

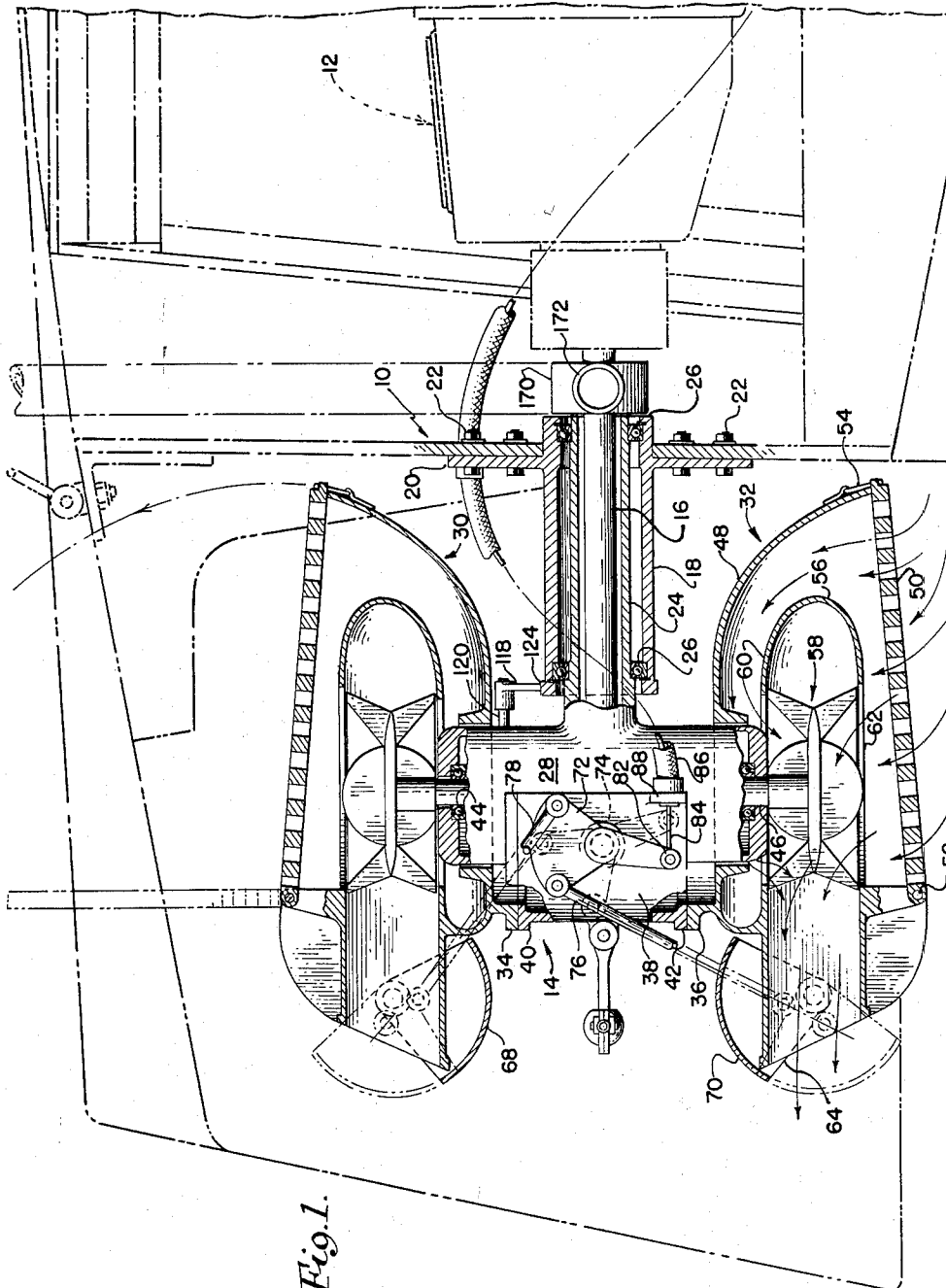
Nov. 19, 1963

J. C. TROTTER
PROPULSION UNIT

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7 Sheets-Sheet 1



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7 Sheets-Sheet 2

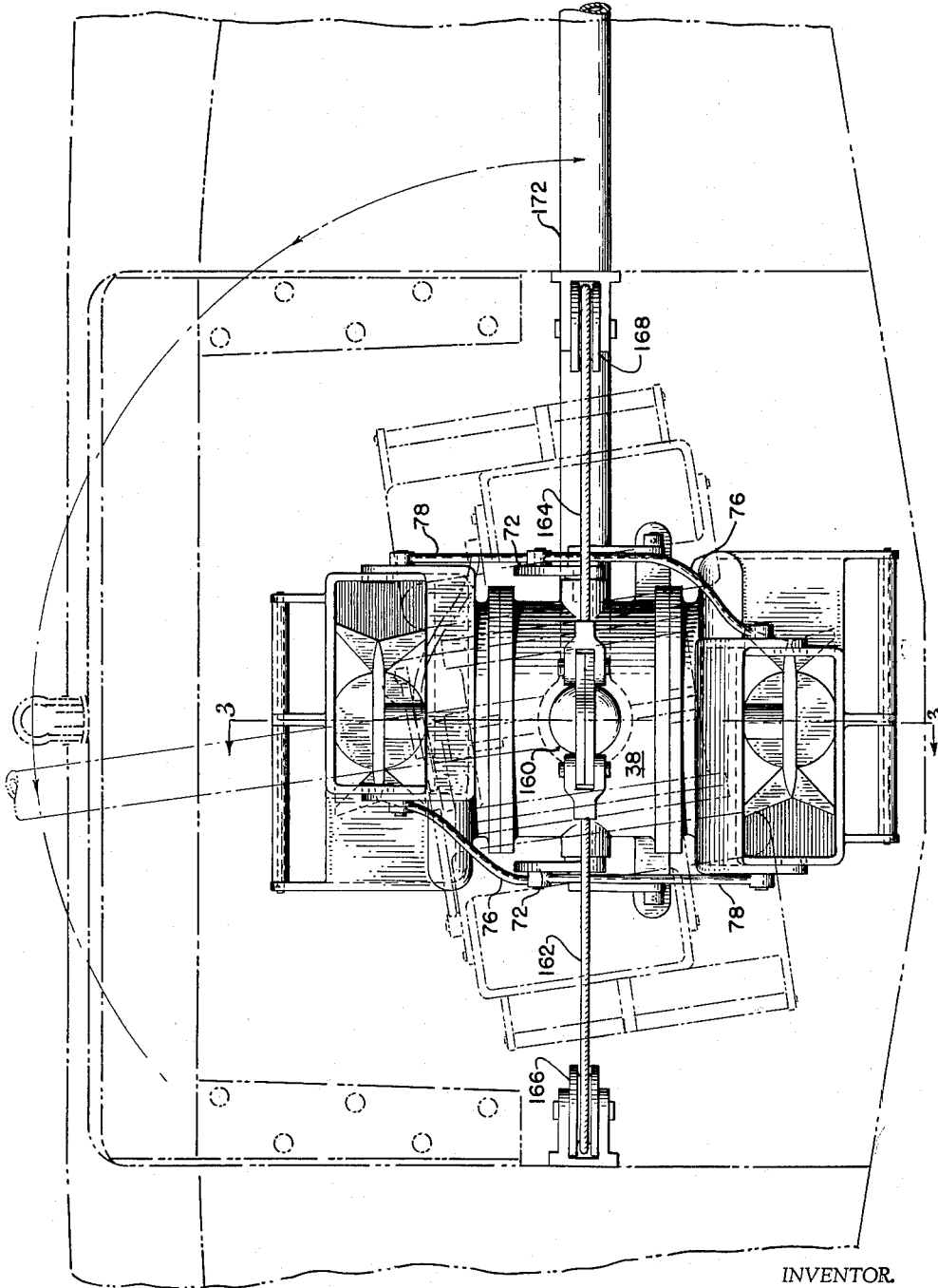


Fig. 2.

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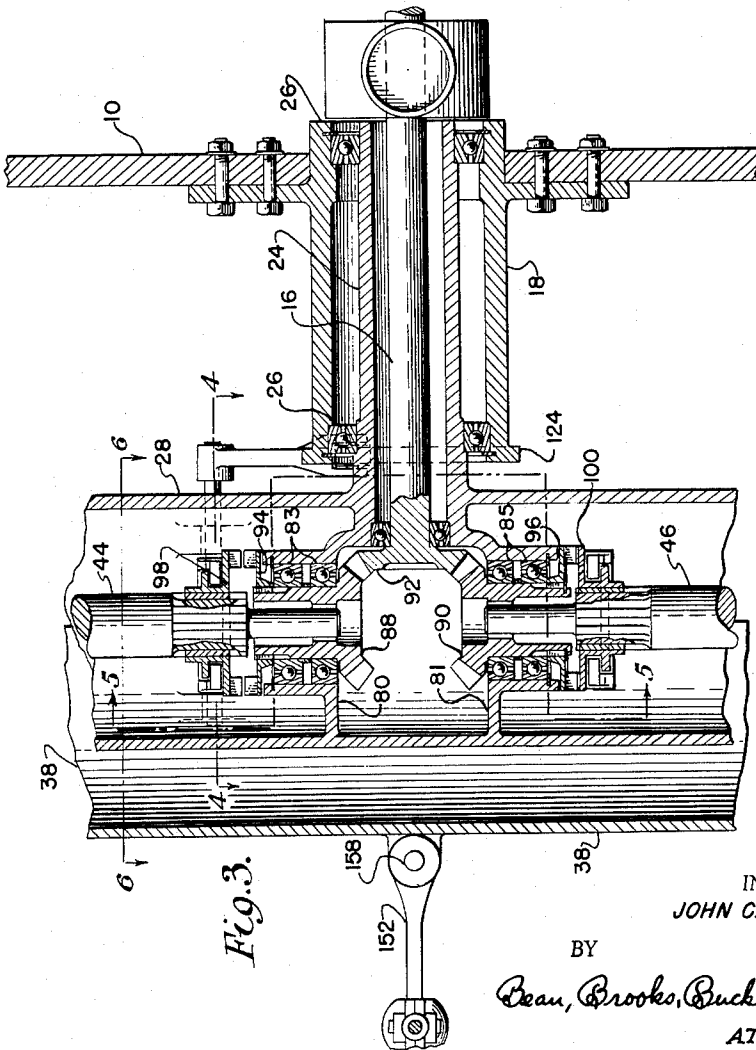
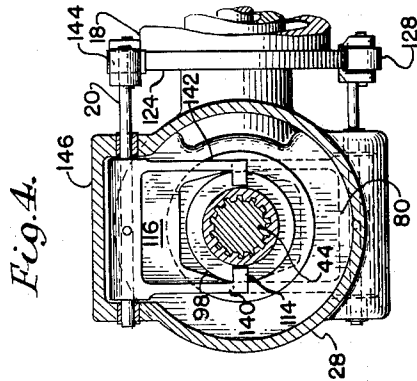
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7 Sheets-Sheet 3



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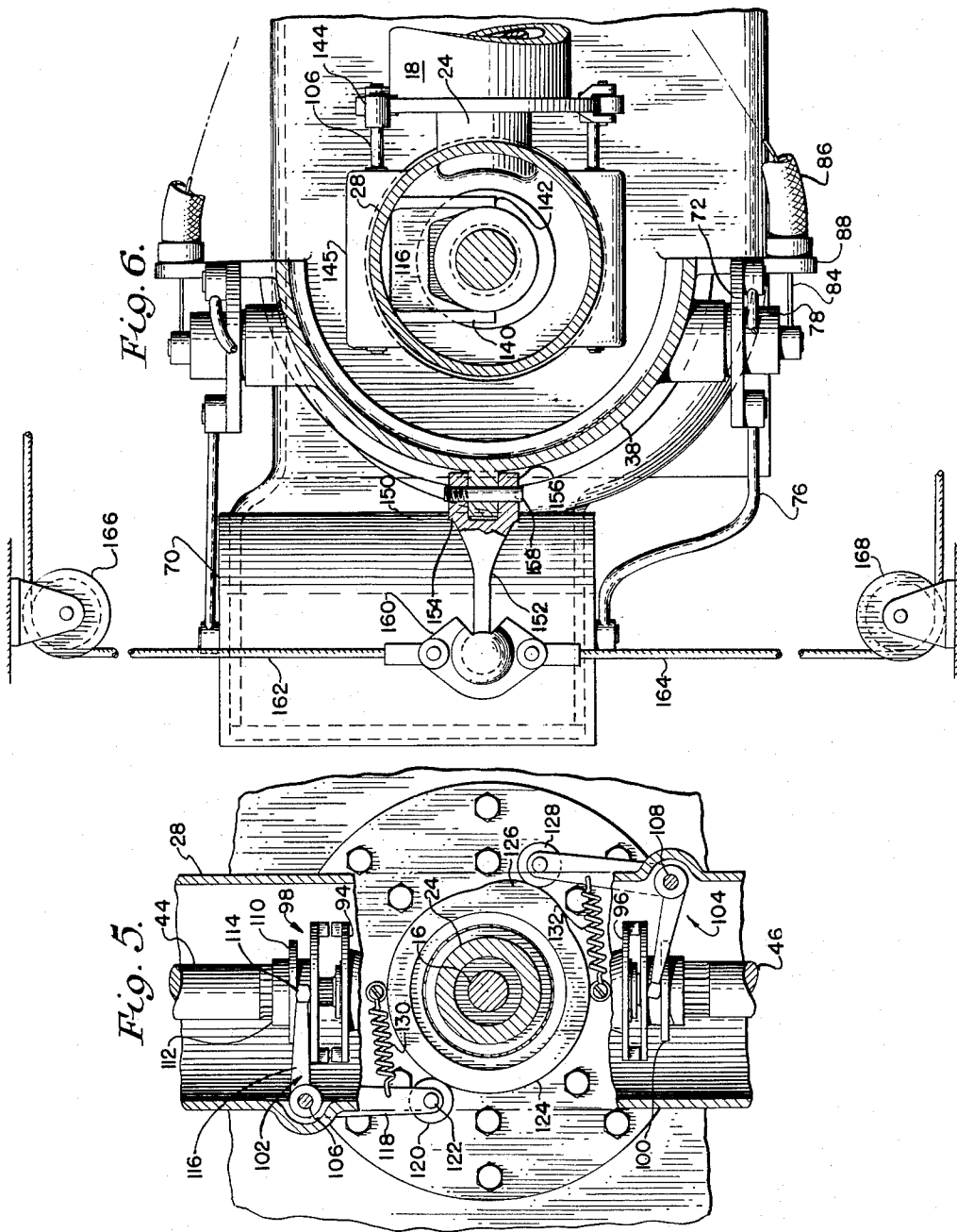
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7 Sheets-Sheet 4



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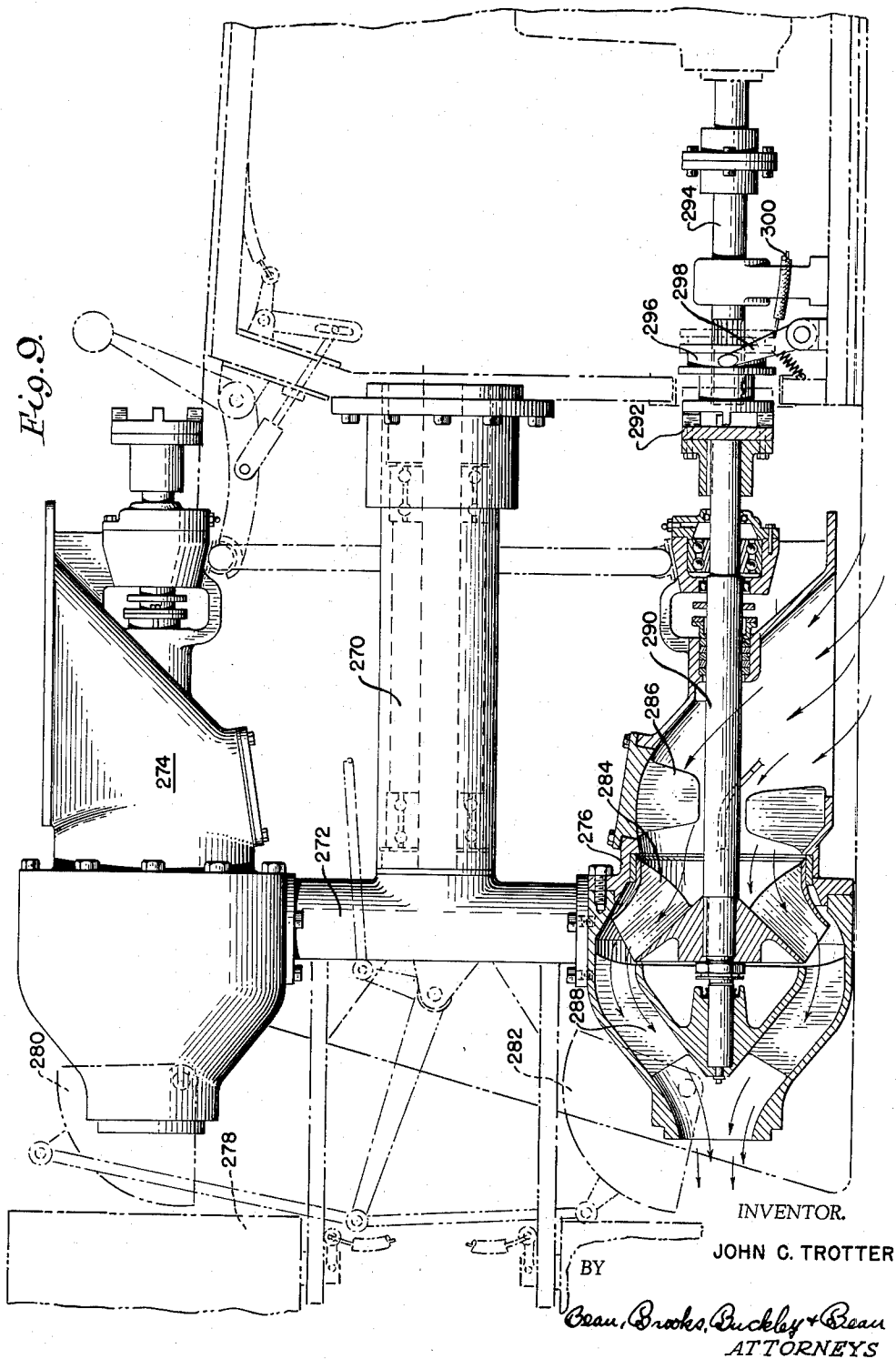
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7 Sheets-Sheet 6



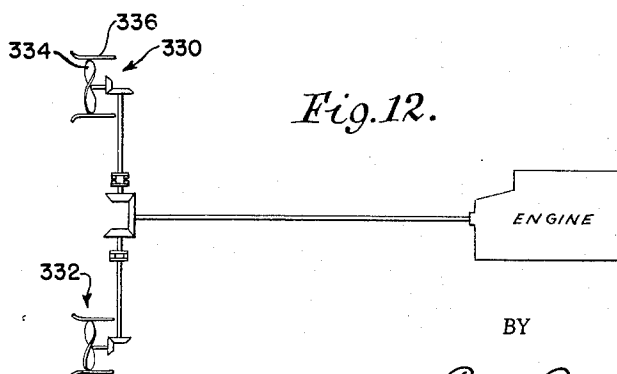
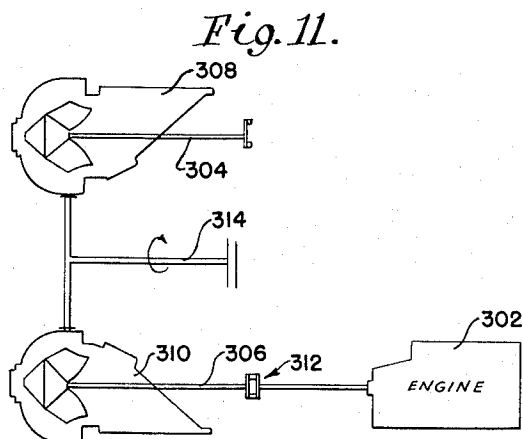
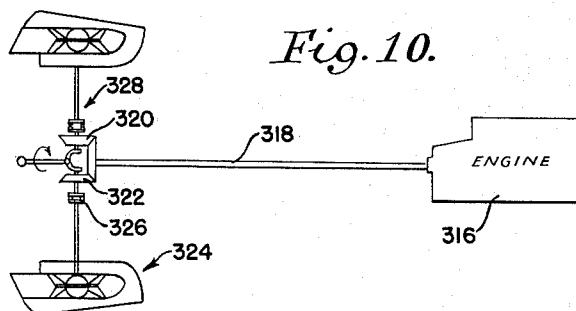
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7 Sheets-Sheet 7



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1

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PROPULSION UNIT

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6 Claims. (Cl. 115-14)

This invention relates to propulsion means for aquatic vehicles and in particular relates to such a propulsion means characterized by the provision of a plurality of propelling devices alternately usable so as to positively assure the availability of an operative propelling device at all times.

Specifically, the present invention is directed to a mechanism adapted to positively assure the availability of propelling means for an aquatic vehicle and the invention therefore can be employed wherever such problem is of paramount importance. However, such requirement is particularly critical in relation to landing craft utilized for military purposes. In connection with such craft, it will be appreciated that the assurance of operative propelling means at all times is of paramount importance and to this end, it is a primary objective of the present invention to provide such a mechanism as will assure that the craft will at all times have available a propulsion unit which is operative and which will produce the requisite and theoretical power required for proper operation of the craft.

More particularly, the present invention has for its main objective the provision of a propulsion unit for military landing craft in which at least a pair of propelling means are employed, the two propelling means being alternately usable and operating as an integral unit, the structure characteristically providing for the operative disposition of one of the propelling means while positioning the other of the propelling means in such disposition and position as will permit ready access thereto by occupants of the craft so that repairs, cleaning and the like may be performed on the inoperative unit to ready it for instantaneous disposition into the operative position if circumstances so require.

Another object of this invention is to provide an improved propulsion unit of a character described wherein in association with a common prime mover, a pair of propulsion units are provided, the two such units being connected for common rotation about the mounting axis therefor so that one of the units is operatively disposed under water for propelling purposes, the other is elevated above the surface of the water and is presented in such position as to be readily accessible to occupants of the craft with which the assembly is associated so that the exposed unit may be cleaned, repaired or the like.

Further, it is an objective of the present invention to provide in association with the assembly as above described, clutch means automatically engageable when the operatively disposed unit is in position to connect such operatively disposed unit to the power supply while the other unit is disconnected from the power supply.

Another object of this invention in relation to a specific embodiment thereof is to provide a dual propulsion unit as above described wherein the propulsion units operate on the principle of expelling a high velocity, high pressure stream or jet of water for propulsion purposes, the two units being provided with screened or grated intakes so positioned and disposed that when a unit is placed in the inoperative position, such screen will be readily accessible to an occupant of the craft for cleaning purposes, the grate or screen also being movably mounted on the body of the propulsion unit so as to admit of ready access to the interior thereof.

Other objects and advantages of the invention will

2

appear from the description hereinbelow and the accompanying drawings wherein:

FIG. 1 is a vertical section taken through one form of the present invention showing various details of internal construction thereof;

FIG. 2 is a rear elevational view of the assembly shown in FIG. 1;

FIG. 3 is an enlarged vertical section taken substantially along the plane of section line 3-3 in FIG. 2 illustrating details of the drive and clutch mechanism to show one form which the same may take;

FIG. 4 is a horizontal section taken substantially along the plane of section line 4-4 in FIG. 3 showing further details of the clutch mechanism;

FIG. 5 is a vertical section taken substantially along the plane of section line 5-5 in FIG. 3 showing still further details of the clutch mechanism;

FIG. 6 is a horizontal section taken substantially along the plane of section line 6-6 in FIG. 3 showing details of the control mechanism for the propulsion assembly;

FIG. 7 is a side elevational view partly in section illustrating a modified form of the invention;

FIG. 8 is a rear elevational view of the assembly shown in FIG. 7;

FIG. 9 is a view similar to FIGS. 1 and 7 but showing a still further modified form of the invention;

FIG. 10 is a diagrammatic view showing the relationship of parts in association with forms of the invention as are shown in FIGS. 1 and 7;

FIG. 11 is a view similar to FIG. 10 but showing the association of parts in the form of the invention shown in FIG. 9; and

FIG. 12 is a view similar to FIGS. 10 and 11 but showing a further modification of the present invention.

Referring now more particularly to FIG. 1, the reference numeral 10 indicates in general a transom of an aquatic vehicle which in the specific embodiment shown serves as the main supporting portion of the craft to which the present invention is attached. The aquatic vehicle or the like is shown mainly in phantom lines in FIG. 1 since it forms no part of the present invention. However, the aquatic vehicle carries some sort of prime mover mechanism indicated generally by the reference character 12 which supplies power for the propulsion assembly indicated generally by the reference character 14. For this purpose, the drive shaft 16 is provided which extends from the prime mover 12 for connection, as hereinafter more particularly pointed out, to the assembly 14 for driving the same.

For mounting purposes, a rigid sleeve 18 is provided, the same having a suitable flange or the like 20 thereon which is secured directly to the transom 10 by means of suitable fasteners such as those indicated by reference character 22. The sleeve 18 mounts a hollow shaft member 24 by means of suitable bearings 26 and the drive shaft 16 projects concentrically through the hollow shaft 24, substantially as is shown.

The hollow shaft extension 24 which is journaled in the sleeve 18 is rigidly formed with a hollow head member 28 which is provided at its opposite ends which project laterally from the shaft extension 24 with propulsion units indicated generally by reference characters 30 and 32. The two propulsion units 30 and 32 are provided with attachment flange portions 34 and 36 which are interconnected by means of a semicircular connector plate 38, the same being provided with flange portions 40 and 42 corresponding and engaging with the flange portions 34 and 36 and fixedly secured thereto by any suitable fastener means as may be desired. Thus, the two propulsion units 30 and 32 are rigidly interconnected by the plate member 38 and are therefore independently movable relative to the crosshead 28. For this purpose, the units 30 and 32

3

may be journaled on the crosshead 28 in a suitable fashion, not shown, by means of which the propulsion units 30 and 32 are rotatable about the axes of pump shafts 44 and 46 journaled within the crosshead 28, as herein-after described.

Each of the propulsion units 30 and 32 is of similar configuration and each includes an outer housing portion 48 provided with an intake opening normally covered by the intake grate or screen assembly 50 in each case. Preferably, the intake screen is hingedly mounted as at 52 to the body 48 and suitable latch means such as the mechanism 54 is provided to normally retain the grate or screen assembly in place relative to the body 48. Internally of the housing or body 48, there is provided a pump shroud 56 housing an impeller assembly indicated generally by reference character 58. The impeller assembly 58 is attached to one of the corresponding shafts 44 or 46 and operates within the shroud 56 to draw water through the openings 60 and 62 therein, as is shown by the arrows in FIG. 1 to ultimately discharge such water through the discharge end 64 of the assembly. The jet or stream of water issuing from the opening 64 provides the propulsive effect for the associated aquatic vehicle.

The details of the pumps in each case form no part of the present invention but suffice it to say that each is provided with a reversing hood assembly indicated generally by reference characters 68 and 70 by means of which the craft may be operated in forward as well as reverse directions. These two hoods are interconnected for common actuation by means of a bell crank 72 pivotally mounted as by a shaft 74 carried by the interconnecting plate assembly 38, there being two tie rod assemblies 76 and 78 extending from this bell crank to the respective hood devices 68 and 70. The opposite end of the bell crank is connected, as at 82, to a suitable control member such as the control wire 84 so that the bell crank may be swung between the full and dotted line positions as shown in FIG. 1 whereby the two reversing hoods 68 and 70 are likewise swung between the full and dotted line positions as is shown. The control wire 84 may work on the Bowden wire principle, the outer sheath 86 therefor being anchored as at 88 to the interconnecting plate 38 and the entire assembly extending therefrom to within the confines of the aquatic vehicle for remote operation of the reversing hood mechanism as will be readily appreciated.

As is shown in FIG. 3, the crosshead 28 comprises simply an elongate tube member extending at right angles to the hollow shaft extension 24, such member 28 being provided internally with suitable internal flanges 80 and 81 receiving suitable bearings 83 and 85 which journal and mount pinions 88 and 90, both of which are in mesh with a common pinion gear 92 affixed to or formed integrally with the inner end of the drive shaft 16. Each of the pinions 88 and 90 is provided with a spline shank mounting respective clutch elements 94 and 96 thereon which clutch elements are rigidly affixed to their respective pinions. Mating clutch elements 98 and 100 are splined or otherwise suitably affixed for sliding movement on the inner ends of the impeller shafts 44 and 46, substantially as is shown. By mechanism subsequently to be described, the propulsion unit which is in operative position is coupled to its associated pinion 88 or 90 whereas the inoperative propulsion units are disconnected from their corresponding pinion or pinions. Thus, in FIG. 3, the impeller shaft 46 is shown with the two clutch elements 96 and 100 drivingly interconnected or coupled together. In the specific form of the invention shown in this figure, the clutch assembly is of the dog clutch or dental type.

The manner of operation of the clutch assemblies will be seen more clearly from a study of FIG. 5. In this figure, it will be appreciated that the housing or crosshead 28 mounts a pair of dog cranks 102 and 104 about respective pivot pins 106 and 108. Each of the clutch elements 98 and 100 as is shown specifically for the

4

clutch element 98 in FIG. 5 is provided with a collar 110 on its shank 112 spaced from the dental clutch element proper so as to provide a circumferential groove there between within which rides the beaded end 114 of the crank arm 116. The other end 118 of each crank is provided with a roller element 120 mounted upon a pivot pin 122 and which rides against the cam 124 rigid with or otherwise fixedly secured to the housing member 18. This cam surface is provided with a lobe 126 which is so oriented with respect to the two bell crank rollers 120 and 128 as to cam the lowermost disposed bell crank, in the case of FIG. 5 the bell crank 104, so as to interengage the corresponding dental clutch elements 94, 98 or 96, 100. Tension springs 130 and 132 are associated with the two bell cranks 102 and 104 substantially as is shown so as to maintain the rollers 120 and 128 in engagement with the cam 124, such springs acting to automatically disengage the associated clutch assemblies whenever the rollers 120 or 128 have passed beyond engagement with the cam lobe 126. Thus, there is provided a positive clutching action and a resilient declutching action.

The crank arms 116 and 118 are offset from each other as will be seen from FIGS. 5 and 6, the crank arm 116 in each case being internally disposed relative to the housing 28 and preferably being in the form of a bifurcated form having spaced arm portions 140 and 142 substantially as is shown in FIG. 6 and the external crank arm 118 being rigidly connected at its hub 144 to the outer end of the pivot shaft 106. The pivot shaft 106 is each case extends through and is journaled in a suitable hub portion 146 formed integrally with or otherwise rigid with respect to the housing 28, substantially as is shown in FIG. 6.

FIG. 6 also illustrates a portion of the steering control for this particular embodiment of the invention. As shown, the interconnecting plate 38 is provided with a lug 150 cooperative with a bifurcated steering arm 152 whose spaced leg portions 154 and 156 straddle such lug and are pivotally secured thereto as by a pivot pin 158 so that the steering arm 152 may pivot up and down in a vertical direction. The steering arm 152 carries a ball at its free end captive within a suitable socket member 160 having connection at opposite sides thereto to steering cables 162 and 164, which pass therefrom around suitable corresponding pulleys 166 and 168 and the cables thence pass forwardly of the craft to suitable steering control mechanism as will be readily apparent. The purpose for the pivot pin 158 is to prevent binding in the steering mechanism should the propulsion assembly be rotated about the axis of the housing 18 when the steering mechanism is in other than a straight ahead position, under which circumstances vertical pivoting action of the steering arm 152 would be necessary to accommodate for such rotation of the propulsion assembly. This relationship will be more clearly evident from a study of FIG. 2 which, in the position as is shown, represents a straight ahead position of the propulsion assembly, the propulsion assembly being shown in dotted lines in the process of being switched end for end or pivoted about the axis of the housing 28.

FIG. 2 taken in conjunction with FIG. 1 illustrates the manner in which the pivoting of the propulsion assembly may be achieved. In this specific instance, an extension of the member 24 has a collar 170 rigidly affixed thereto and projecting laterally, normally horizontally, from this collar 170 is a bar member 172. Thus, when it is desired to reverse the propulsion assembly 14, the bar 172 is simply moved from the full line position shown in FIG. 2 to an opposite full line position wherein it will be displaced 180° from that position shown in FIG. 2. An intermediate position of such bar 172 is shown in dotted lines in FIG. 2 and the corresponding position of the propulsion assembly 14 is also shown in dotted lines in such figure.

Referring now more particularly to FIGS. 7 and 8, a modification is illustrated therein, although the same does

5

not depart from the basic concepts of the invention thus far described. In FIGS. 7 and 8, the rigid mounting sleeve is indicated by reference character 180, the same being provided with a suitable collar 182 for fixed securement to the craft with which the propulsion unit is associated, such fastening being obtained for example by fasteners 184 as shown. The crosshead 186 which rigidly mounts the two propulsion units 188 and 190 at its opposite ends is provided with a tubular extension 192 projecting within the mounting sleeve 180 and suitably journaled therein as by bearings 194 and 196. It will be appreciated that since the two propulsion units 188 and 190 are rigidly affixed to the crosshead 186, such propulsion units are not movable for steering purposes. Instead, suitable rudders or vanes 198 are provided in association therewith to effect the proper directing of the jet or stream of fluid issuing from the propulsion units 188 and 190. Steering connection to these rudders 198 is made by means of a pitman arm 200 having a horizontal aligning pivot 202 connecting such arm 200 to the crank 204. The crank 204 is pivoted by means of a vertical pivot member 206 to an aft projecting bracket 208 rigid with the crosshead assembly 186, substantially as is shown. The crank 204 is pivotally connected as at 210 to a link member 212 having connection with an arm rigid with the shaft member 214 which, through the medium of a further arm and link member 216 connects to the steering arm member 218 suitably connected to the rudders 198 to effect turning thereof in response to movement of the pitman arm 200. The pitman arm 200 is connected at its aft end to a steering cable 220 which runs within a fixed tube member 222 connected as by brackets 204 and 206, see particularly FIG. 8, to certain portions of the craft and this tube is slotted as is shown in FIG. 7 to receive the aft end of the pitman arm 200 and the cable 220 is connected to suitable steering means to effect rudder control as aforesaid.

The propulsion units 188 and 190 are also provided with reversing hood assemblies 224 and 226, each of which is provided with rigid extension arms 230 and 232, see particularly FIG. 8. These arms 230 and 232 are pivotally connected to links 234 and 236 in each case which are journaled at their opposite ends on the interconnecting bar 238. The bar 238 is pivotally connected to the aft end of an arm 240 of a bell crank mechanism pivotally mounted as at 242 to a fixed ear 244 on the crosshead 186. The other arm 246 of this bell crank is pivotally connected to the aft end of a drag link 248 which extends therefrom to a point of pivotal connection as at 250 to the outer ring member 252 of a swash plate assembly indicated generally by the reference character 254. The inner ring member 256 of the swash plate assembly 254 is pivotally mounted about an axis indicated by reference character 258 to the mounting sleeve 180 and suitable connection (not shown) is made to this inner ring 256 for pilot control to tilt the ring about the horizontal axis 258 to effect the corresponding movement of the reversing hood assemblies.

To effect selective disposition of the units 188 or 190 in operative position, lock mechanism 260 is released so as to free the annular member 262 which is rigidly connected to the two units 188 and 190 substantially as is shown. The lock mechanism may be provided with a manual release handle 264 and also remote release mechanism including the bell crank 256 and associated cable control 268 extending to the pilot's station.

Referring to FIG. 9, a further modification of the present invention is shown therein. In this case, a mounting sleeve 270 is once again utilized for direct connection to the associated hull and the crosshead assembly 272 is likewise rotatably mounted within the mounting sleeve 270. As in the modification shown in FIGS. 7 and 8, the propulsion units 274 and 276 are rigidly affixed to the crosshead 272 and suitable rudder assemblies 278 are utilized instead. These two propulsion units are also

6

provided with suitable reversing hood assemblies 280 and 282, the construction being in general the same as is shown in FIGS. 7 and 8. The construction of the individual propulsion units 274 and 276 is somewhat different from the forms previously described. In the instance shown in FIG. 9, each propulsion unit includes an impeller member 284 cooperating with fixed vanes 286 and a diffuser 288, substantially as is shown whereby the fluid is inducted and discharged as indicated by the arrows in FIG. 9. The impeller in each case is fixed relative to an elongate drive shaft 290 which extends substantially parallel to the center line of the associated hull and projects forwardly from its associated unit to terminate in a clutch element 292 as is shown. The drive shaft 294 of the prime mover is provided with a slidable clutch element 296 and a throwout fork 298 and associated control 300 are provided for selectively coupling the prime mover drive shaft 294 with the selected one of the propulsion units.

Thus, it will be evident that the construction shown in FIG. 9 is similar to the diagrammatic illustration of FIG. 11. That is, a prime mover 302 is selectively coupled to the drive shafts 304 and 306 of the two propulsion units 308 and 310 by means of the common clutch indicated generally by the reference character 312, the two propulsion units being pivotally rotated about a suitable mounting member axis at 314. FIG. 10 illustrates the coupling connection for the form of the invention shown in FIGS. 1-8. In this figure, the prime mover is indicated by reference character 316 and its drive shaft by reference character 318 which simultaneously drives the output stub shafts which are connected to the pinions 320 and 322. The operatively positioned propulsion unit 324 is coupled by clutch assembly 326 to its associated stub output shaft while the clutch assembly 328 is disengaged.

FIG. 12 illustrates a further modification of the system which although similar to that shown in FIG. 10, differs therefrom in that the propulsion units indicated by reference characters 330 and 332 are of a different type than thus far disclosed. This particular type of propulsion unit in each case constitutes a ducted fan, having a blade 334 and shrouding 336 surrounding the same. This type of propulsion unit is particularly well suited for low speed operation since it has a high mass rate of flow at relatively low velocities.

In any case, it will be appreciated that the propulsion assembly disclosed herein is directed to a mechanism wherein a plurality of propulsion units are provided, the same being disposed in circumferentially spaced relationship with respect to each other, the several units being pivotally mounted about a common center so that a selective one of the propulsion units may be disposed in operative position for driving the associated aquatic vehicle. The disposition of at least one of the inoperatively disposed propulsion units is such as to permit ready access to the intake grate or screen thereof so that the same may be cleaned to permit the unit to subsequently work at maximum capacity. Preferably, such grate is also so associated with the moving parts of the propulsion unit that access thereto may be easily had. It will be obvious that although only two propulsion units are shown in each propulsion assembly, any desired number of individual propulsion units may be provided.

I claim:

1. In an aquatic vehicle having a hull, a propulsion assembly including a frame pivotally mounted on said hull about a generally horizontal axis for positionally fixed adjustments thereabout, a plurality of individual propulsion units carried by said frame in radially offset relation to the pivot axis for said frame and disposed in circumferentially spaced relation to each other about such pivot axis for the frame,

said pivot axis being located on said hull above the waterline thereof a distance less than the radial offset

7

of said propulsion units so that at least one of said propulsion units is disposed above water while at least one other is disposed in operative, in-water position,
 power plant means mounted in said hull, 5
 and means for selectively connecting that propulsion unit which is in operative position to said power plant means.
 2. In an aquatic vehicle having a hull,
 a propulsion assembly including a frame pivotally 10
 mounted on said hull,
 a plurality of individual propulsion units carried by said frame in radially offset relation to the pivot axis for said frame and in circumferentially spaced relation relative to the pivot axis of said frame, 15
 said pivot axis being located on said hull above the waterline thereof a distance less than the radial offset of said propulsion units so that at least one of said propulsion units is disposed above water while at least one other is disposed in operative, in-water 20
 position,
 means for fixing said frame relative to said hull such that any selected one of the units is disposed in operative, vehicle-propelling position while another of the units is disposed above water so as to be exposed to 25
 hull-carried personnel for cleaning and the like.
 3. In an aquatic vehicle having a hull,
 a propulsion assembly including a frame having a generally horizontal tubular extension,
 hull-carried bearing means engaging said extension 30
 whereby the propulsion unit is positionally adjustable relative to said hull,
 a pair of propulsion units on said frame disposed in radially spaced relation to the axis of said tubular extension and diametrically opposed to each other, 35
 a power plant mounted in said hull,
 a drive shaft connected to said power plant and projecting through said tubular extension,
 said drive shaft being connected to both of said propulsion units, 40
 a clutch associated with each propulsion unit,
 and means for maintaining the clutch of one propulsion unit engaged while the clutch of the other propulsion unit is disengaged,
 said means being responsive to the position of said 45
 propulsion units so that the uppermost of such units is idle for cleaning and like purposes.

8

4. In an aquatic vehicle having a hull,
 a propulsion assembly including a frame having a generally horizontal tubular extension projecting from said hull,
 hull-carried bearing means engaging said extension whereby the propulsion unit is positionally adjustable relative to said hull,
 a pair of propulsion units on said frame disposed in radially spaced relation to the axis of said tubular extension and circumferentially spaced with respect to each other,
 a power plant means mounted in said hull,
 drive means connected to said power plant means and projecting from said hull,
 and coupling means for selectively connecting said propulsion units to said drive means,
 said coupling means being responsive to the position of said propulsion units so that the uppermost of such units is idle for cleaning and like purposes while the lowermost of said units is connected to said drive means.
 5. In the vehicle as defined in claim 4 wherein said drive means is a shaft extending through said tubular extension and said coupling means is a pair of clutches interposed between said shaft and the individual propulsion units.
 6. In the vehicle as defined in claim 4 wherein said drive means is a drive shaft projecting from said hull below said tubular extension,
 each propulsion unit having a driven shaft projecting therefrom toward said hull,
 each driven shaft having a clutch element thereon and said drive element having a clutch element thereon, such clutch elements forming said coupling means.

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