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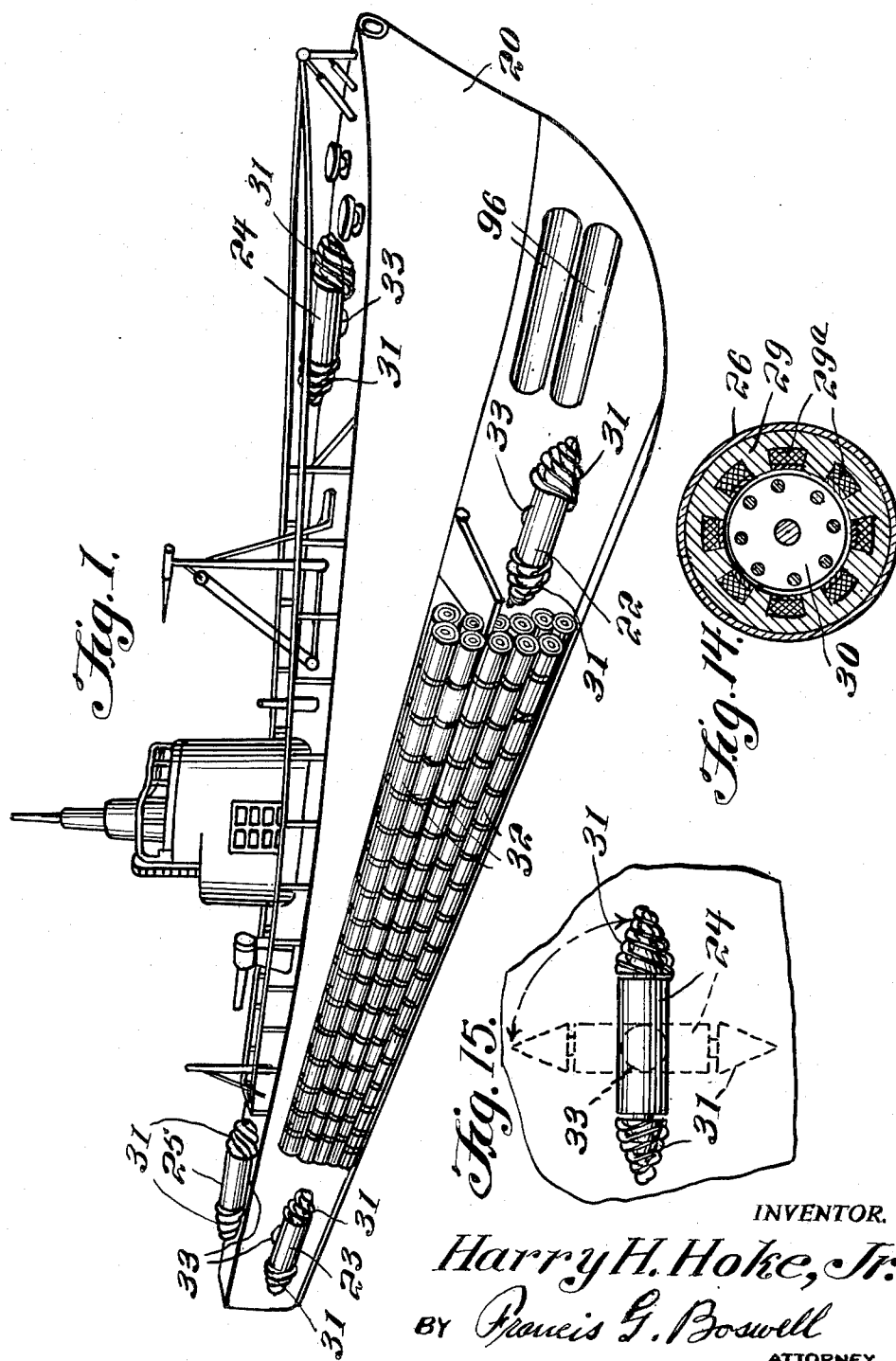
H. H. HOKE, JR

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APPARATUS FOR STABILIZING AND MANEUVERING SUBMARINES

Filed May 15, 1952

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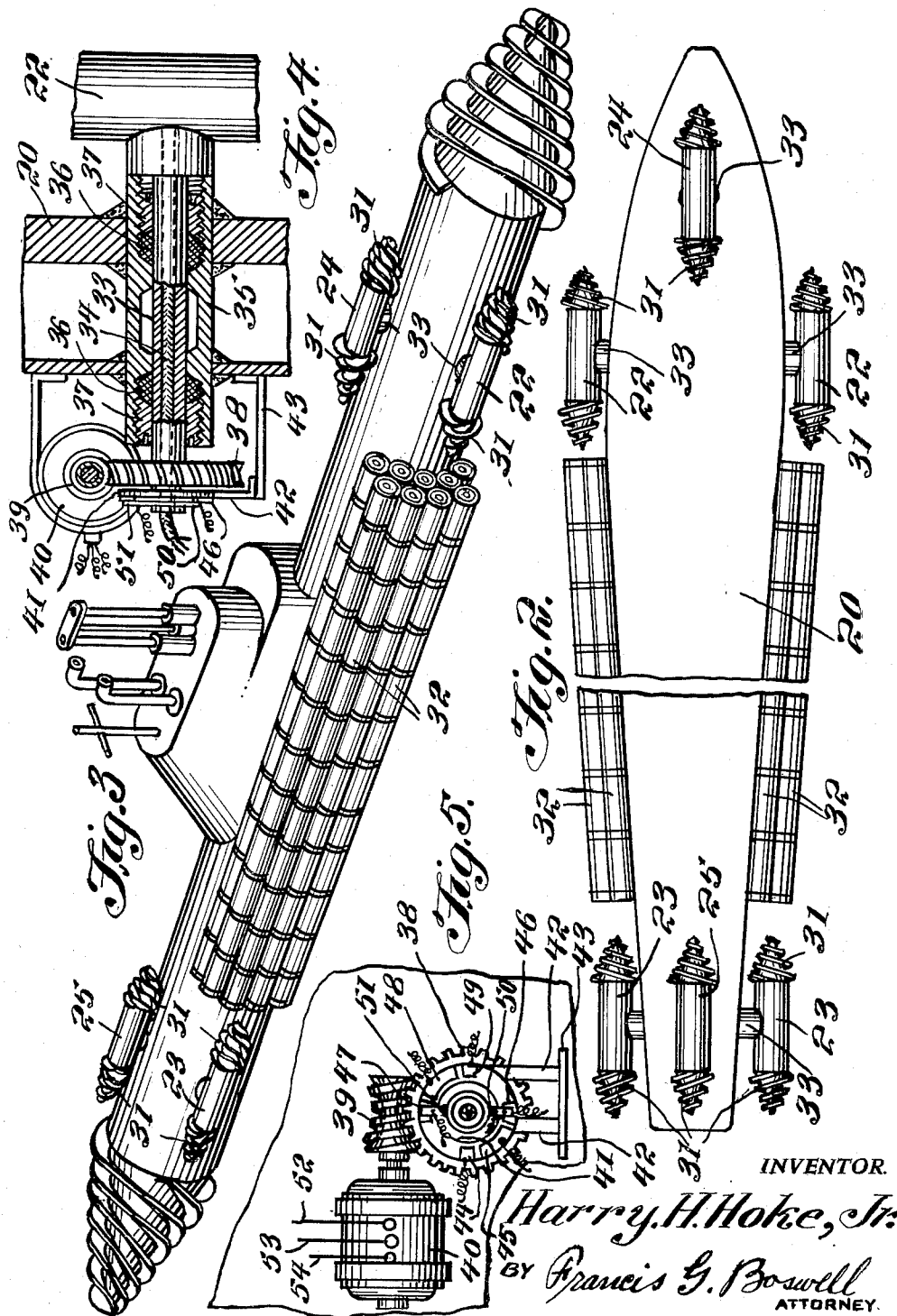
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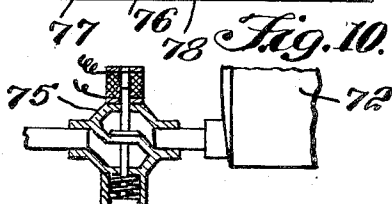
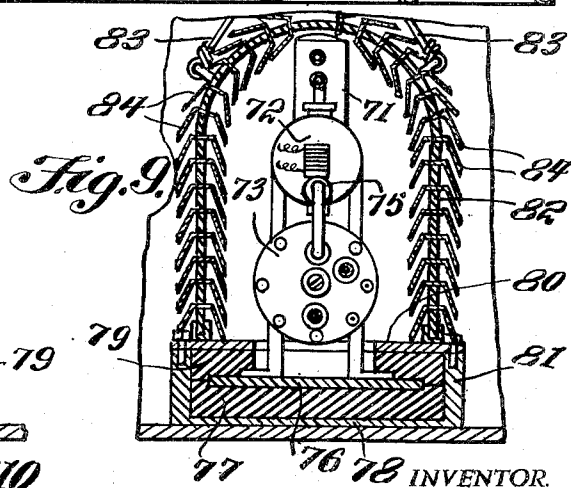
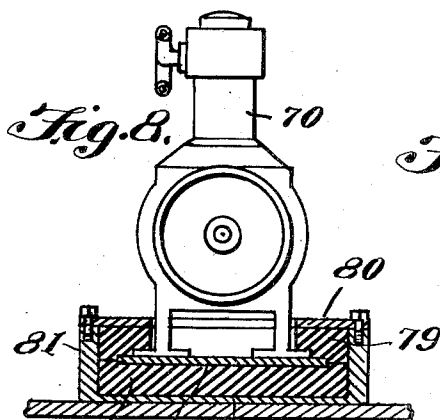
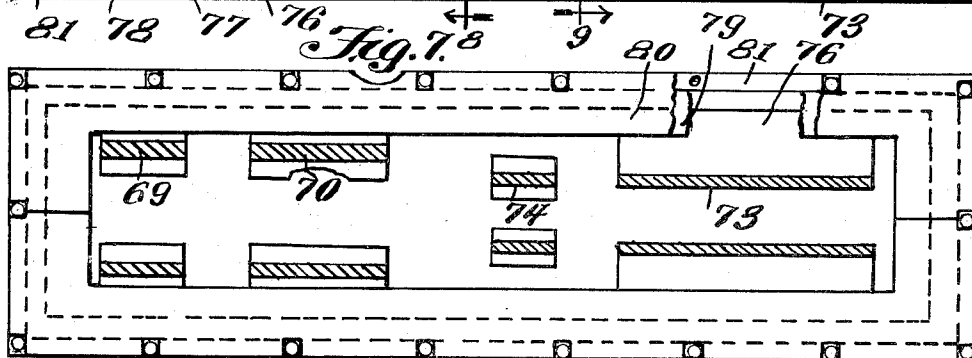
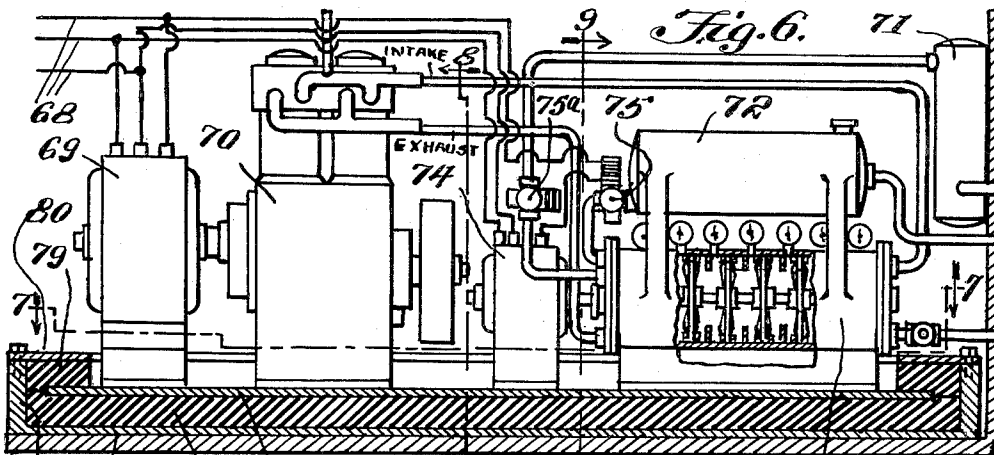
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APPARATUS FOR STABILIZING AND MANEUVERING SUBMARINES

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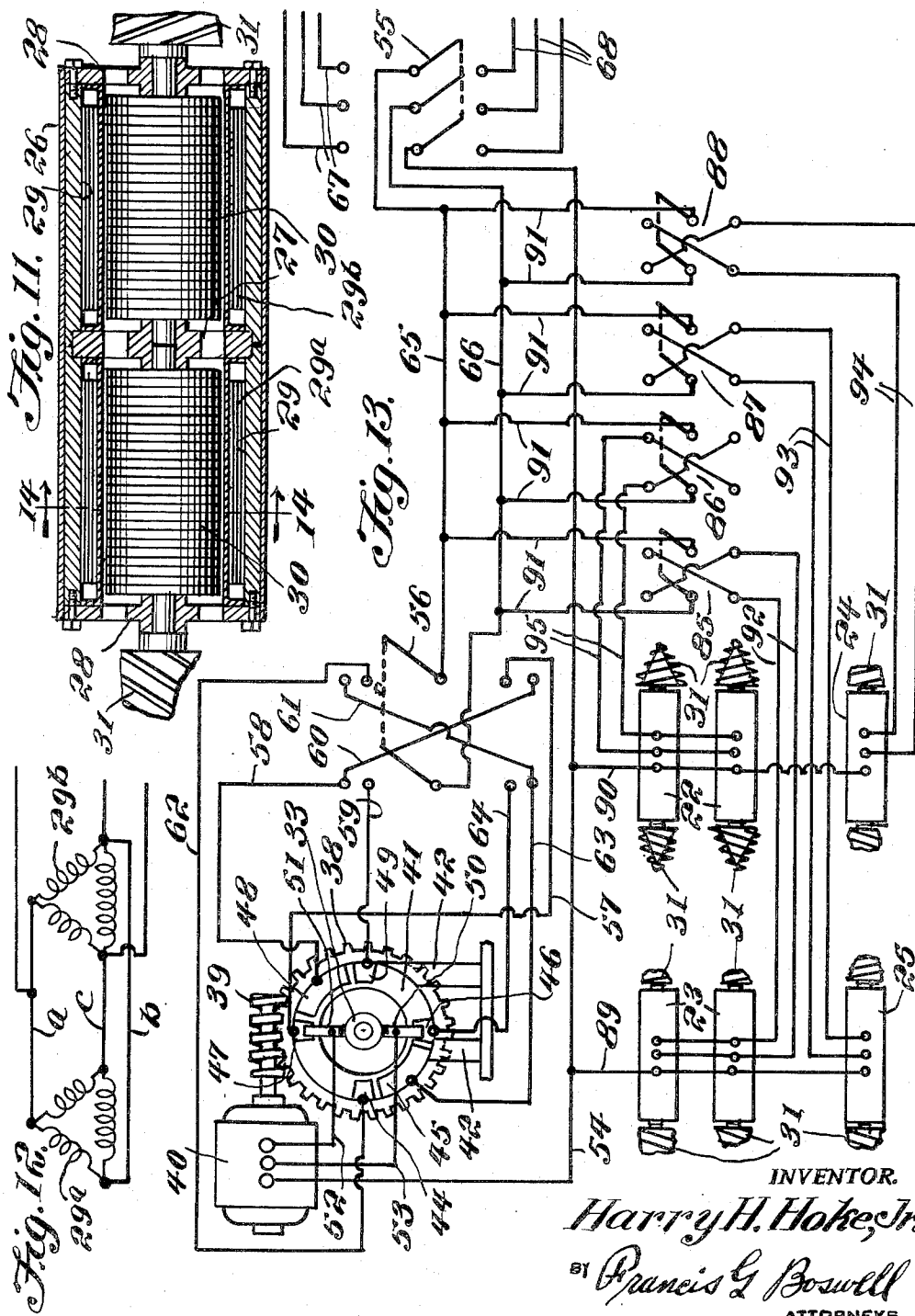
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APPARATUS FOR STABILIZING AND MANEUVERING SUBMARINES

Harry H. Hoke, Jr., Washington, D. C.

Application May 15, 1952, Serial No. 287,980

8 Claims. (Cl. 114—16)

The object of the invention is to provide apparatus for stabilizing and maneuvering submarines without the use of the regular power plant and its attendant noise, where the submarine is seeking to hide from attack and would otherwise have its position disclosed by the noise emanating from the regular power plant; to provide apparatus for the purpose indicated in which the stabilizing appliances may be selectively actuated, so that the helmsman will have no difficulty in keeping the submarine on an even keel; to provide a steering apparatus that will enable the helmsman to maneuver the submarine within a small area; to provide apparatus of a character stated which, when not in use for maneuvering or stabilizing, may be made to function as an auxiliary propelling means; and generally to provide a maneuvering and stabilizing apparatus which, for the functions performed, is of comparatively simple form, comparatively cheap to manufacture, and of a character unlikely to get out of order in use.

With this object in view, the invention consists in a construction and combination of parts of which a preferred embodiment is illustrated in the accompanying drawings, wherein:

Figure 1 is a perspective view of a conventional submarine showing the manner of applying the invention thereto;

Figure 2 is a top-plan view of the structure of Figure 1;

Figure 3 is a perspective view of an improved form of submarine showing the invention applied thereto;

Figure 4 is a sectional view showing the construction by which the stabilizing and maneuvering propellers are shifted from their positions as auxiliary propellers into the positions which they assume in carrying out their primary function;

Figure 5 is a front elevational view of the structure of Figure 4;

Figure 6 is a view in elevation and partly in section of the miniature power plant by which the stabilizing and maneuvering propellers are energized;

Figure 7 is a sectional view on the plane indicated by the line 7—7 of Figure 6;

Figure 8 is a sectional view on the plane indicated by the line 8—8 at Figure 6;

Figure 9 is a sectional view on the plane indicated by the line 9—9 of Figure 6;

Figure 10 is a sectional view illustrating the electric valve employed in the oxygen tank line;

Figure 11 is an elevational view, partly in section, of one of the dual motors for driving the maneuvering and stabilizing propellers;

Figure 12 is a diagrammatic view of the stator wiring of said motors;

Figure 13 is a diagrammatic view of the wiring by which the various propellers are controlled and are shifted from their positions as stabilizing and maneuvering propellers to positions where they function as auxiliary propellers;

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Figure 14 is an enlarged cross-sectional view of the structure of Figure 15;

Figure 15 is an elevational view of one of the stabilizing units, showing, in dotted lines, its vertical position.

Under present conditions it is impossible for a submarine to secrete itself when submerged without giving audible evidence of its approximate position, due to the necessity of operating the propellers. The present invention contemplates the provision of apparatus for maneuvering and stabilizing the submarine but without the use of the power plant, or batteries which constitute the source of power supply with submerged conventional submarines.

Whether the submarine be of the form shown at 20 in Figure 1, which is the conventional style or of the form shown at 21 in Figure 3, which is a deviation from the conventional style, the stabilizing means are identical and consist of the forward stabilizing units 22 and the rear stabilizing units 23. But identical units 24 and 25 are provided fore and aft for maneuvering or steering. All of these units are identical in construction and each consists of a cylindrical housing 26 formed with a central bearing web 27 and end cases 28. Interiorly, the housing carries the stators 29, and rotors 30 which are designed for operation on three-phase alternating current, so that rotation is imparted to the rotors solely through the rotating magnetic fields set up in the stators. The stators are made water-proof and in this respect are identical with the stators illustrated and described in application No. 266,429, filed January 14, 1952. It is not necessary, therefore, to go into the details of how the windings of the stators are kept dry, as they must be, since the entire case or housing 26 is submerged.

The propellers 31 are positioned at opposite ends of the case and their shafts, which carry the rotors, are journaled in the end cases and in the division web 27. The propellers are of the form shown in application No. 241,513, now Patent No. 2,755,867, filed August 13, 1951, but are rotated in opposite directions, so that the spiral blade on the forward one is the reverse of the spiral blade on the aft one.

In Figure 12, the stator windings are illustrated diagrammatically. The windings 29A and 29B are connected together as shown, corresponding points in the two windings being connected together as indicated at "a" with relatively opposite points connected as indicated at "b" and "c." Thus it is apparent that one phase in the winding 29B is reversed as respects that phase in the winding 29A. Thus the two rotors 30 of any unit will rotate in relatively opposite directions, but since the spiral blades of the propellers follow reverse spiral angles, the two propellers have a combined propelling force in the same direction.

But the stabilizing and maneuvering propeller units are auxiliary appliances, and the submarine, when in movement is driven by the propeller units 32, the detailed construction of which it is not necessary to outline in view of the fact that they are identical to the propellers illustrated in application No. 266,429, filed on January 14, 1952, and No. 242,655, filed August 20, 1951.

Except when the submarine is submerged and it is being endeavored to keep its location secret, the propeller units 22, 23, 24, and 25 have their axes of rotation parallel to the keel of the submarine, or in axial coincidence with some of the propellers 32. In these positions, they constitute supplementary driving means for the vessel.

When the maneuvering or stabilizing functions are to be performed, however, the axes of the propeller units 22, and 23 must be vertical, or normal to the horizontal plane of the keel while the units 24 and 25 must have their axes transverse to the keel. To make this possible, each unit is provided with a lateral arm 33 which is of

tubular form, so that the conductors 34, energizing the stators may reach the windings of the latter. The arm 33 is mounted in a bearing box 35 passing through the wall of the hull and is so constructed as to receive the packing 36 at the outside and inside of the hull and to receive the packing nuts 37 to compress the packing and effect a water-tight connection, so that there may be no leaking; where the maneuvering or stabilizing unit is mounted.

Interiorly to the hull, the arm 33 (which is in effect a hollow shaft) is equipped with a worm gear 38 in mesh with a worm 39 driven by a three-phase motor 40 on the shaft of which the worm is mounted.

On the outer face of the gear 38 but spaced from the latter is a contact plate 41 supported by bracket arms 42 upstanding from a bracket 43. The contact plate is of insulating material and carries on its outer face adjacent its periphery the contact segments 44, 45, 46, 47, 48 and 49. These segments are positioned as shown and are transversely by the contact arms 50 and 51 connected by the conductors 52 and 53 with two of the binding posts of the motor 40. The other binding post is connected by means of a conductor 54 with one pole of a triple-pole switch 55. The purpose of this construction is to provide a power means of shifting the maneuvering and stabilizing units from their vertical to their horizontal positions and vice versa. Such a function of course calls for reversing the direction of rotation of the motor 40, but, being a three-phase motor, reversal can be effected by reversing or interchanging any two of the three leads, and this is accomplished when the contact arms 50 and 51 traverse their attendant segments 44 to 49.

Between the switch 55 and the contact disc 41, a double-throw double pole switch 56 is interposed, but this switch is of a form to have each of its two legs bridge two contacts in either of its two positions, the inner contacts being referred to as supplemental contacts. To this end, the lower right and supplemental contact is electrically connected to the segment 47 by a conductor 57. The segment 48, which is longer than either the segment 47 or 49, is connected by the conductor 58 with the upper left hand main contact of the switch, while the segment 49 is connected by means of the conductor 59 with the upper auxiliary left-hand contact of the switch. The main contacts are cross-connected by the conductors 60 and 61.

The segment 44 is connected to the upper right-hand auxiliary contact by means of a conductor 62; the segment 45 to the lower left hand main contact by means of a conductor 63 and the segment 46 to the lower left-hand auxiliary contact by means of a conductor 64. The blades of the switch 56 are connected by the conductors 65 and 66 with two of the blades of the switch 55.

The switch 55 is a triple-pole double-throw switch and when in the upper position, connects the motors 40 with the conductors 67 which lead to the three-phase generator of the main power plant of the submarine, which is the position the switch will be in when the submarine is traveling on the surface or, for that matter, when it is navigating below the surface in accordance with the plan outlined in application No. 247,008, now Patent No. 2,720,856, filed September 17, 1951. When the switch 55 is in the lower position, it connects the motors 40 with the conductors 68 which are the output conductors of the auxiliary or sound-proof power plant which embodies the generator 69 driven by a small diesel 70 to which it is directly connected and which is fuelled from the main fuel source with air supplied from an auxiliary air tank 71, or oxygen supplied from an auxiliary oxygen tank 72 passed through an auxiliary injector 73 and driven by a motor 74, the electric valve 75 being interposed between the oxygen tank and the injector. In function and principle, this power plant is identical with that illustrated in application 247,008 filed September 17, 1951, now Patent No. 2,720,856, but it is a miniature form of that

invention, being designed to supply only limited power sufficient for stabilizing and maneuvering.

In order that it may be sound-proof, the base 76 is imposed on a rubber mat 77, seated on a secondary base 78, and a marginal cushion of rubber 79 is imposed upon the base and secured in position by a marginal flange 80 bolted to an upstanding flange 81 formed integrally with the secondary base. The cushioned mounting for the plant constitutes a noise-silencer. In order to eliminate all noise emanating from the apparatus, the whole is covered with a rubber hood 82 which, when access is to be had to any of the plant apparatus, may be raised by means of the cables 83.

To provide for adequate heat dissipation, the hood is provided with heat dissipation flanges 84 extending through the wall thereof but since these are spaced from each other and are solely rubber supported, they do not operate as a means for transmitting noise, but only for dissipating heat.

The maneuvering and stabilizing units when their axes are normal to the keel, are operated from the auxiliary power plant, but when parallel to the keel are operated from the main power plant, since they are then auxiliary propellers.

In describing the operation of the motor 40, it was intended that that should apply to shifting all of the units 22 to 25, each of which has the switching mechanism comprising the segments 44 to 49, but the switch 50 controls the whole set.

It being necessary to reverse the rotation of the units, a reversing switch is provided for each; that is, there is a single reversing switch 85 for all of the aft units, a similar switch 86 for all of the forward units, a switch 87 for the aft-steering unit 25 and a switch 88 for the forward steering unit 24. But these switches only control two conductors, since that is all it is necessary to control for change of direction in a three-phase circuit. One terminal of each of the units 22, 23, 24 and 25 is connected in on the conductor 54, as by conductors 89 and 90. The switches 85 through 88 are double-pole, double-throw switches and the hinge contacts are connected by the conductors 91 in on the conductors 65 and 66. The clip contacts are cross-connected, as is usual in double-throw double-pole switches used for reversing purposes and the clip contacts of the switch 85 are connected by the conductors 92 with two of the binding posts on the units 23. The switches 85 through 88 are identical in construction and their outer contacts are cross-connected as before explained. The clip contacts of the switch 87 are connected by the conductors 93 with the aft maneuvering unit 25, while the clip contacts of the switch 88 are connected by the conductors 94 with the forward maneuvering unit 24. The clip contacts of the switch 86 are connected by the conductors 95 with the forward stabilizing units 22. Obviously, if any of the switches 85 through 88 is closed, three-phase current will be fed to the selected units, or to all, if all the switches be closed; the path of such current being over the conductors 91, 92 and 89. Since the maneuvering units are separately closed and the stabilizing units independently controlled in pairs, any one being susceptible of rotation, either right-handedly or left-handedly, depending on the position of its particular switch, it is obvious that the maneuvering propellers may be run in relatively opposite directions so that the ship may be turned on an axis practically at the longitudinal center of the keel, or if one of the maneuvering units only be in operation, turned with a point at one end of the keel as an axis. Thus the boat may be conveniently set for the firing of torpedoes, as from the torpedo tubes indicated at 96 in Figure 1. Of course, this control of the units assumes that they are then adjusted on axes normal to the keel, as otherwise they would all run in the same direction, when the ship is proceeding on its course.

The operation of shifting the units from positions angular to the keel to positions parallel to the keel is accom-

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plished by the actuation of the switch 56. Suppose that the unit is vertical, if it be a stabilizing unit, or transverse, if it be a maneuvering unit, then the arms 50 and 51 will appear as in Figure 13, that is, they will bear on the segments 46 and 47 respectively. But then, the switch 56 will be in the elevated position, it having been raised to that position to effect the assumed position of the unit. And in such position, the motor 40 is deprived of current, the segments 46 and 47 being connected with the then unenergized supplemental clips at the bottom of the switch. It is now desired to actuate the units to bring them into parallelism with the keel and the switch 56 is depressed so that its blades bridge the main and supplemental clips at the bottom. Then the segments 46 and 47 become energized, three-phase current flowing over the conductor 65, the switch blade, the supplemental clip, the conductor 57, the segment 47, arm 51, the conductor 52 to another binding post of the motor, and over the conductor 66 to the left-hand blade of the switch, over the conductor 64, the segment 46, arm 50, the conductor 53 to the center binding post of the motor. Thus the motor will be put in operation, and rotating its worm and with it the worm gear will rotate the arm 33. But this results in rotating the arms 51 and 50 and they pass from the segments 47 and 46 onto the segments 48 and 45 respectively, so that the increments of current that passed over the conductors 64 and 57 now pass over the conductors 63 and 58 to the segments 45 and 48 and to the motor binding posts as formerly. When the arms 50 and 51 reach a horizontal position, they bear on the segments 49 and 44 but these segments are connected with the top supplemental contacts of the switch 58 and are dead when the switch is in the lowered position, so that the motor is brought to rest, two phases having been opened. The units will thus assume their positions longitudinally of the submarine until the switch 56 is reversed to have them assume axial positions transverse of the submarine. The arms 50 and 51 being disposed as they are, will act as indicators to show the positions of the units, whether their axes are transverse or longitudinal of the boat. And the position of the switch 56, which will be in the helmsman's cabin along with the switches 85, 86, 87, 88, and 55 will, by its position, indicate the positions of the units, the lowered position of the switch meaning that the units are longitudinally of the submarine and the upper position meaning that the units have their axes transverse of the submarine.

It is obvious that the apparatus or mechanism constitutes a convenient means both for maneuvering and stabilizing, so that the main power plant may be cut out of service and the stabilizing units operated independently, together, or relatively reverse directions to bring the boat on an even keel, just as the maneuvering units may be employed for turning the boat.

The invention having been described, what is claimed as new and useful is:

1. Apparatus for the purpose indicated comprising, in combination with a submarine, propellers mounted laterally of said submarine at its forward end on opposite sides thereof and positioned to rotate on substantially vertical axes, other propellers also mounted laterally of said submarine at its aft end on opposite sides thereof and positioned to rotate on substantially vertical axes, a motor driving each propeller and positioned exteriorly of the submarine with its rotor coupled directly to such propeller, a miniature power plant energizing all the propeller motors and positioned interiorly of the submarine, and separate manual controls interposed between the power plant and the motors, one to control the operation of the forward lateral propellers and one to control the operation of the aft lateral propellers, so that either the forward propellers or the aft propellers may be operated or all operated together to keep on an even keel a submerged submarine seeking to conceal its position.

2. Apparatus for the purpose indicated comprising, in combination with a submarine, propellers mounted lateral-

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ly of said submarine at its forward end on opposite sides thereof and positioned to rotate on substantially vertical axes, other propellers also mounted laterally of said submarine at its aft end on opposite sides thereof and positioned to rotate on substantially vertical axes, additional propellers mounted exteriorly of said submarine with at least one at its forward end and the other at its aft end and positioned to rotate on substantially horizontal axes transverse to the longitudinal axis of the submarine, a motor driving each propeller and positioned exteriorly of the submarine with its rotor coupled directly to such propeller, a miniature power plant energizing the propeller motors and positioned interiorly of the submarine, and a plurality of manual controls interposed between the power plant and the propeller motors to provide for the selective or combined operation of the propellers, one for the forward propellers, one for the aft propellers, one for the forward transverse propeller, and one for the aft transverse propeller, so that when the submarine is submerged and seeking to conceal its position, it may be kept on an even keel and maneuvered laterally.

3. Apparatus for the purpose indicated comprising, in combination with a submarine, motor units mounted laterally of said submarine at its forward end and positioned one on each side thereof, other motor units mounted laterally of the submarine at its aft end and positioned one on each side thereof, each unit comprising dual rotors, a propeller directly connected to each rotor and positioned one at each end of each of said units, all of said units being mounted to dispose the rotors on substantially vertical axes, a miniature power plant energizing all of said motors, and a plurality of manual controls for said motors, one to control the operation of the forward motor units and one to control the operation of the aft motor units, whereby the propellers may be actuated to keep the submarine on an even keel when it is submerged and seeking to conceal its position.

4. Apparatus for the purpose indicated comprising, in combination with a submarine, motor units mounted laterally of said submarine at its forward end and positioned one on each side thereof, motor units mounted laterally of the submarine at its aft end and positioned one on each side thereof, said units being mounted with their axes substantially vertical, additional motor units mounted on top of said submarine with one adjacent to the forward end and one adjacent to the aft end, the last said units having their axes of rotation substantially horizontal but transverse to the longitudinal axis of the submarine, each motor unit comprising dual rotors, a propeller directly connected to each rotor and positioned one at each end of said unit, a miniature power plant energizing all of said motors, and separate manual controls interposed between the motor units and the power plant, one to control the operation of the forward lateral motor units, one to control the operation of the aft lateral motor units, one to control the forward transverse motor unit and one to control the rear transverse motor unit, whereby a submerged submarine, whose position is sought to be concealed, may be kept on an even keel and maneuvered laterally.

5. Apparatus for the purpose indicated comprising, in combination with a submarine, stabilizing propellers mounted laterally of the submarine at its forward and aft ends and on opposite sides thereof, steering propellers mounted on top of the submarine at its forward and aft ends, motors directly connected one to each propeller, mounting means for said motors whereby they may be rotated bodily through an angular distance of ninety degrees by which the axes of rotation of the stabilizing propellers may be changed from substantial verticality to substantial horizontality and the axes of the steering propellers from positions transverse to the longitudinal axis of the submarine to positions parallel to said axis, a miniature energizing plant for all of said motors, and a plurality of manual controls interposed between the propeller motors and the power plant, one to control the

forward stabilizing propellers, one to control the aft stabilizing propellers, one to control the forward steering propellers, and one to control the rear steering propellers, whereby the submarine may be kept on an even keel when submerged and concealing its position and the stabilizing and steering propellers may be made to function as propelling units when the submarine is progressing.

6. Apparatus for the purpose indicated comprising, in combination with a submarine, stabilizing propellers mounted one on each side of the submarine both at its forward end and aft end, steering propellers mounted on top of said submarine both at its forward end and one at its aft end, driving motors directly connected to each of said propellers, means for bodily shifting said propellers, the stabilizing propellers from substantial verticality to substantial horizontality and the steering propellers from positions transverse to the longitudinal axis of the submarine to positions parallel with the submarine axis, a central submarine-contained energizing source for said propeller motors, a single manual control for the bodily shifting means, and a plurality of manual controls for the propeller driving motors, one for those of the forward stabilizing propellers, one for those of the aft stabilizing propellers, one for the forward steering propellers, and one for the aft steering propellers, whereby the submarine may be kept on an even keel when submerged in concealment of its position and the stabilizing and steering propellers employed to assist in propelling it when progressing.

7. Apparatus for the purpose indicated comprising, in combination with a submarine, stabilizing propellers mounted one on each side of the submarine both at its forward end and aft end, steering propellers mounted on top of said submarine both at its forward end and aft end, energizing motors directly connected to each of said propellers, motor driven means for bodily shifting said propellers, the stabilizing propellers from substantial verticality to substantial horizontality and the steering propellers from positions transverse to the axis of the submarine to positions substantially parallel to such axis, a central submarine-contained energizing source for said propeller motors, a manual control interposed between the energizing source and the motor driven bodily shifting means, and a plurality of manual controls for the propeller motors, one for the forward stabilizing propellers, one for the aft stabilizing propellers, one for the forward steering propellers, and one for the aft steering

ing propellers, whereby when the submarine is submerged and concealing its position, it may be kept on an even keel and maneuvered laterally, and the stabilizing and maneuvering propellers may be employed as driving units when the submarine is progressing.

8. Apparatus for the purpose indicated comprising, in combination with a submarine, stabilizing propellers mounted one on each side of the submarine both at its forward end and aft end, steering propellers mounted on top of said submarine both at its forward end and at its aft end, energizing motors directly connected to each of said propellers, means for bodily shifting said propellers, the stabilizing propellers from substantial verticality to substantial horizontality and the steering propellers from positions transverse to the axis of the submarine to positions where such axes are parallel with the submarine axis, a central submarine-contained energizing source for said propeller motors, a plurality of manual controls interposed between the energizing source and the propeller motors, one to control the operation of the forward stabilizing propellers, one to control the operation of the aft stabilizing propellers, one to control the operation of the forward steering propellers and one to control the operation of the aft steering propellers, the bodily shifting means comprising a motor operatively connected with each propeller driving motor and having an automatic switch included in said operative connection, whereby the operation of the bodily shifting motor is limited to effect the shifting of the propeller driving motor an angular distance of ninety degrees, and a single control switch for all of the motors effecting bodily movement of the propeller motors.

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