United States Patent

[11] 3,561,392

[72] Inventor **Guillermo Federico Baez**
759 Jujuy St., Buenos Aires, Argentina

[21] Appl. No. **769,289**
[22] Filed **Oct. 21, 1968**
[45] Patented **Feb. 9, 1971**
[32] Priority **Oct. 23, 1967**
[33] **Argentina**
[31] **210,440**

[54] **UNIT OF PROPULSION BY HYDRODYNAMIC REACTION**
1 Claim, 11 Drawing Figs.

[52] **U.S. Cl.** **115/12**
[51] **Int. Cl.** **B63h 11/10**
[50] **Field of Search** ..... 115/12, 14, 16 (Cursory)

[56] **References Cited**

UNITED STATES PATENTS

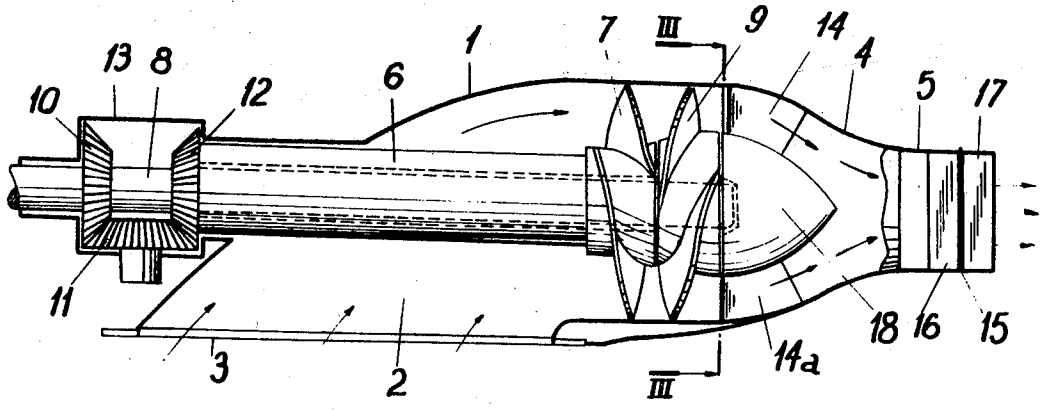
3,114,239 12/1963 Aylor 115/12X

FOREIGN PATENTS

741,570 8/1966 Canada 115/12

Primary Examiner—Milton Buchler
Assistant Examiner—G. O'Connor
Attorney—Browdy and Neimark

ABSTRACT: The improved unit of propulsion by hydrodynamic reaction consists of an integral turbine which has a pair of adjacent, counterrotating rotors, driven either by one motor through suitable gearings, or by two separate motors. The casing which encloses this counterrotating turbine ends in a nozzle. A conical or bullet shaped element provided with one or two baffles is housed in the casing between the second rotor and the nozzle and directs the jet towards the said nozzle which has movable sidewalls for regulating the outlet.



PATENTED FEB 9 1971

3,561,392

SHEET 1 OF 2

FIG. 1

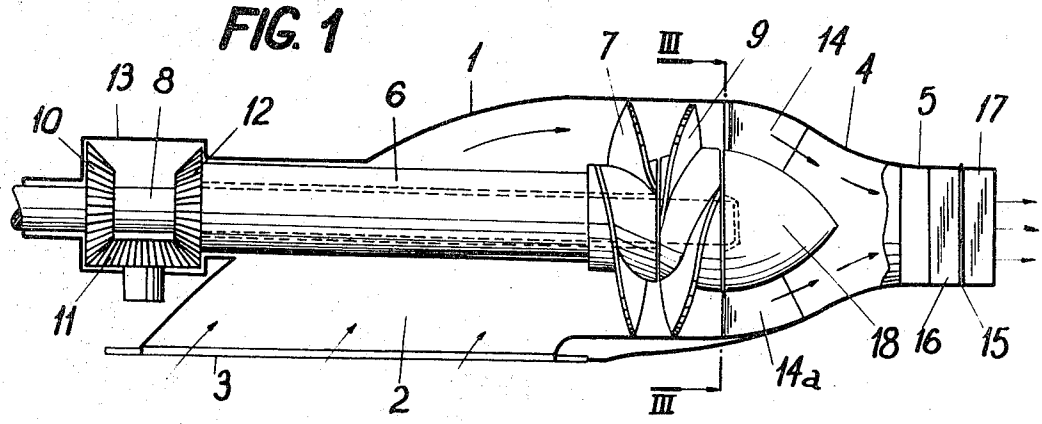


FIG. 2

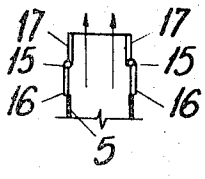


FIG. 2a

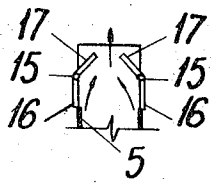


FIG. 2b

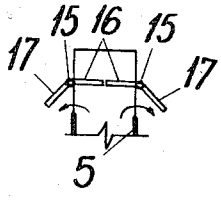


FIG. 2c

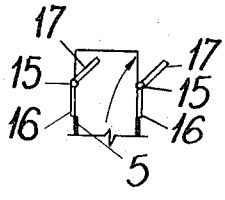
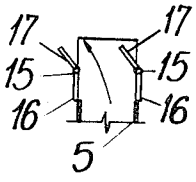


FIG. 2d



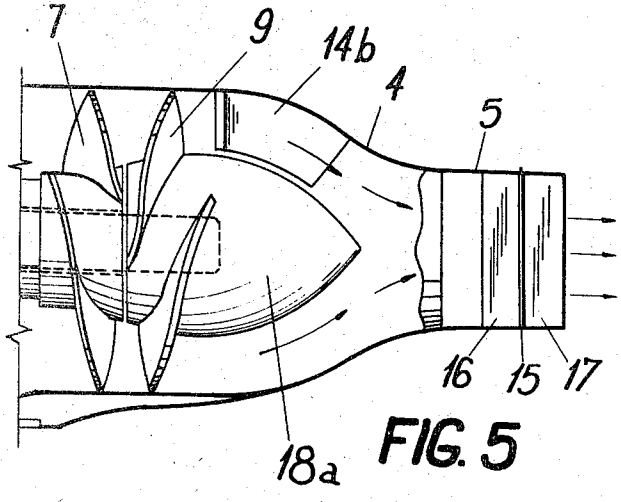


FIG. 5

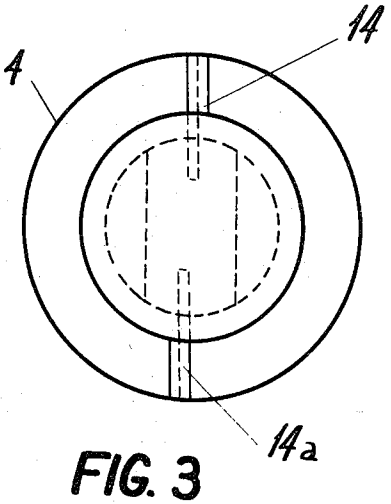
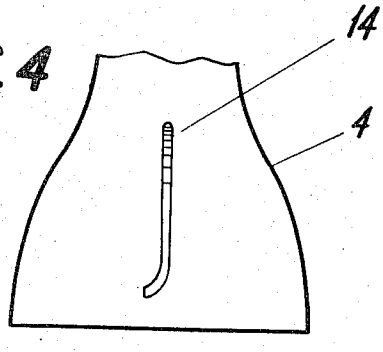


FIG. 3

FIG. 4



INVENTOR

Guillermo Federico Buz

BY Alvin Browdy

ATTORNEY

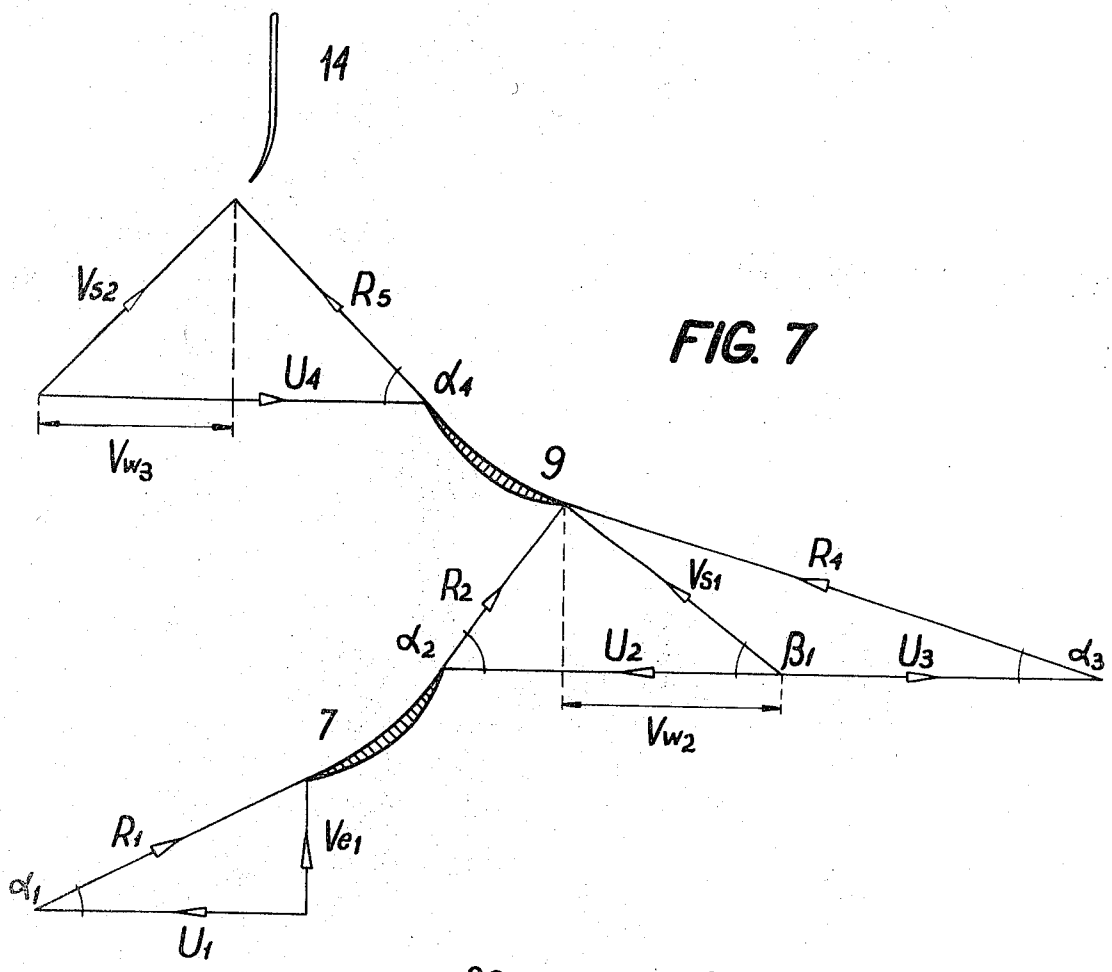


FIG. 7

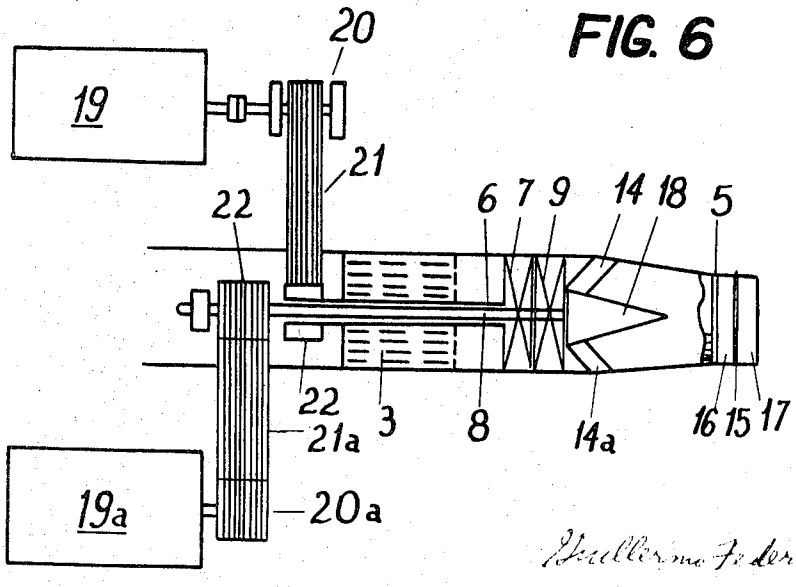


FIG. 6

INVENTOR

Wolfgang Federico Baez

BY Alvin Browdy

ATTORNEY

UNIT OF PROPULSION BY HYDRODYNAMIC REACTION

The present invention refers to an improved unit of propulsion by hydrodynamic reaction. The application of reaction to propulsion has been known and used for some years and this principle, which is commonly known as "Jet Propulsion," both in aircraft and in waterborne vessels, consists of exerting and forcing out a charge in the opposite direction to that in which it is desired to travel; said charge being a heated gas when used in aviation and water when used in a vessel.

The well-known method of propulsion by hydrodynamic reaction consists of an intake opening in or near the keel of the vessel, provided with a filter-screen, a horizontal shaft directly coupled to a motor passing through a substantially horizontal tubular casing connected to said intake opening, an outlet in the form of a nozzle provided with jet-regulating means, a plurality of turbine wheels or rotors provided with fixed blades attached to said shaft and a corresponding set of stationary wheels, or stators, similarly provided with fixed blades, duly interposed between said rotors, the whole series of rotors and stators ending with a stator so as to transform the resulting helicoidal current into an axial current that is ejected from the nozzle and moves the craft.

The above description of a unit is merely given as an example and can be modified in different ways and parts to increase output or efficiency, facilitate maneuvering, etc.

The present invention, based upon the method described above, introduces the principle of counterrotation between turbine wheels, whereby a substantially improved unit of hydraulic propulsion is obtained and the vessel becomes more readily maneuverable; the novel unit of propulsion by reaction also having an improved outlet nozzle.

DESCRIPTION

When compared with the known jet propulsion units consisting of a series of rotors and stators the last of which is a stator, the improved unit of the present invention presents the following advantages:

1. Immediate production of high pressure, due to counterrotation, allowing of high speed starting.
2. Improved hydrodynamic efficiency, due to the reduction of friction surfaces and fewer changes in the direction of flow.
3. Better equilibrium due to the torsion-coupling of counterrotation.
4. Reduction in volume of the propulsion unit. This reduction can be as much as 50 percent without modification of the power unit or loss of efficiency.
5. Potential production of super pressure in cases of emergency.

When applied exclusively to marine and river vessels the improved unit presents certain inherent advantages derived from reaction propulsion, namely:

1. Navigation in shallow waters.
2. Navigation in muddy or weedy waters.
3. Elimination of many causes of breakdown.

A special advantage of the improved unit is in its more efficient yield of motor power due to the elimination of cavitation in the interior of the same, such as often occurs in conventional turbines at high speed, when this cavitation unavoidably reduces the efficiency of the plant.

Compared with multistep, hydrodynamic turbine pumps consisting of alternately disposed rotors and stators, the improved unit of the present invention is of much simpler construction and therefor enjoys a far more unlikely retention of foreign matter that could penetrate into the propulsion cavity, as occurs frequently in the case of units with several stages of rotors and stators, or fixed-flow directing blades.

One preferred embodiment of the improved unit of hydrodynamic propulsion by reaction is characterized in that the integral turbine of this unit consists of a pair of coaxial adjacent, counterrotating rotors, mounted upon coaxial shafts, the inner of which shafts carries one of said rotors fixed to same, while the other rotor is fixed upon the outer shaft, which outer shaft is operatively coupled to the motor through the inner shaft and by a suitable reverse rotating gear; the interior of the casing enclosing said rotors being provided with a pair of fixed, directing baffles, disposed diametrically opposite each other and extending longitudinally within the tubular outlet end of the casing which ends in a nozzle provided with movable sidewalls that can be regulated.

In another embodiment the two rotors are coupled to two separate, counterrotating engines, such as are used in many screw-driven river boats, which may thus be transformed into turbine-propelled crafts with a minimum of modifications.

IN THE DRAWINGS

FIG. 1 shows a longitudinal section of the propulsion unit in position for advance at full throttle.

FIGS. 2, 2*a*, 2*b*, 2*c* and 2*d* show various positions in plan of the regulating means in the unit that offer the different maneuvering possibilities.

FIG. 3 is a transverse section of the propulsion unit through line III–III in FIG. 1 to indicate the position of the current aligning baffles.

FIG. 4 is a view in plan of one of the aligning baffles illustrated in FIG. 3.

FIG. 5 is a modified embodiment of the unit illustrated in FIG. 1.

FIG. 6 is a schematic longitudinal section of a propulsion unit powered by two separate, counterrotating engines.

FIG. 7 is a diagram showing the average theoretical vectorial values of the counterrotation applied in the improved propulsion unit.

The propulsion unit consists of a casing 1 of substantially horizontal channel shape having an enlarged, downwardly inclined end terminating in an inlet opening 2, in the keel of the craft, protected by a screen to prevent the entry of foreign matter. The other end 4 of said casing 1 is reduced truncoconically and finishes in a nozzle 5 of prismatic shape and preferably of rectangular cross section. The casing 1 is provided with a tubular, longitudinal shaft 6 that carries one rotor or set of turbine blades 7, and a solid shaft 8 that passes coaxially through the said tubular shaft 6 and extends beyond both ends of same. At one end, adjacent the rotor 7, the interior shaft 8 carries a rotor 9 the blades of which are preferably inclined in the opposite direction to that of the blades of the rotor 7 on the outer, tubular shaft 6. At the other end said interior shaft 8 is coupled to a motor (not shown in the drawings). The outer, tubular shaft 6 is coupled to the motor through the inner shaft 8 by means of a planetary reversing gear in which the gear wheel 10 engages gear wheel 12 through a pinion 11, said gear wheel 12 being fixedly disposed upon the tubular, outer shaft 6, whereby the inner shaft 8 receives approximately two thirds of the motor power and the outer, tubular shaft 6 receives approximately one third of said power during their respectively contrary revolutions.

The inlets of shafts 6 and 8 on the casing 1 are provided with adequate glands to prevent the entry of water and the portion of the casing 13 that encloses the gear-wheels 10, 11 and 12 is disposed at a suitable distance from the main body of said casing 1. These glands are not shown in the drawings, being of any suitable type and the portion 13 of the casing is not the only form in which the gear-wheels can be enclosed, neither do these gear-wheels indicate the only manner in which counterrotation could be applied to the rotors.

The truncoconic reduction 4 of the casing 1 that forms the outlet for the turbulent liquid is provided internally with a pair of diametrically opposed baffles 14, 14*a*, that extend longitudinally within the unit. As can be seen in FIG. 4 these fixed blades or baffles 14, 14*a* consist respectively of flat plates having curved ends where adjacent to the rotor 9, said curves being in the direction of aligned current flow and therefore being curved in opposite directions. These fixed baffles 14, 14*a* therefore serve to align the flow of water that emerges

with tangential movement at high pressure from the second rotor **9**, as the curved ends tend to reduce the impact and help to avoid any sharp change in direction of the current which thus suffers a minimum loss of power on being changed from giratory to axial flow

Inside the truncoconic reduction **4** of the casing a conic or bullet-shaped element **18** is disposed so as to prevent the turbulence of the flow of water which streams out of the second rotor **9**. This element **18** thus cooperates with the baffles **14**, **14***a*, and can be independent of the adjacent rotor **9**, as in FIG **1**, in which case it is stationary and fixed to the casing **4** by means of the baffles **14**, **14***a*, or it can be fixed to the rotor **9** or form part of its body, as in FIG. **5**, in which case only one baffle **14***b* is necessary and sufficient space must be left between the bullet-shaped element **18***a* which forms part of the rotor **9** and thus rotates, and the said baffle **14***b* which is stationary.

The prismatic outlet nozzle **5** receives the current of water thus aligned and this current is ejected from said nozzle as shown by arrows. The embodiment of the propulsion unit as described so far would require the addition of a rudder and other elements for changing the direction and the speed of the craft. According to this invention, however, the prismatic nozzle **5** has sidewalls formed by hinged plates that allow of changes in velocity and direction of the jet and thereby serve as rudder and movement astern. One of said sidewalls of the nozzle **5** can be seen in FIGS. **1** and **5** and the opposite sidewalls is identical. Each of these sidewalls consists of a vertical hinge-rod **15** upon which the two halves **16**, **17** of the wall articulate. These half-walls **16**, **17** can be moved independently of each other and the halves of one sidewall are independently movable with respect to the halves that form the opposite side of the nozzle **5**.

When both halves **16**, **17** of both sidewalls are aligned as illustrated in FIGS. **1** and **2** the jet is at full force, as the outlet is then open to the maximum extent. This position, therefore, corresponds to cruising speed and straight ahead steering. When the outer edges of the outer halves **17** are moved towards each other, as shown in FIG. **2***a*, the outlet area is reduced, thus reducing the size of the jet, while increasing the velocity of flow by the consequent increase of pressure and thus raising the forward speed of he craft. FIG. **2***b* shows the position to which the two inner halves **16** can be moved to close the main outlet area, whereby side outlets controlled by the outer halves **17** are opened. This position **2***b* of the sidewalls produces a current that is contrary to the forward movement of the vessel, which then proceeds astern. FIGS. **2***c* and **2***d* show different positions of the outer halves **17**, whereby the craft can be steered to port or starboard. In the case of large vessels this method of steering can be assisted by means of the conventional mechanical rudder. The gear for manipulating said side-walls **16**, **17** of the nozzle is not shown, as this can be of any suitable type that brings this control within reach of the steersman. This can, therefore, be brought to end on an instrument panel that also carries the motor controlling means and indicating dials.

In the case of screw driven boats provided with two independent motors, as happens in some larger river boats, the same can be converted to turbine power by making use of the said two motors **19**, **19***a*, as shown schematically in FIG. **6**. No planetary gearing is required since the impulse is given independently through pulley **20**, belt **21** and pulley **22** from motor **19** to shaft **6** and through pulley **20***a*, belt **21***a* and pulley **22***a* from engine **19***a* to shaft **8**.

FIG. **7** is a theoretical representation of the average vectorial values of counterrotation in a propulsion unit according to the present invention. For the sake of clarity only two obliquely disposed blades are shown and an ideal laminar current is assumed, without dynamic losses due to turbulence or friction and without volumetric losses due to the ideal absence of cavitation while assuming the blades to be infinitely thin.

In the case of blade **7** we have the following values:

U_1—Average tangential velocity at entry.

Ve_1—Axial velocity at entry of fluid.

R_1—Relative velocity of fluid in respect to the blade.

U_2—Tangential velocity at outlet

R_2—Relative velocity of fluid at pressure outlet (angle α_2).

Vs_1—Absolute velocity of the fluid at outlet

In the case of the second rotor, or blade **9**, there are the following values:

U_3—Average tangential velocity of counterrotation. The relation between Vs_1 and U_3 determines the relative velocity R_4 and therefore indicates the inclination of the blades that corresponds to the counterrotation of the second rotor blade **9** resulting in angle α_3.

U_4—Average tangential velocity at outlet.

R_5—Relative velocity of fluid at pressure outlet in respect to angle α_4.

Vs_2—Absolute velocity of the fluid at the outlet. The theoretical exit-pressure of the first rotor is given hydrodynamically by the formula

$$H=\frac{U_2\times Vw_2}{G}$$

Where H—Exit pressure,

U_2—Average tangential velocity at outlet,

Vw_2—Tangential velocity of rotation,

G—Gravity.

The consequence of counterrotation first becomes apparent in the second rotor blade **9** on comparing the absolute velocity Vs_1 of the fluid when this blade **9** is mounted on the rotor at an angle β_1 and not axially as the first rotor blade **7**. These functional conditions create a tangential velocity of rotation or transformation of kinetic energy as follows;

$$Vw_4=Vw_2+Vw_3$$

the values of which can be found from the graph of FIG. **7**. By the application of this formula a unit of hydrodynamic propulsion can be constructed that has greater efficiency than that of any of the hydrodynamic propulsion units known in the art.

While certain preferred embodiments of the present invention have been illustrated and described herein, it is to be understood that the invention is not limited thereby, but is susceptible of changes in form and detail within the scope of the appended claims.

I claim:

1. A hydrodynamic-reaction propulsion unit comprising:

A casing for attachment along the keel of a vessel, said casing including an upstream fluid inlet and a downstream fluid outlet nozzle;

means to provide counterrotation within said casing and to eliminate cavitation therewithin comprising turbine rotor means in said casing between said inlet and outlet for generating fluid pressure in the casing to be emitted from said outlet nozzle, said turbine rotor means comprising two coaxial adjacent, counterrotating rotors, each said rotor carrying a plurality of blades, the blades of one rotor having a reversed helical pitch relative to the blades of the other rotor;

power means operatively connected to said coaxial adjacent rotors for rotating each said rotor in an opposite direction to each other and about a longitudinal axis extending generally along the keel to which said casing is attached;

means to regulate and maneuver operatively connected to said casing in relation to said outlet nozzle for controlling fluid pressure emission relative to the axis of said turbine rotor means comprising opposed sidewall portions of said outlet nozzle, said opposed sidewall portions comprising plates hinged intermediately of said sidewalls and including upstream and downstream portions positionable into or out of said outlet nozzle; and

at least one internal baffle means downstream from said two coaxial adjacent turbine rotors, said internal baffle means extending longitudinally.