No. 702,729. Patented June 17, 1902.

J. P. HOLLAND.

SUBMARINE BOAT.

(Application filed Oct. 5, 1900.)

(No Model.)

Fig. 1.

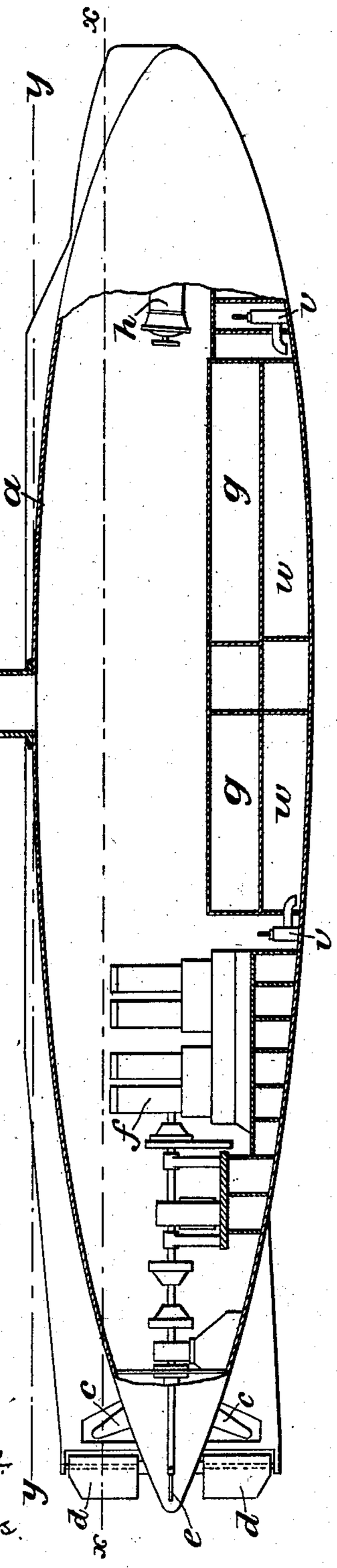
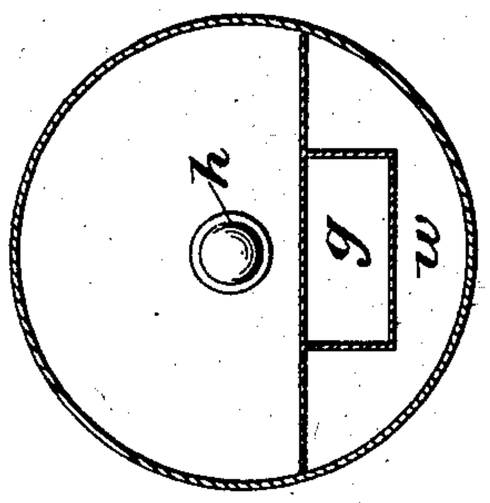


Fig. 2.



WITNESSES:

L. N. Legendre.

Peter A. Ross.

INVENTOR

John P. Holland.

BY Munn & Co.

ATTORNEY

UNITED STATES PATENT OFFICE.

JOHN P. HOLLAND, OF NEWARK, NEW JERSEY, ASSIGNOR TO ELECTRIC BOAT COMPANY, A CORPORATION OF NEW JERSEY.

SUBMARINE BOAT.

SPECIFICATION forming part of Letters Patent No. 702,729, dated June 17, 1902.

Application filed October 5, 1900. Serial No. 32,117. (No model.)

To all whom it may concern:

Be it known that I, JOHN P. HOLLAND, a citizen of the United States, residing at Newark, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Submarine Boats or Vessels, of which the following is a specification.

This invention relates to the class of submarine boats or vessels which are designed to operate both on the surface of the water and under the water and which are normally intended for use in war against the vessels of an enemy.

A most essential requisite for a boat operating on the surface of the water is that positive buoyancy with a very safe margin be always preserved intact, because lacking buoyancy the boat sinks and is lost. The buoyancy of a boat depends on its specific gravity—that is, on the weight of its total volume or bulk in comparison with an equal volume of the water of flotation. If the weight included in the volume of the boat be greater than that of an equal volume of water, the boat will sink in the water. If it be lighter, the boat will float, and the margin of safety against sinking depends upon how much lighter is the boat's volume than an equal volume of the water of flotation.

A boat designed to navigate under the surface of the water must be capable of fulfilling certain conditions that are not required in those intended to operate only on the surface, and these new conditions are essential for a submarine boat intended for war purposes. It must have unchangeable weight while running light on the surface of the water and also while diving, and it must have a fixed center of gravity while in each condition. The submarine boat or war vessel will ordinarily, like other vessels, move on the surface of the water, and it will be submerged only while making an attack or while concealing its presence or movements. As it may encounter enemies unexpectedly while at the surface, it is essential that it be capable of diving quickly in order to escape their attack—that is, it must have the power of going rapidly from the light to the awash or diving condition—and it must also be capable of coming to the surface for observation and of disappearing beneath the surface quickly or rapidly. This submerging is accomplished by admitting water into water-ballast tanks in the boat until the buoyancy is reduced to about one five-hundredth of its displacement. The boat being in motion, this reserve buoyancy is overcome by the horizontal or diving rudders, and it is then steered under water. The use of reserve buoyancy is to cause the boat to rise to the surface unaided in case of a disabling accident to the propelling machinery. It is important that the water-ballast tanks be completely filled before the boat is submerged, because if they be not filled when the boat is submerged owing to their being of too great capacity or for any other reason the water will run to their lower ends when the boat heels slightly from the horizontal plane in steering downward or in maneuvering, thus changing the position of the center of gravity of the boat and its contents. Should this heeling occur when the boat is running forward and when the direction of heeling is downward ahead, the boat is likely either to run against the bottom and be wrecked or if the water happens to be deep enough to run to a depth sufficient to cause collapse, owing to excessive hydrostatic pressure. Should the direction of heeling be downward astern while the boat is running ahead, there is serious risk that the boat may rise to the surface before its operator gains control, and thus expose itself to destruction by its enemies. It is equally important that just enough water be admitted quickly or rapidly to reduce the margin of buoyancy to about one five-hundredth of the displacement. It is not practicable to do this by the exercise of the operator's judgment alone, except very slowly and in still water, in order that he may be able to estimate and correct the margin of emersed volume, which should be equal to the reserve buoyancy. It would be quite impracticable to perform this operation properly in a seaway or while enemies were rapidly approaching on the surface. It is therefore essential that the water-ballast chambers have a certain fixed volume, so that they may be filled as rapidly as possible with a certain definite weight of water, thus render-

ing it impossible that a dangerous weight be taken on board through error or accident. Lacking this arrangement the risk would be incurred of being unable to dive quickly at the critical moment, and thus expose the boat to destruction by its enemies, or of running to so great a depth that it would be crushed by excessive hydrostatic pressure. To accomplish this object, the emersed volume of the boat while floating light on the surface of the water must be maintained unchangeable, and it must be equal to the volume of the water-ballast tanks plus a volume equal to the volume of the reserve buoyancy.

In the accompanying drawings, which will serve to illustrate the invention, Figure 1 is a longitudinal section of a submarine boat embodying my invention, and Fig. 2 is a cross-section of the same.

a designates the body or hull of the boat, which is provided with the usual conning-tower or turret *b*, propeller *c*, rudders *d* for horizontal steering, and rudders *e* for diving.

f designates the motors.

g designates the accumulators.

h is the expulsion-tube, and *w* the water-ballast tank or tanks. The ballast-receptacle is ordinarily a single tank partitioned for strength and rigidity into a number of cells or chambers; but this feature is not essential to my present invention, which consists in providing a submarine boat or vessel with a water-ballast chamber or receptacle having a fixed capacity of such volume as to contain just enough of the water of flotation to put the boat in diving condition when said receptacle is completely filled or, in other words, to contain enough water to submerge the emersed portion less the portion reserved for buoyancy. The tank or tanks *w* may be filled by means of Kingston valves *v*, operated in any way known in the art, and the contained air may be allowed to escape at an air-cock at the highest part of the tank. In the figure the line *x* indicates the water-level when the boat is in condition for surface running with the ballast receptacle or tanks empty, the part above this line being called the "emersed" portion, and the line *y* indicates the water-level when the boat is in diving condition.

Having thus described my invention, I claim—

In a submarine boat, the combination with water-ballast means having a fixed capacity to contain just sufficient water to overcome the normally emersed portion of the boat, less the reserve buoyancy, of the means for propelling and steering the boat, whereby the boat may be made to dive, to run while submerged, and return to the surface without varying the amount of water-ballast.

In witness whereof I have hereunto signed my name, this 20th day of September, 1900, in the presence of two subscribing witnesses.

JOHN P. HOLLAND.

Witnesses:

HENRY CONNETT,

PETER A. ROSS.