No. 884,079. PATENTED APR. 7, 1908.

E. J. DUFF.

PROPULSION OF SHIPS.

APPLICATION FILED OCT. 3, 1906.

3 SHEETS—SHEET 1.

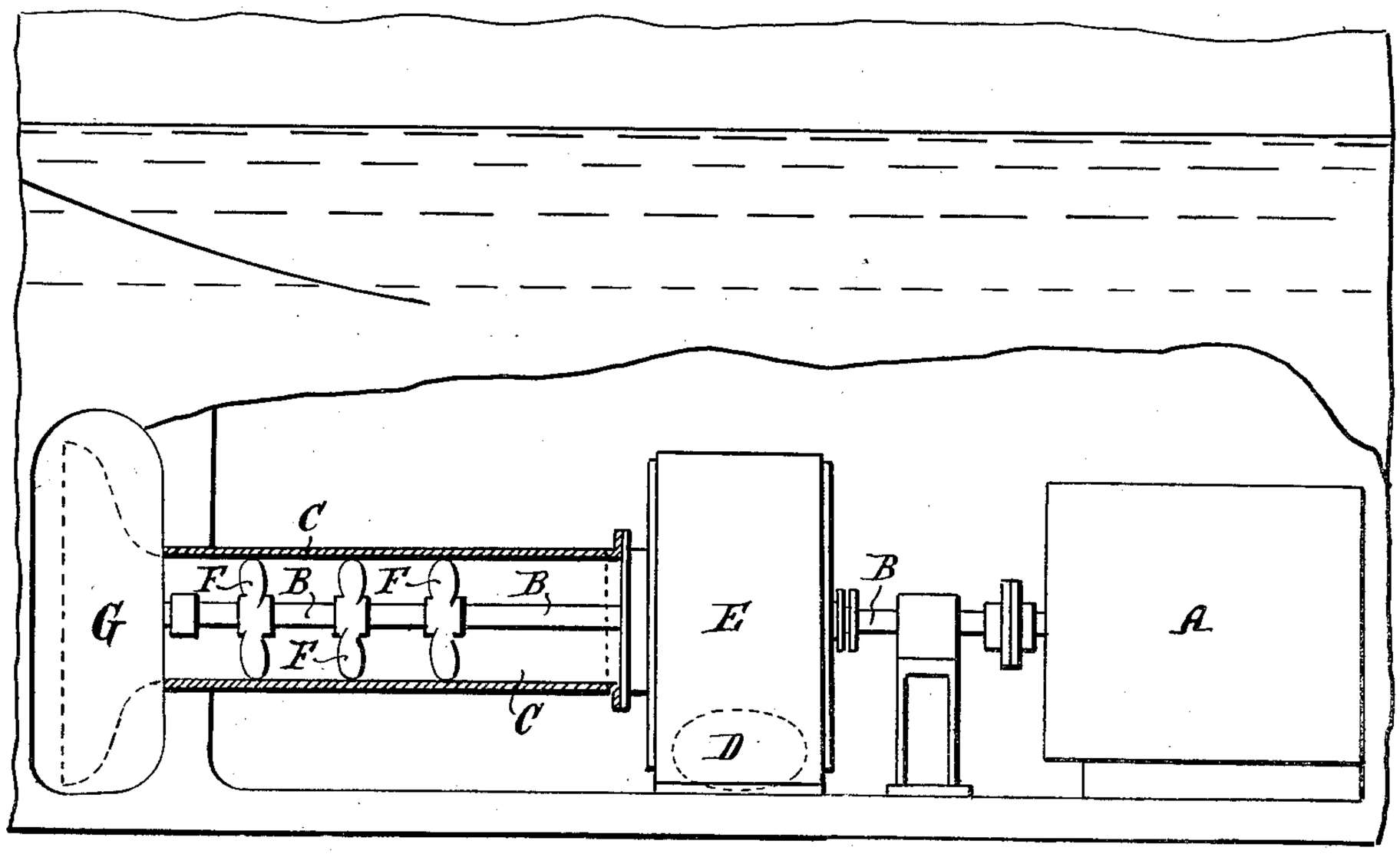


FIG. 1.

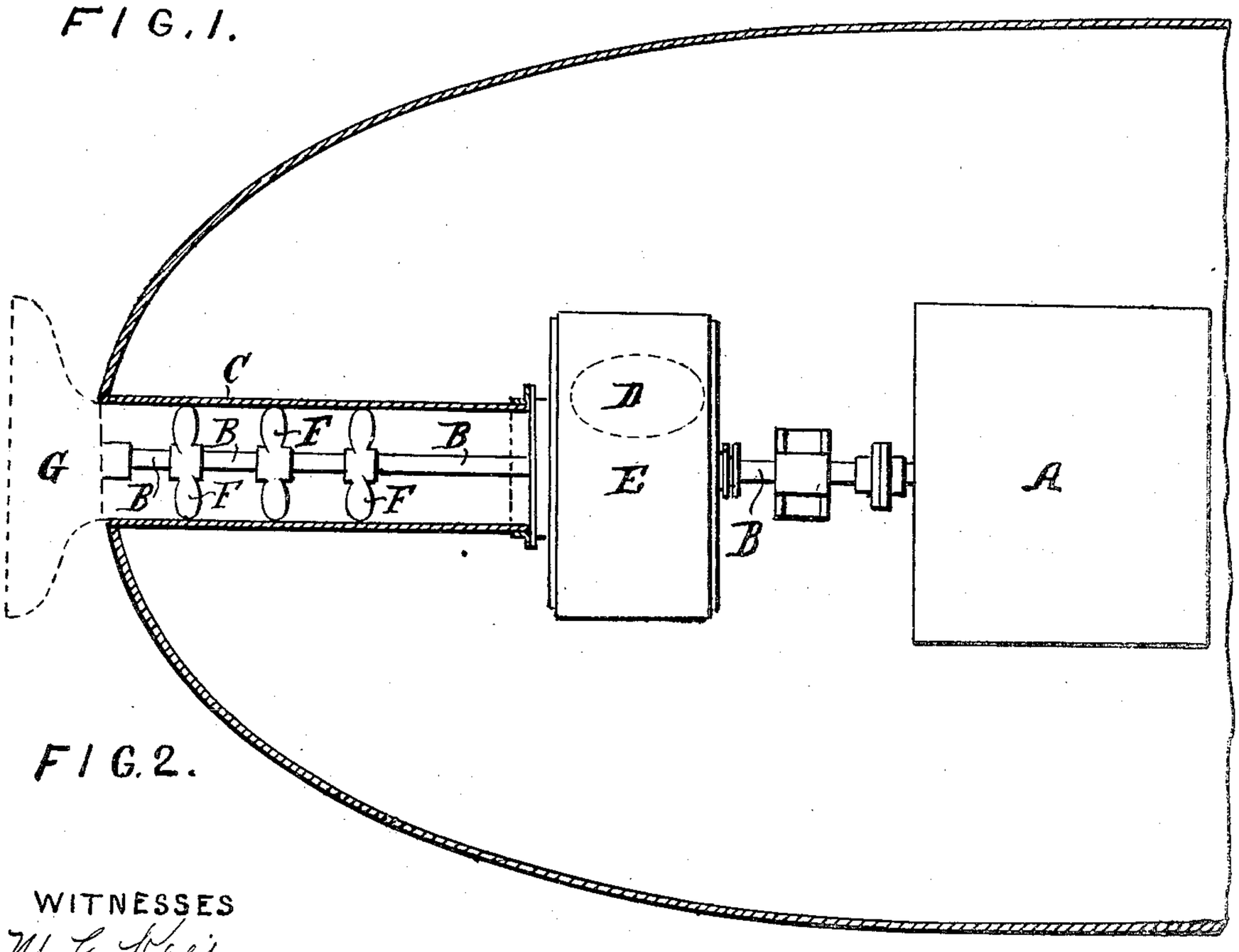


FIG. 2.

WITNESSES

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3 SHEETS—SHEET 2.

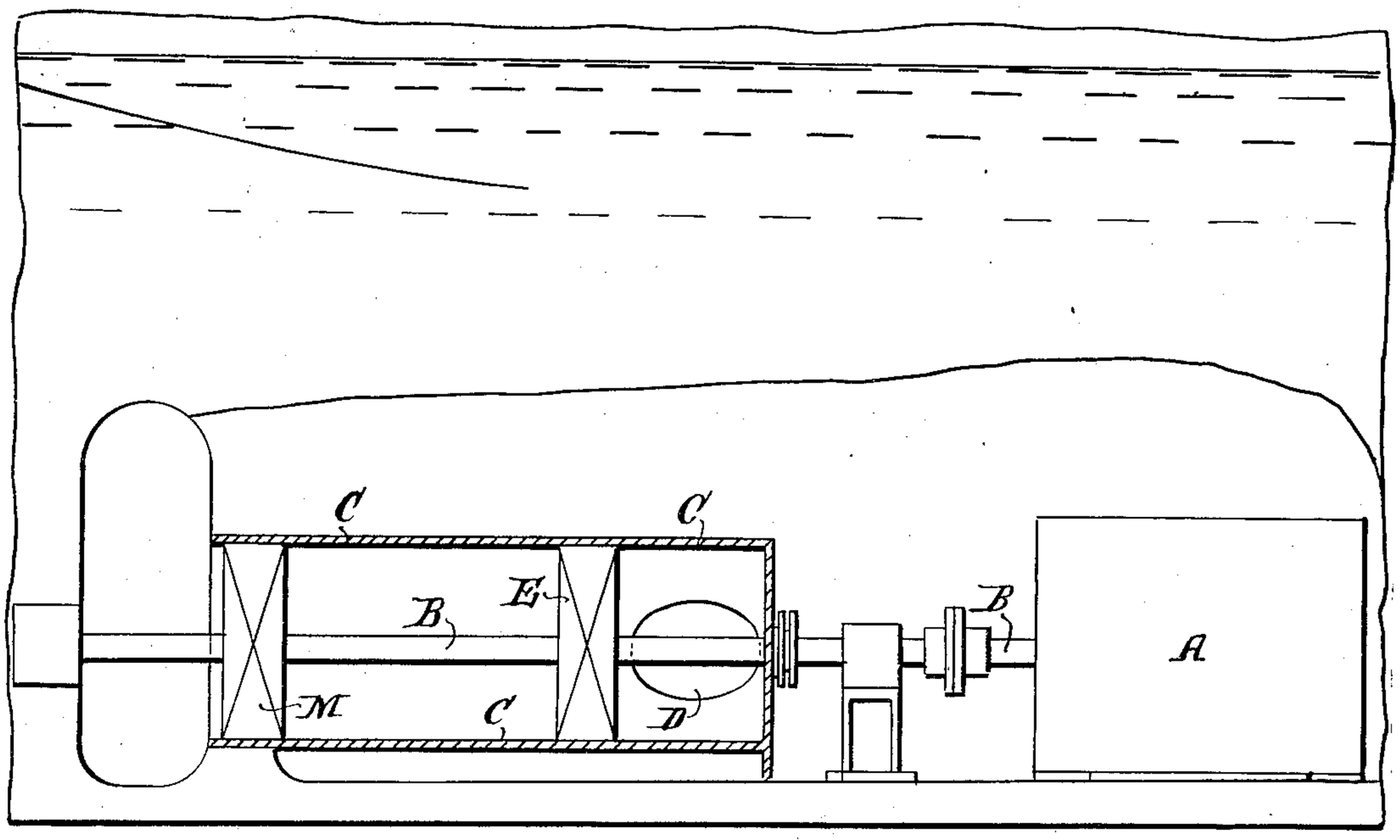


FIG. 3.

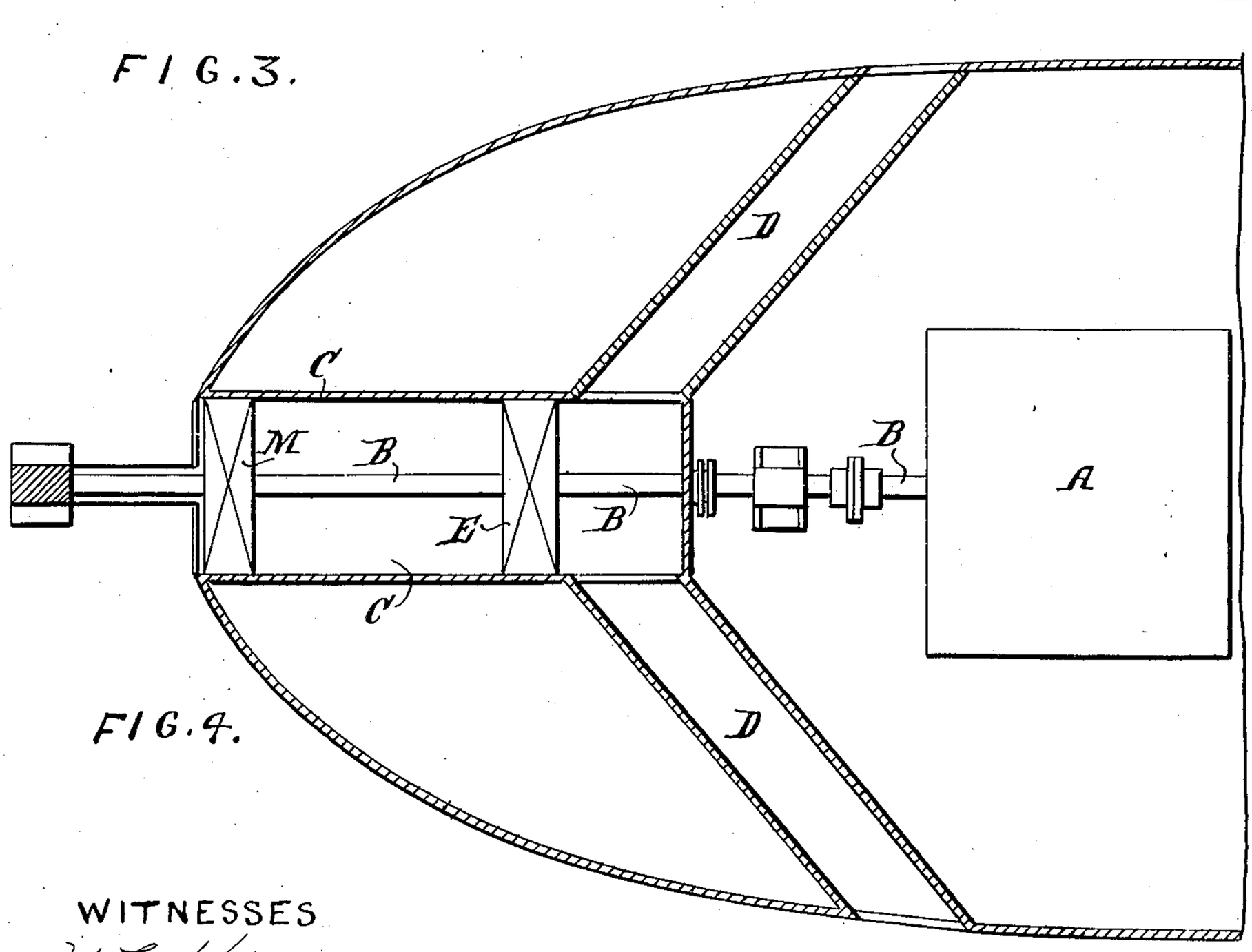


FIG. 4.

WITNESSES

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3 SHEETS—SHEET 3.

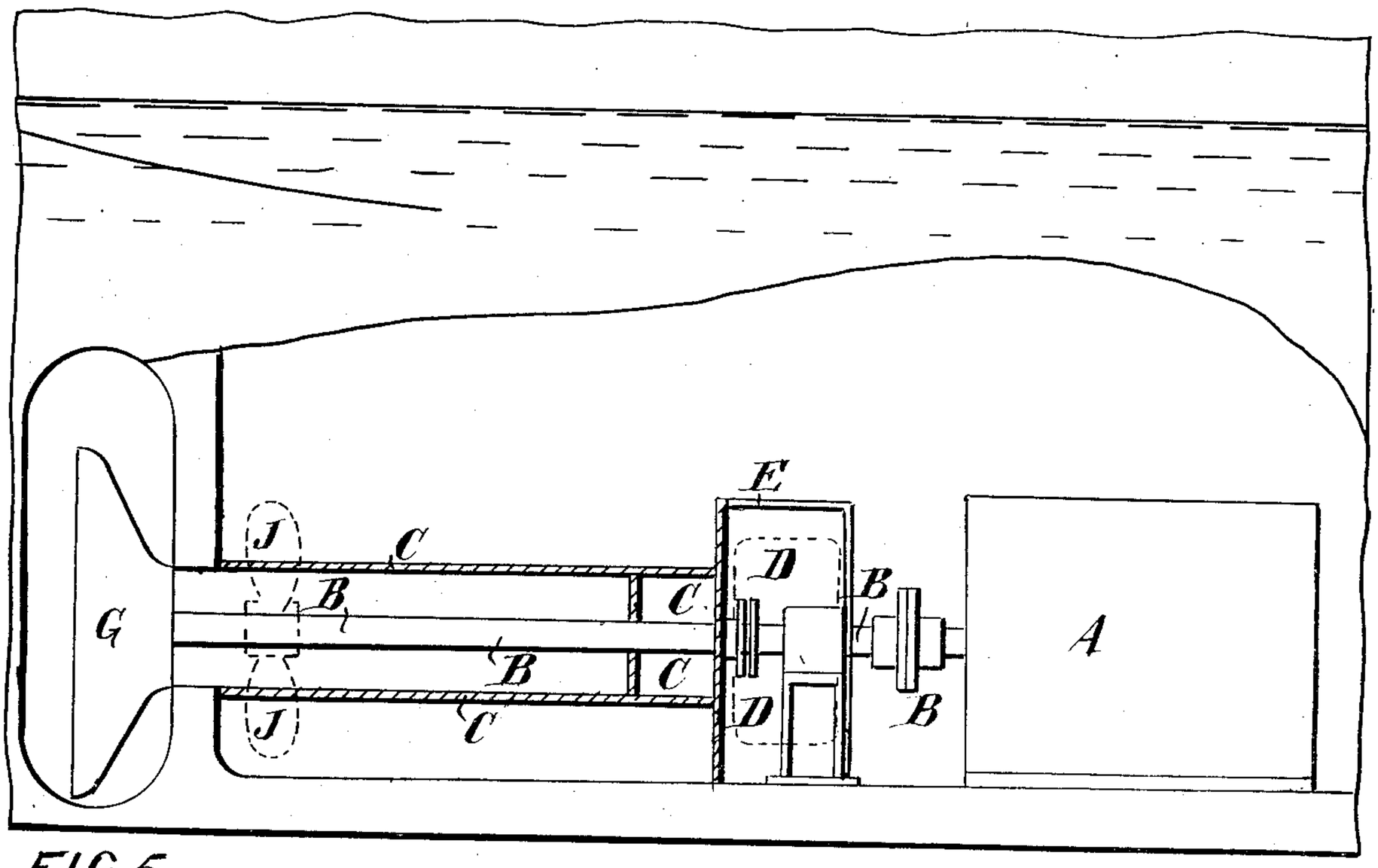


FIG. 5.

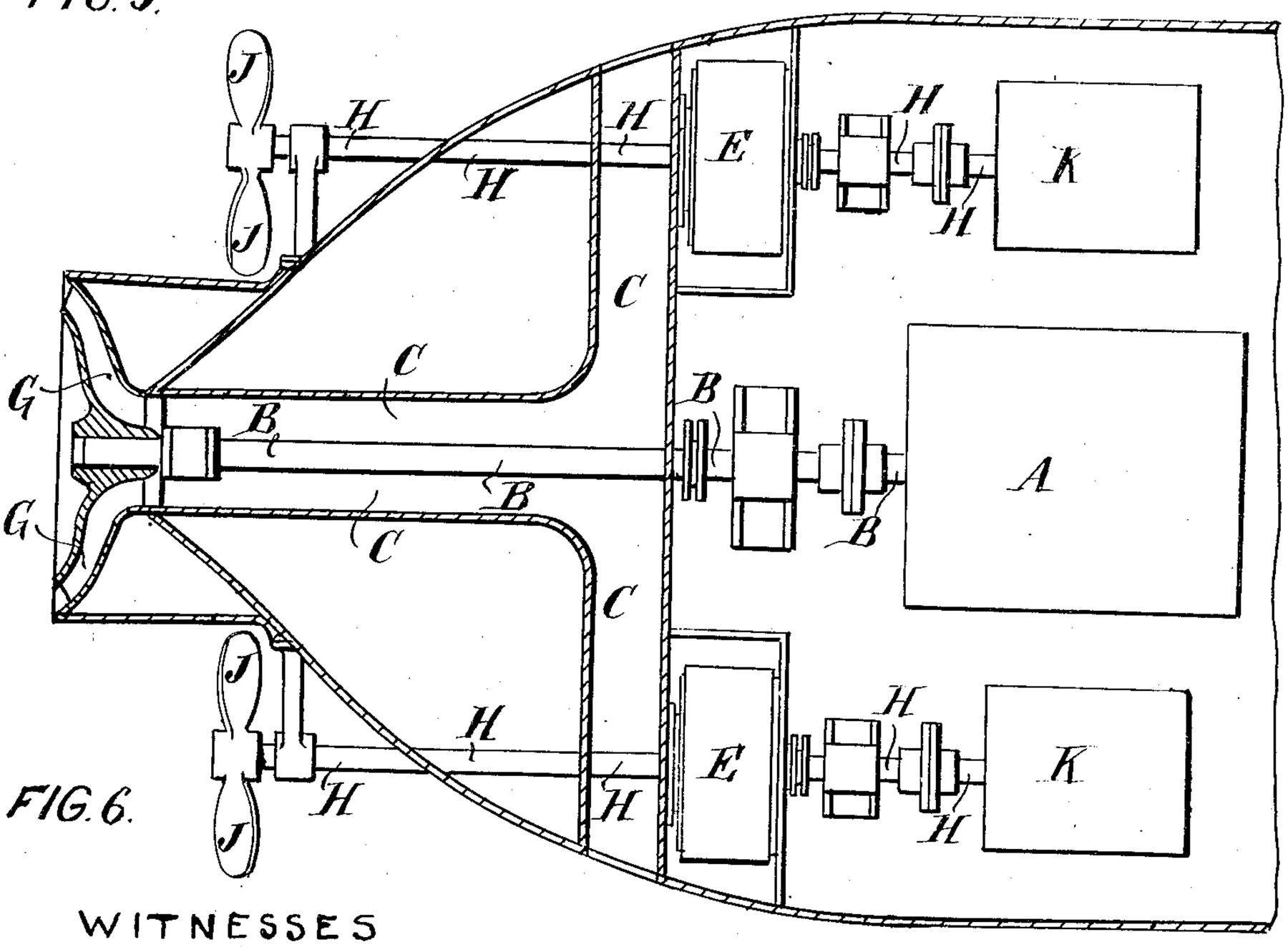


FIG. 6.

WITNESSES

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# UNITED STATES PATENT OFFICE.

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## PROPULSION OF SHIPS.

No. 884,079. Specification of Letters Patent. Patented April 7, 1908.

Application filed October 3, 1906. Serial No. 337,193.

*To all whom it may concern:*

Be it known that I, EDWARD JAMES DUFF, a subject of the King of Great Britain and Ireland, and a resident of Liverpool, in the county of Lancaster, England, have invented certain new and useful Improvements in Connection with the Propulsion of Ships, and of which the following is the specification.

My invention has for its object to provide improved means for the propulsion of ships so as thereby to augment the speed hitherto obtainable when using an engine or engines of a given power; or so as to obtain any desired speed with lighter engines thereby effecting economy in steam and coal consumption, (when a steam engine is used) and consequently also saving boiler and bunker space.

According to my invention the engine, or engines, drives a propeller shaft or shafts passing through a tunnel in the ship, the tunnel being open at both ends, and I augment the rotative effort put upon the shaft or shafts by the engine by utilizing the power which is in the head of water required to float the ship, the pressure water thus obtained entering one end of the tunnel and driving a turbine or turbines or equivalent motor on the shaft or shafts, or geared thereto, or on a second propeller shaft. The water from the turbine is ejected from the tunnel by a second turbine, a rotary pump, geared thereto, and reacts upon the depth of water to give the propulsive thrust.

It will be obvious that in carrying out my invention the different integers may be arranged in various ways without departing from the essence of the invention, which is the utilization of the power which is in the head of water required to float the ship to augment the capacity of a prime mover for propulsion of such ship; but in order that my invention and the manner of performing the same may be properly understood I hereunto append three sheets of explanatory drawings showing, by way of example only, in diagrammatic form three possible applications of my invention, Figures 1 and 2, Sheet 1, being, respectively, a sectional side elevation and a sectional plan of a portion of a ship and showing one example; while Figs. 3 and 4, Sheet, 2, and Figs. 5 and 6, Sheet 3, are, respectively, similar views showing second and third examples.

In carrying out the invention according to the example shown in Figs. 1 and 2, a prime mover, A, which may be an ordinary reciprocating steam engine, or other engine of any suitable known construction, drives a propeller shaft, B, passing through a tunnel, C, in the ship, the tunnel being open at both ends, the inlet to the forward open end being through an opening, D, (shown by dotted lines) leading from the hull of the ship to the casing of a turbine, E, or equivalent motor, (hereinafter referred to) which in turn communicates with the tunnel, C. The turbine, E, is on the shaft, B, or it may be geared thereto, and to drive the turbine I utilize the power which is in the head of water required to float the ship, the pressure water thus obtained entering the opening, D, and driving the turbine, E, thus augmenting the rotative effort put upon the shaft, B, by the engine, A.

The first turbine or motor, E, which may be of any suitable known construction, is of such capacity that it and the engine, A, work together at such a speed that the pressure of water gives up its power in aiding the rotative power of the engine upon the shaft, B, and leaves the turbine practically without pressure. The centrifugal pump, G, or second turbine which may also be of any suitable known construction, must be capable of such a duty that the tail water leaving the first turbine, E, is removed at such a speed as prevents the possibility of pressure accumulating in the portion of the race behind the first turbine, and by the ejection of the water by the propellers, or the like, against the head of water in the tail end of the tunnel, C, increased power is obtained towards propulsion of the ship. In other words, the pump G should be capable of displaying as much or a little more water than is admitted to the tail race by the turbine.

Owing to the augmentation of shaft torque by the first turbine or motor, the capacity of a prime mover of given power is considerably augmented towards propulsion of the vessel, so that with a given motive power increased speed may be obtained, or for a given speed less power be required.

The arrangement hereinbefore described could be fitted in duplicate to a ship, one at each side, and thus give twin screw propulsion; and, if desired, an ordinary screw propeller shaft could be arranged between so as to provide for reversing when necessary.

The examples shown in Figs. 3 and 4, shows an arrangement practically similar to the modification hereinbefore described, but not

requiring a separate propeller shaft for reversing. In this example, the turbine, E, on the forward end of the shaft, B, is of the axial flow type, and instead of the rotatory pump (G) on the shaft, B, at the exit end of the tunnel as described in the preceding example, a second axial flow turbine, M, is used. Turbines of this type are reversible machines and consequently when the prime mover, A, rotates the shaft, B, so that water entering the openings, D, drives the forward turbine, E, then the rear turbine, M, will throw out the water to obtain the propulsive effort as hereinbefore described; but when the shaft B, is rotated in the opposite direction for reversing, the rear turbine, M, which previously threw out the water is now driven by water then entering that end of the tunnel, C, and the forward turbine, E, now acts as a propeller and throws out the water through the openings, D.

According to the example shown in Figs. 5 and 6, the tunnel, C, is so shaped that two turbines, E, or equivalent motors, may be used to utilize the power which is in the head of water required to float the ship, these turbines being each on a separate shaft, H, arranged one on each side of the ship, and each shaft having on its outer end a screw propeller, J. The water from the turbines, E, passes into the central portion of the tunnel C, from which it is discharged against the head of water existing outside the ship, as hereinbefore described, by means of a rotatory pump, G, on a shaft, B, driven by a prime mover, A, of any suitable known construction. Instead of a pump, G, a second turbine, may be used in this example as in the example hereinbefore described with reference to Figs. 1 and 2, of the accompanying drawings; and as the reaction of this water discharging pump, G, or the like, is equivalent in efficiency to that of an ordinary screw propeller, the net gain in propulsion is that given by the pressure of the sea water to the two outside turbines, E.

To facilitate reversing when necessary a reversing steam turbine, K, or other suitable motor is arranged in connection with each shaft, H, so that it may be connected to such shaft by any suitable form of clutch (not shown) when it is required to run the ship backwards. Or these motors, K, may be permanently connected with the shafts, H, and run idle while the turbines, E, are working, and, of course, when the motors are working the turbines will not be doing any useful work, but as reversing is only usually required for short periods this is of little moment. It is possible also that instead of using reversing motors, K, the shafts, H, might be connected, when desired for reversing purposes, to the main engine shaft, B, by means of suitable gearing or by a belt or chain drive. Or, as in the example hereinbefore described with reference to Figs. 3 and 4, the turbine, E, and rotatory pump, G, may be replaced by two axial flow turbines so that either will act as the turbine when the other is acting as a propeller, depending on the direction of rotation of the shaft, B, and the desired aid to propulsive effort will thus be obtained for both directions of propulsion.

It is to be understood that although in the claims unities of integers are expressed, pluralities are within their scope and it is to be understood that where turbines are mentioned their equivalents expressed in the specification are included.

What I claim is:

Means for propelling ships, comprising a prime mover, a centrifugal pump actuated thereby, a shaft therefor, a turbine mounted directly on said shaft and in the lower part of the boat, means connecting the turbine with the water outside the boat whereby the power which is in the head of water required to float the ship is utilized, said centrifugal pump adapted to eliminate the back pressure on the turbine and capable of removing more water than is admitted by the turbine.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses.

EDWARD JAMES DUFF.

Witnesses:

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RALPH GIBBS.