet unit so that its reservoir portion **13** extends into the open portion above the jet unit intake thereby permitting the top of the engine to be practically on a level with the top of the transom **10***t* of boat **10**.

The principal support for the engine is provided by the brackets **14** which are secured to transom **10***t* in any suitable manner as by bolting. The brackets **14** are provided with the flanges **15** to which adaptors of various sorts may be secured as shown representationally at **16** so that engines of various types and sizes may be supported by the brackets. The engine also may be provided with a front mount as at **17** which is secured to a pedestal **18** that is part of the jet unit.

At **19** appears the intake for the jet unit having a grille with a stationary frame **20** surrounding the opening in the bottom of the boat hull **10***b* through which water may be drawn into the propulsion unit. The central portion of the grille, shown in broken lines at **23**, may be lowered below the grille frame **20**, as the grille is pivoted to frame **20** at **33** to allow it to swing down to the position shown in broken lines whenever the handle **43** is pushed to position shown in broken lines. When the grille is down, water flowing past it will cause weeds or the like trapped on the grille to be washed off. An inspection well **53** is provided at the top of intake **19** by which any material that gets into the intake and which tends to foul the impeller unit may be removed even while the boat is in the water.

The propulsion unit itself consists of a high volume water pump housed at **21** and driven by shaft **22**. Engine shaft **24** and shaft **22** are interconnected conventionally as shown representationally at **25**. An oil pan **26** and wiper **27** may be lightly engaged with the bottom of the driving mechanism. A suitable cover **63** encloses the drive connection **25** for both preventing fouling of the drive and random dispersion of drive lubricant.

The intake unit **19** has a flange **28** which is held tightly against grille frame **20**. Flange **28** also has a downwardly extending collar formed integrally therewith that extends through the bottom of the boat hull **10***b*. For this reason, water being thrust against the rear of the opening as the boat rushes through the water cannot penetrate between the boat hull and the flange as at **29** since the neck of flange **28** is flush with the bottom of the boat.

The jet being emitted from unit **21** is forced through nozzle exit **30** which terminates in a vertical plane. Since boats have transoms that vary in angle, an adapter plate **31** is provided which may be altered to fit transom conditions while the main jet unit may be constructed in one

standard pattern for all hulls. The adapter plate **31** is rigidly secured in the transom by any suitable means as by the bolts **32** and any suitable seal is placed at **34** to assure a water-tight joint at this point. The interconnection between adaptor plate **31** and jet nozzle **30** will be discussed in more detail in connection with FIGURE 2 below.

A directional nozzle structure **35** incorporates within it a vertically pivoted directional vane **36**. This vane **36** is connected to a suitable control shaft **37**. This shaft may be turned by any conventional boat directional controls and therefore is not continued beyond arriving at the interior of the boat. Insert **38** serves as a bearing for this shaft. The joint **39** makes it possible to disassemble the unit readily in case of repairs, etc. At **40** is shown a universal joint which connects the steering shaft **37** to the shaft **41** of vane **36** the precise structure of which will be discussed in connection with FIGURE 5 below. At **42** may be seen one of the two reversing directional doors having the reverse port **44** shown in fragment.

Below the nozzle structure **35** appears the yielding rudder unit **45** which as shown by the broken lines may pivot up to a point above the bottom **10***b* of the hull of the boat. Rudder **45** is secured to directional vane **36** as will be discussed in connection with FIGURE 5 below, and a pair of support plates, one of which appears at **46**, embrace either side of the rudder so that the directional control over it is retained in either position of pivoting. The purpose of having rudder **45** is to provide directional control over the boat when coasting with the jet nozzle not functioning. At very high speeds or in the case rudder **45** strikes an obstruction, the rudder will yield upwardly to the position shown in broken lines to offer minimum resistance and to avoid destruction in case of striking a rock or other obstruction.

As the reversing doors **42** close, there is sometimes thrown upward a spray of water if the jet unit is putting forth maximum power and for this reason a combination step and splash shield **47** is secured to the rear of the boat and covers the nozzle at the top. The step portion **47S** provides together with the rails **48** an easy access means into the boat.

The entire engine and jet propulsion unit assembly may be suitably covered as at **49** with a shell of any kind in order to allow it to serve as a combination arm rest and table arrangement between seats placed on either side of the propulsion unit and engine at the rear of the boat.

In FIGURE 2, the boat transom **10***t* is shown to have the adaptor plate **31** extending through it and joined to the propulsion unit flange **30** and propulsion unit **21** by any suitable means such as the cap screws **50** or the like. Jet unit **35** is secured to adaptor plate **31**. In FIGURE 2 also the pivot point **51** of door **42** is shown at the bottom while the link **52** may be seen in fragment which interconnects the two doors so that a single directional rod may actuate both doors simultaneously and symmetrically.

Turning now to FIGURE 3, the door **42** will be seen to be one of a mating pair, the other being **54**. Each has a reverse port like the one shown for door **42**. Link **52** is also seen clearly interconnecting the two doors and at **55** appears the reversing rod by means of which the doors **42** and **54** may be thrown open or closed. In FIGURE 5 the nature of vane **36** appears in that it is thickened and enlarged at both the top and the bottom in order to receive supporting structure. In that figure, housing **35** is seen to have an insert bearing as at **56** within which a thrust plate member **57** may rest in turn. Thrust plate **57** is rigidly secured to shaft **41** in any suitable manner not considered inventive and therefore not shown in detail. Cap screws **58** secure the thrust plate **57** to the top of the vane **36**. Thus, when shaft **41** is turned, the vane **36** is rotated in the same manner. A second thrust plate **59** and cap screws **60** secure the lower end of vane **36** in the housing, but in a manner that allows it to rotate freely

with rod 41. At 61 appears the square end shaft that connects to the rudder plates 46. This shaft has a flange associated with it as at 62 through which screws may extend into thrust plate 59 in misalignment with the screws 60 in order to hold the rudder plates on the lower end of directional vane 36. The square shaft 61 absorbs all of the turning thrust applied to the rudder and the cap screws which hold flange 62 to thrust plate 59 merely prevent the square shaft 61 from being dislodged.

In FIGURE 6 the control rod 55 is seen to extend through the bored boss 64 in the flange of adapter plate 31. It should be noted that there is substantial clearance between the rod 55 and the internal bore of boss 64 because as the doors pivot, this rod must necessarily move laterally slightly. The collapsing boot of conventional nature 65 makes a substantially water-tight seal between the end of boss 64 and shaft 55.

In FIGURE 4 the position of the doors 42 and 54 is shown when rod 55 is placed in the forward position. This time the fan-like exterior of nozzle 35 is wide open so that water may be thrust out through the opening at high speeds providing propulsion. In this view also, vane 36 has been turned to provide directional control for the boat. At this position of vane 36, almost the entire thrust of the jet is used in causing lateral motion of the rear end of the boat and it will practically spin on its axis.

In FIGURE 7 a structure very similar to the nozzle shown in the preceding six figures is illustrated except that it has a pair of rods 66 and 67 each of which is pivotally secured as at 68 and 69 to a pair of doors 70 and 71. The doors are pivoted to the housing 72 suitably as shown at 74 and 75. This structure is substantially identical to that shown in the previous figures, housing 72 being equivalent to housing 35 and so forth. The only difference resides in having a separate rod for opening and closing the doors 70 and 71 as compared to the single rod for opening and closing the doors 42 and 54. The two rods 66 and 67 may be yoked together as shown at 76 and a single control 78 will actuate them. As illustrated here, the control 78 is applied directly only for pulling the doors to an open position and yoke 76 may be driven in a reverse direction by spring tension or other means when cable 78 has pressure on it released.

In FIGURE 8, the directional nozzle structure is indicated by the number 35 as it is substantially identical to the direction nozzle illustrated earlier. Only one-half of the unit is shown, however, in order to illustrate one door, the other being merely a reverse duplicate. The door in FIGURE 8 is assigned the number 90, because it is modified somewhat from the structure as shown previously. The door is suitably pivoted at 91 to the directional nozzle 35 but is provided with an ear 92 which is used for the opening and closing mechanism.

An anchor member 94 is secured to the boat transom at a distance from the nozzle 35. Between the anchor 94 and the ear 92 of door 90 is an extensible and contractible motor 95. This is preferably an hydraulic unit and is connected conventionally as by the tube 96 to a source of fluid under pressure that can be controlled by the operator. Cylinder 95 is pivoted to ear 92 in a suitable manner as by the pin 97 and similarly to the anchor 94 by the pin 98. When pressure is directed to motor 95 through tube 96, the motor extends and closes door 90.

As shown in FIGURE 9, the pins 97 and 98 extend below the cylinder a substantial distance. Each is provided with a hole through which one end of the spring 99 is hooked. Whenever hydraulic pressure on line 96 is relieved, the spring 99 compresses the cylinder and forces fluid in a reverse direction back through the hose 96 thereby pulling the doors open as shown in FIGURE 8. Substantially identical structure is provided at the opposite side to operate the companion door to door 90.

Door 90 also varies from the door designated 54 as shown in FIGURE 3 in that it has a projection 100 at a point where it approaches the jet structure 35 which limits the amount of swinging open of door 90 that can be achieved.

A boat equipped with this unit is operated rather similarly to any other power boat with this exception. This inboard boat may be beached because substantially no working part rigidly extends below the hull thereof. In essence, then, one is provided with the advantages of an inboard boat but also incorporating the advantages of an outboard where the propeller and rudder may be tipped up to allow beaching. In addition, the compactness of having the engine and the thrust unit arranged one above the other provides a much more open and attractive boat hull than is otherwise possible. The doors and yielding rudder structure provide for control of the boat whenever it is moving through the water regardless of whether there is any thrust being provided by the jet unit or not. Also, the means for supporting the engine is flexible enough to allow many different engines to be adapted to the single jet unit. Also, of course, the jet unit is readily adaptable to boats having different transom angles requiring only that the adaptor plate and nozzle be modified to fit the particular structure in which the unit is to be mounted.

It is apparent that many modifications and variations of this invention as hereinbefore set forth may be made without departing from the spirit and scope thereof.

What is claimed is:

1. A water craft jet-propulsion directional device comprising:
   (a) an outlet nozzle formed generally fan-shaped in plan view having diverging side walls;
   (b) a jet-directing vane pivoted about a vertical axis within said fan-shaped nozzle at approximately its lateral center;
   (c) directional control means connected to said jet directing vane; and
   (d) door means pivotally connected to said outlet nozzle and having at least one port therein directed oppositely and downwardly to the output opening of said outlet nozzle when said door means is in closed position, said door means unobstructing flow through said outlet nozzle when said door means is in open position.

2. The structure of claim 1 including:
   (e) a splash shield disposed above said fan-shaped nozzle.

3. The door means of claim 1 comprising:
   (f) a plurality of oppositely disposed and horizontally pivoting doors that close said fan-shaped nozzle means from opposite sides.

4. The door means of claim 1 comprising:
   (g) at least two parts which are interlocked when said door means are closed.

5. The door means of claim 3 comprising:
   (h) interlocking portions of said doors that engage each other when said doors are closed.

6. The structure of claim 1 including:
   (i) rudder means yieldingly secured to said directional control means, said directional control means extending downwardly through said fan-shaped nozzle.

7. The structure of claim 6 in which said rudder is pivotally connected to said directional control means.

8. The structure of claim 1 including:
   (j) fluid passage means formed in the lower portion of said outlet nozzle, said door means having at least said one port communicating therewith to form a reverse flow mechanism.

9. The door means of claim 1 including:
   (k) a pair of substantially symmetrical door elements having at least one outlet nozzle in each of said door elements, said outlet nozzles oriented towards each other at an angle with respect to a longitudinal axis of said outlet nozzle.

10. The jet-directing vane of claim 1 wherein said vane is disposed in said fan-shaped nozzle substantially at the apex of a triangle formed by the leading edge of said vane

rotated to each of the inlet sides of said fan-shaped nozzle.

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U.S. Cl. X.R.

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