

No. 702,728.

Patented June 17, 1902.

J. P. HOLLAND.
SUBMARINE BOAT.

(Application filed Oct. 3, 1900.)

(No Model.)

2 Sheets—Sheet 1.

Fig. 1.

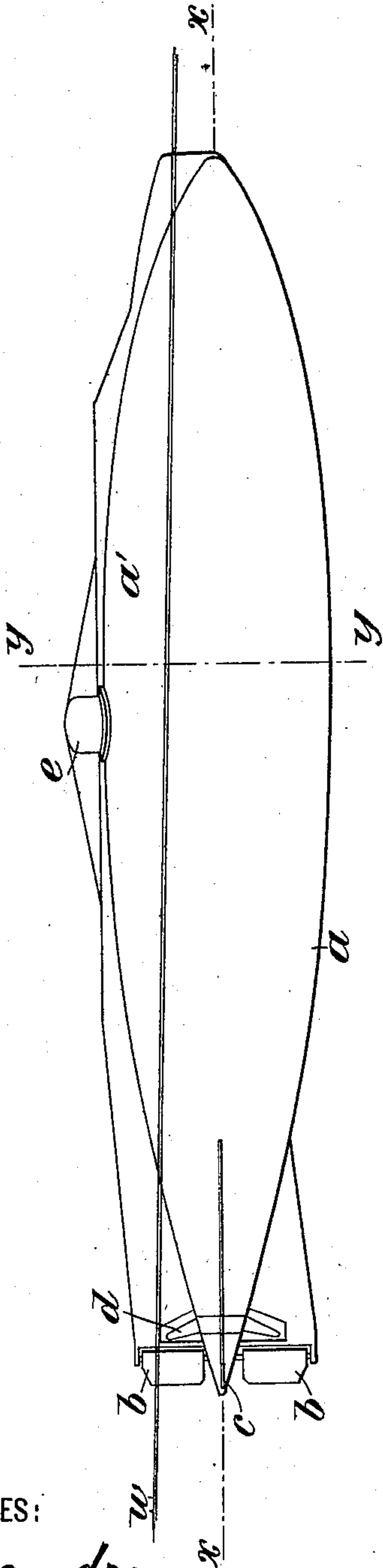
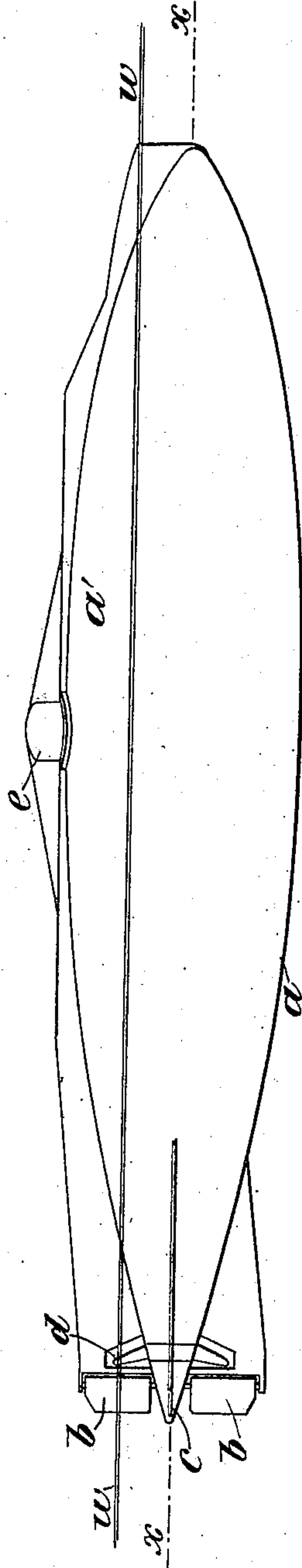


Fig. 2.



WITNESSES:

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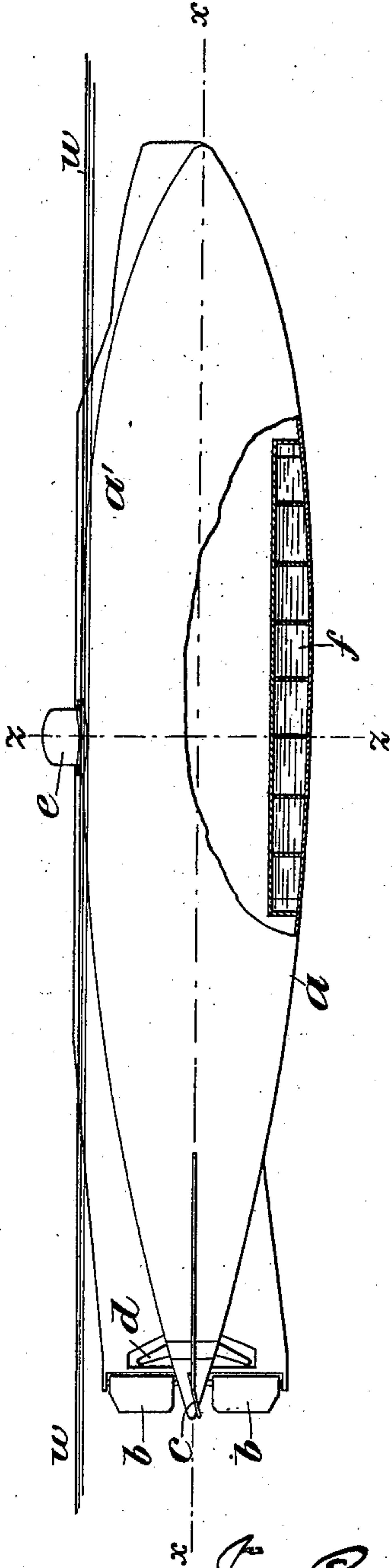
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Fig. 3.



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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. 702,728, dated June 17, 1902.

Application filed October 3, 1900. Serial No. 31,874. (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 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 for operation both on the surface of the water and below the surface thereof and which are normally intended for employment in war against the vessels of an enemy.

A vessel designed to navigate under the surface of the water must fulfil certain conditions in order to be available as a submarine war vessel. Among these conditions may be mentioned ability to maneuver rapidly in the horizontal plane while moving on the surface of the water with normal emersion and in horizontal and vertical planes while submerged. While operating on the surface the vessel must possess a moderate transverse and longitudinal metacentric height, and while operating submerged she must possess the quality of handiness and stability in a high degree.

In order to provide the best conditions for speed while the vessel is running on the surface of the water with empty water-ballast tanks, she must be so trimmed that she will lie on an even keel, and to render it possible to maintain this trim at full speed the center of gravity of the vessel must be a considerable distance aft of its center of volume, so that it will float while lying still with the stern more deeply submerged than the bow, and the distance separating the centers of buoyancy and gravity will depend on the shape of the vessel and especially on the fineness of its lines. As this trim would not afford favorable conditions for speed and handiness while running submerged, it is necessary to so alter the relation of the centers of buoyancy and gravity during the act of submergence that the vessel shall lie on an even keel while it is submerged and stationary, the elevating power due to the reserve buoyancy being then effective vertically over the center of buoyancy of the submerged vessel. In order to accomplish these objects, the center of gravity of

the water-ballast tanks is placed forward of the center of buoyancy of the vessel such a distance that the volume of the water-ballast tanks multiplied by the distance of their center of volume forward of the vessel's center of buoyancy when the water-ballast tanks are empty is equal to the volume of the emersed portion of the vessel's body multiplied by the distance of its center of volume forward of the vessel's center of buoyancy under the same conditions. With this arrangement of ballast-tanks the best trim for least resistance during surface running and the best trim for submerged running are obtained automatically by emptying or filling the water-ballast tanks.

The condition of buoyancy which produces an elevation of the stem or bow and a corresponding submergence of the stern while the vessel is lying still on the surface with empty ballast-tanks and which provides that the weight of water thrown on her bows by the bow-wave while she is running shall just balance this excess of buoyancy forward, so that she will run on the surface on an even keel, is altered by filling the ballast-tanks so that the excess of buoyancy maintained forward while running on the surface is exactly counterbalanced, and the boat is in a condition to run while submerged on an even keel, its center of gravity being vertically under its center of buoyancy.

In the drawings, which illustrate a submarine boat or vessel embodying my invention, Figure 1 is a side elevation of the vessel represented as at rest on the surface with the ballast-tanks empty and the hull down at the stern, and Fig. 2 is a similar view showing the vessel under full speed on the surface on an even keel. Fig. 3 is an elevation, partly in section, of the boat in diving condition with the ballast-tanks full and the deck awash.

In the views, *a* is the hull of the boat, of cigar shape, and *a'* the normal emersed portion thereof.

b represents the rudders for horizontal steering.

c represents the diving-rudders.

d is the propeller, and *e* is the conning tower.

It will be noted that when the vessel is at

rest, with the ballast-tanks for diving empty, as in Fig. 1, the stern sinks lower than the stem and the longitudinal axis x of the vessel is inclined to the plane w of the surface of the water. When the vessel is running at full speed on the surface, however, with the ballast-tanks empty, as in Fig. 2, it will be on an even keel, or, in other words, the axis x will be parallel with the surface w of the water.

When, as seen in Fig. 3, the ballast-tanks f are filled for diving and the vessel is stationary, this filling of the tanks will bring the stationary vessel to an even keel, with the elevating power of the reserve buoyancy vertically over the center of buoyancy of the submerged vessel.

As above stated, the distance between the center of buoyancy and the center of gravity in the vessel will depend on the shape and fineness of the lines of the vessel, and this being a matter of calculation no attempt has been made to indicate with exactness these centers in the drawings, nor has it been deemed necessary to indicate in the drawings the centers of gravity when the ballast-tanks are empty and when they are filled. These are matters that will be readily understood by the naval constructor. In Fig. 1, however, the line y indicates approximately the transverse plane in which is situated the center of gravity of the emerged portion a' and of the ballast-space f , and in Fig. 3 the line z indicates approximately the transverse plane in which is situated the vessel's center of gravity when submerged.

Having thus described my invention, I claim—

1. A submarine vessel designed to float on an even keel when running on the surface of

the water, having the center of volume of the emerged portion of its body situated forward of the center of buoyancy of the vessel, to counterbalance the weight of the bow-wave tending to depress the boat at the stem, and having water-ballast tanks of which the center of gravity is placed forward of the center of buoyancy of the vessel such a distance that the volume of the water-ballast tanks, multiplied by the distance of their center of volume forward of the vessel's center of buoyancy when the water-ballast tanks are empty, is equal to the volume of the emerged portion of the vessel's body multiplied by the distance of its center of volume forward of the vessel's center of buoyancy under the same conditions, whereby, when said tanks are filled for diving, the buoyancy of said emerged portion may be neutralized and the boat brought with its longitudinal axis substantially parallel with the surface of the water, for the purpose set forth.

2. A submarine vessel designed for operation both on and under the surface of the water, and having water-ballast tanks of capacity for sinking it to the awash condition, said vessel having its center of gravity situated, when said tanks are empty, aft of the center of buoyancy, and said tanks being of such capacity as, when they are filled, to put the vessel on an even keel, substantially as set forth.

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.