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J. H. GREAR & T. S. BAILEY

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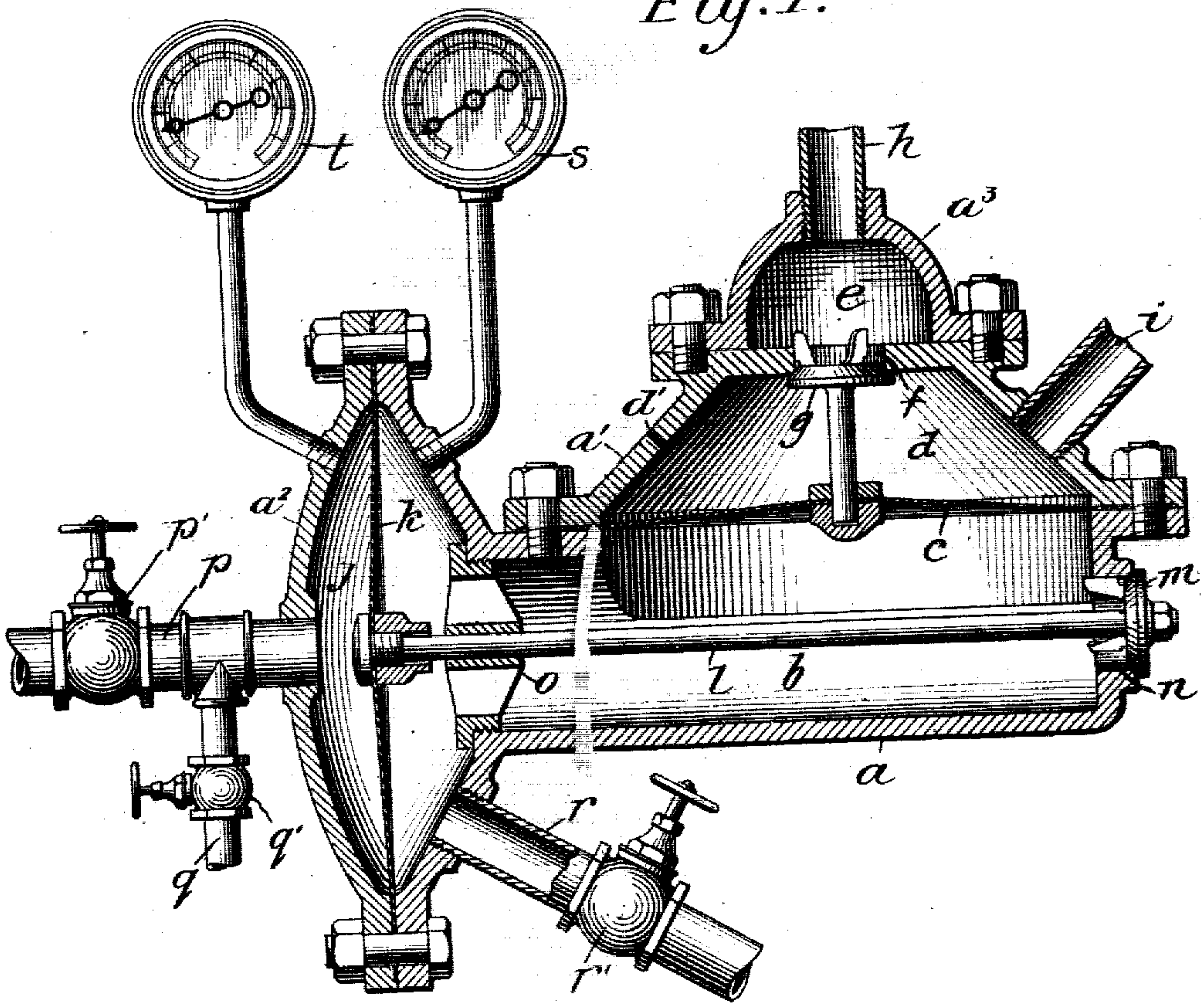
L. Y. SPEAR & T. S. BAILEY.

AUTOMATIC SAFETY DEPTH REGULATING VALVE FOR SUBMARINE
OR SUBMERSIBLE BOATS.

APPLICATION FILED JUNE 26, 1905.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

D. W. Edlin.
R. Court.

Inventors:

Lawrence Y. Spear.
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No. 820,872.

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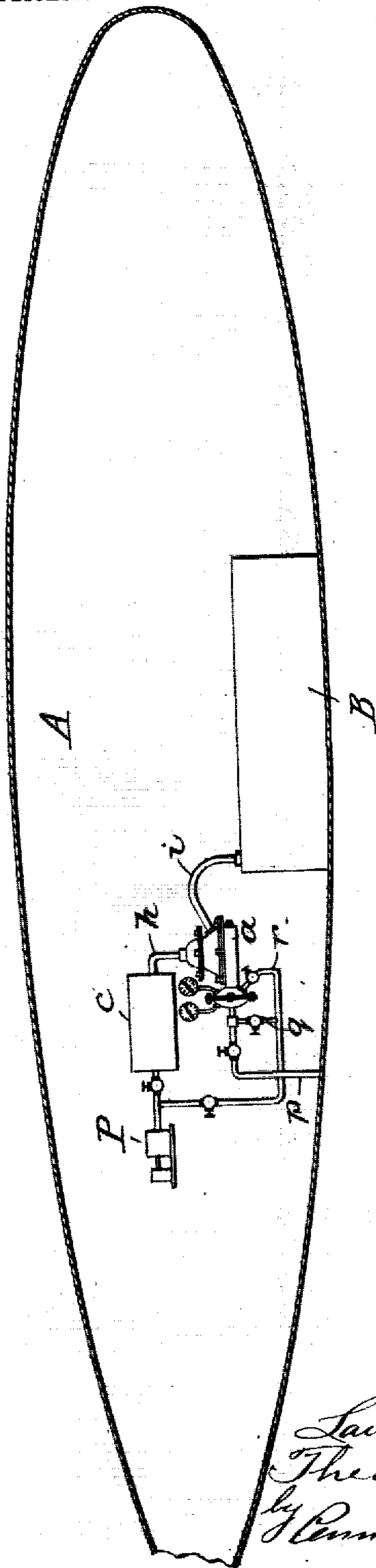
L. Y. SPEAR & T. S. BAILEY.

AUTOMATIC SAFETY DEPTH REGULATING VALVE FOR SUBMARINE
OR SUBMERGIBLE BOATS.

APPLICATION FILED JUNE 26, 1905.

2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

LAWRENCE Y. SPEAR AND THEODORUS S. BAILEY, OF QUINCY, MASSACHUSETTS, ASSIGNORS TO ELECTRIC BOAT COMPANY, OF BAYONNE, NEW JERSEY, A CORPORATION OF NEW JERSEY.

AUTOMATIC SAFETY-DEPTH-REGULATING VALVE FOR SUBMARINE OR SUBMERGIBLE BOATS.

No. 820,372.

Specification of Letters Patent.

Patented May 8, 1906.

Application filed June 26, 1905. Serial No. 267,018.

To all whom it may concern:

Be it known that we, LAWRENCE Y. SPEAR and THEODORUS S. BAILEY, citizens of the United States, residing at Quincy, county of Norfolk, State of Massachusetts, have invented certain new and useful Improvements in Automatic Safety-Depth-Regulating Valves for Submarine or Submergible Boats; and we do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates to submarine or submergible boats, and more particularly to a submergence-regulator or automatic safety-depth-regulating valve therefor, by means of which the boat may be prevented from descending beyond a certain predetermined depth, at which the regulator operates to admit air under pressure into certain water-ballast or submergence tanks, displacing the water therein contained, and thereby lightening the boat to the extent of the water expelled.

In the accompanying drawings, Figure 1 is a sectional elevation of a submergence-regulator. Fig. 2 is a vertical longitudinal section through a submarine or submergible boat having the invention applied thereto.

Referring to the drawings, *a* indicates the casing or housing of the depth-regulating valve or submergence-regulator, which is provided with caps *a'* *a''*, between which and the main portion of the casing are located the diaphragms *c* and *k*, respectively, so that that portion of the casing included between the diaphragms constitutes a pressure-chamber, of which the diaphragms form movable walls.

Connected to the diaphragm *c* is a valve *g*, coöperating with a seat *f* in the top of the cap *a'* and serving to establish or cut off connection between a pipe *h*, connected to a source of fluid under pressure, and a pipe *i*, leading to a water-ballast or submergence tank. The pipe *h* is connected to a removable cap *a''*, mounted upon the cap *a'*, which cap *a''* constitutes the inlet side of the valve *g*, and the pipe *i* opens into the chamber *d*, formed within the cap *a'* above the diaphragm, so that when said valve *g* is opened fluid under

pressure enters by way of pipe *h*, inlet-chamber *e*, chamber *d*, and escapes by way of pipe *i*.

The main chamber *b* of the casing is provided with an outlet *n*, adapted to connect said chamber with the atmosphere, which outlet is normally closed by a reciprocating valve *m*, which opens outwardly and is controlled by the movement of the diaphragm *k*, to which said valve is connected by a suitable stem *l*, guided in the spider or bridge-piece *o*. Connected to the chamber *b* is a pipe *r*, having therein a cut-off valve *r'*, which pipe leads to a suitable source of fluid-pressure, and a pressure-gage *s* is likewise attached to said chamber in order that the pressure admitted to said chamber may be accurately determined.

The diaphragm *k* forms with the cap *a''* a chamber *j* in the end of the casing which is adapted to be thrown into communication with the water of submergence, so as to submit the diaphragm *k* to the hydrostatic pressure of the water outside of the boat. For this purpose a pipe *p* connects chamber *j* with the exterior of the boat, which pipe is provided with a cut-off valve *p'* to exclude the exterior hydrostatic pressure when desired. The chamber *j* is likewise provided with a pressure-gage *t*, by means of which the pressure in chamber *j* may be accurately determined, and in order to provide means for practically testing the operation of the regulator without admitting water thereto from outside the boat a source of fluid under pressure inside the boat may be connected to chamber *j* to operate upon diaphragm *k* through pipe connection *q*, provided with a cut-off valve *q'*.

Fig. 2 shows diagrammatically the apparatus above described installed in a submarine boat A of the ordinary type, said boat being provided with a water-ballast or submergence tank B, which is connected to the regulator by the pipe *i*. A compressed-air tank C is connected to the regulator by pipe *h*, and an air-pump P serves to store air under pressure in the tank C and is also adapted to be put into communication with the pressure-chamber *b* or the chamber *j* by means of the valved pipes hereinbefore described, so that any desired degree of pressure may be established in chambers *b* and *j* either directly from the pump P or from the storage-tank C.

The apparatus as above described operates substantially as follows: Air under pressure is admitted to chamber *b* by way of the pipe *r*, either directly from the pump *P* or from the storage-tank *C*, until any desired degree of pressure is established in said chamber, as indicated by the gage *s*. This air under pressure within the chamber *b* acts against diaphragm *c*, forcing it upward and seating the valve *g*, so as to cut off communication between pipe *h*, leading to the compressed-air tank, and the pipe *i*, connected to the water-ballast or submergence tank. This air-pressure also forces the diaphragm *k* outward, thereby drawing the valve *m* firmly against its seat, so that the air cannot escape from the chamber *b*, but is retained therein with little or no diminution of pressure. Should any leakage occur, the pressure may be maintained by partly opening the valve *r'* and admitting more air to the chamber *b*. When the boat reaches a depth at which the pressure of the water on the outside of diaphragm *k* exceeds that of the air confined within chamber *b*, said diaphragm *k* is forced inward, thereby opening the valve *m* and allowing the air in chamber *b* to escape. The diaphragm *c* being thus relieved from pressure on its under side no longer holds the valve *g* to its seat *f*, and air-pressure from storage-tank *C*, by way of pipe *h*, forces the valve *g* off its seat, thereby establishing direct communication between said pressure-tank *C* and the water-ballast tank *B*, so that the compressed air flowing into said tank *B* displaces the water therein by blowing or forcing it out through a valve in the bottom of the tank in the ordinary manner, which permits the boat to rise. As air under pressure is always acting against the valve *g*, and as any considerable pressure on the diaphragm *c* would tend to force it down and open the valve *g*, a small vent-hole *d'* is drilled in the cap *a'* to allow any leakage of air past the valve *g* to escape. As above stated, pipe *q* is connected to the compressed-air tank or to the air-pump at will, and its purpose is to permit the depth-regulating apparatus to be tested, as follows: Sea-valve *p'* is closed, and air under pressure is admitted through valve *q'* and enters the chamber *j* behind the diaphragm *k*, the gage *t* registering the pressure in said chamber. When a pressure in said chamber *j* is established sufficient to overbalance the pressure in chamber *b* on the other side of the diaphragm, the diaphragm *k* is forced inward and valve *m* is opened, which relieves the pressure in chamber *b* and permits diaphragm *c* to fall and valve *g* to open and opens up communication between the air-storage tank *C* and the water-ballast tank *B*. By this means the pressure in chamber *b* necessary to counterbalance a given hydrostatic pressure on the sea side of diaphragm *k* may be accurately determined

by means of the gages *s* and *t*, and accordingly the necessary pressure may be established in chamber *b* to prevent the boat sinking beyond any desired degree of submergence.

Having thus described our invention, what we claim, and desire to secure by Letters Patent, is—

1. A submergence-regulator for submarine boats, comprising a casing, a pressure-chamber therein having movable walls, one of which is subject to pressure from the water of submergence, a valve connected to said latter wall and controlling communication between said chamber and the atmosphere, a valve controlling communication between a source of fluid-pressure and a water-ballast tank and operatively connected to the other movable wall, whereby opening of the first-named valve will cause the latter valve to open.
2. A submergence-regulator for submarine boats, comprising a casing, a valve therein controlling communication between a source of fluid-pressure and a water-ballast tank, a diaphragm supporting said valve, a valve controlling communication between a pressure-chamber in said casing and the atmosphere, and a diaphragm-controlling the movement of said valve and open to pressure from the water of submergence, the space between said diaphragms forming the pressure-chamber aforesaid connected to a source of regulable fluid-pressure.
3. A submergence-regulator for submarine boats, comprising a casing, two diaphragms in said casing forming a pressure-chamber therein connected to a source of fluid-pressure to hold said diaphragms distended, a valve connected to one diaphragm controlling communication between a source of fluid-pressure and a water-ballast tank, a valve connected to the other diaphragm controlling communication between the pressure-chamber and the atmosphere, said latter diaphragm having connection with the water of submergence on the side opposite its valve, and means for regulating the pressure in said chamber.
4. A submergence-regulator for submarine boats, comprising a casing, two diaphragms in said casing forming a pressure-chamber therein connected to a source of fluid-pressure to hold said diaphragms distended, a valve connected to one diaphragm controlling communication between a source of fluid-pressure and a water-ballast tank, a valve connected to the other diaphragm controlling communication between the pressure-chamber and the atmosphere, said latter diaphragm having connection with the water of submergence on the side opposite its valve, means for excluding the water of submergence from said diaphragm, means for admitting fluid-pressure to said diaphragm in lieu

of the water of submergence, and means for regulating the pressure in said chamber.

5 5. A submergence-regulator for submarine boats, comprising a pressure-chamber having a movable wall subject to pressure from the water of submergence, a valve connected to said wall and controlling communication between said chamber and the atmosphere, a valve controlling the amount of water in a ballast-tank, and means operated by reduction of pressure in said chamber to open said latter valve.

10 6. A submergence-regulator for submarine boats, comprising a pressure-chamber having movable walls, one of which is subject to pressure from the water of submergence, a valve connected to said wall and controlling communication between said chamber and the atmosphere, and a valve controlling the amount of water in a ballast-tank and operatively connected to another of said movable walls so as to be opened upon reduction of pressure in said chamber.

20 7. A submergence-regulator for submarine boats, comprising a pressure-chamber having a movable wall subject to pressure from the water of submergence, a valve connected to

said wall and controlling communication between said chamber and the atmosphere, a valve controlling communication between a source of fluid-pressure and a water-ballast tank, and means operated by reduction of pressure in said chamber to open said latter valve. 30

8. A submergence-regulator for submarine boats, comprising a pressure-chamber having movable walls, one of which is subject to pressure from the water of submergence, a valve connected to said wall and controlling communication between said chamber and the atmosphere, and a valve controlling communication between the source of fluid-pressure and a water-ballast tank and operatively connected to another of said movable walls, whereby the ballast-controlling valve will be opened upon the reduction of pressure in said chamber. 40 45

In testimony whereof we affix our signatures in presence of two witnesses.

LAWRENCE Y. SPEAR.

THEODORUS S. BAILEY.

Witnesses:

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W. D. FESLER.