No. 693,272. Patented Feb. 11, 1902.

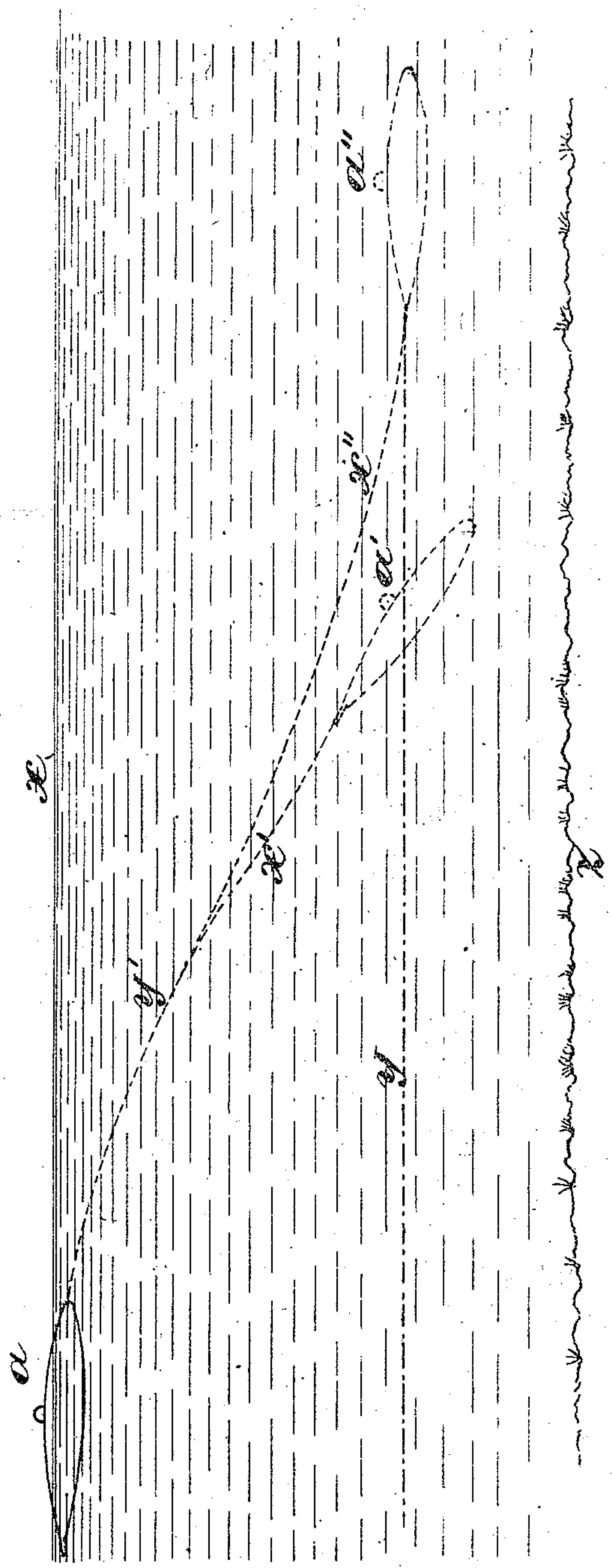
J. P. HOLLAND.

AUTOMATIC DIVING MECHANISM FOR SUBMARINE BOATS.

(Application filed Aug. 13, 1901.)

(No Model.) 4 Sheets—Sheet 1.

Fig: 1.



WITNESSES:

F. W. Wiman

Peter A. Ross.

INVENTOR

John P. Holland

BY

Henry Connett

ATTORNEY

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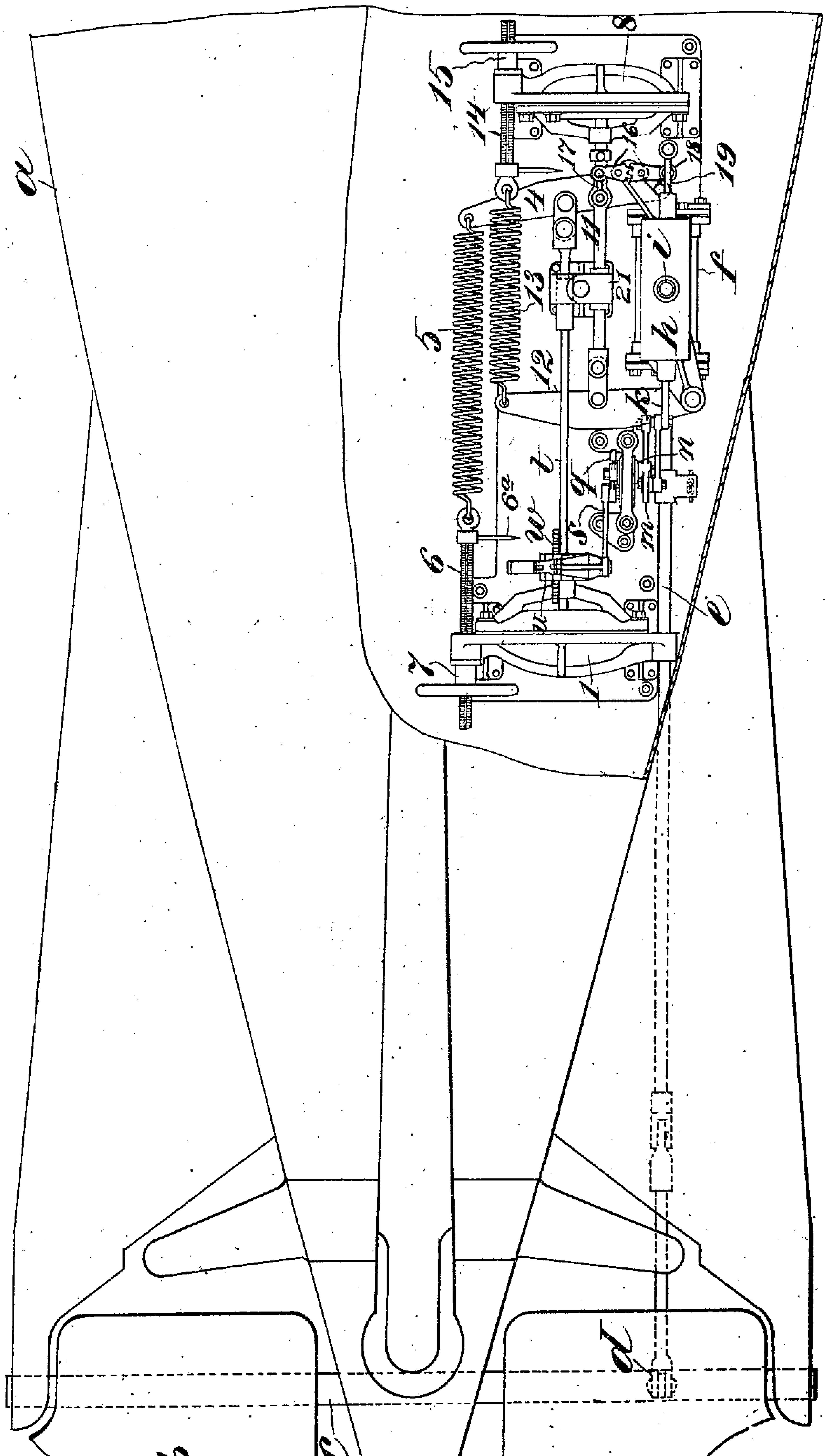
Fig: 2.



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F. W. Wiman

Peter A. Ross

INVENTOR

John P. Holland

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Henry Connett

ATTORNEY

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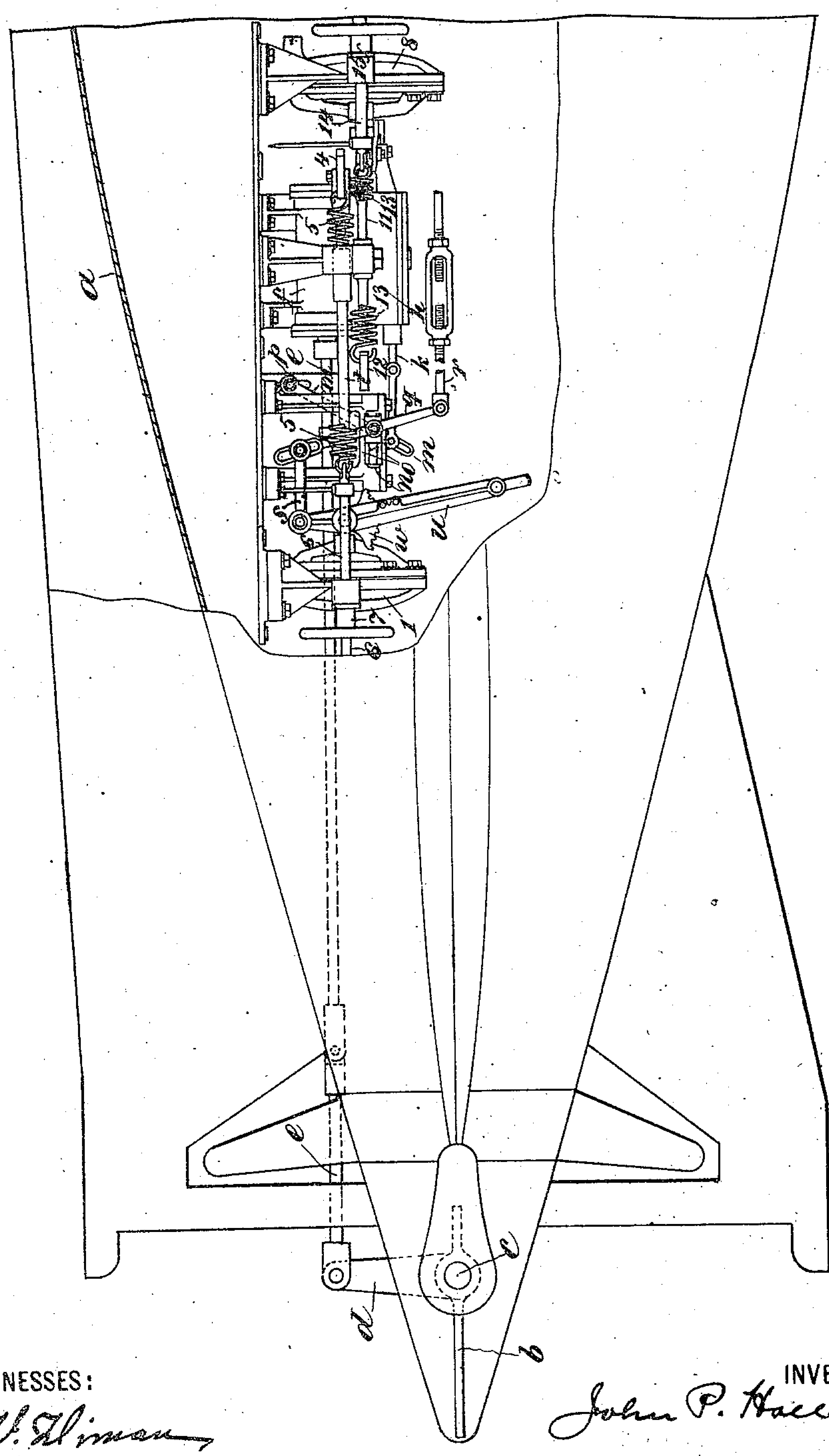
Fig. 3.



WITNESSES:

F. V. Winman

Peter A. Ross

INVENTOR

John P. Holland

BY

Henry Connett

ATTORNEY

No. 693,272. Patented Feb. 11, 1902.

J. P. HOLLAND.

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(No Model.) 4 Sheets—Sheet 4

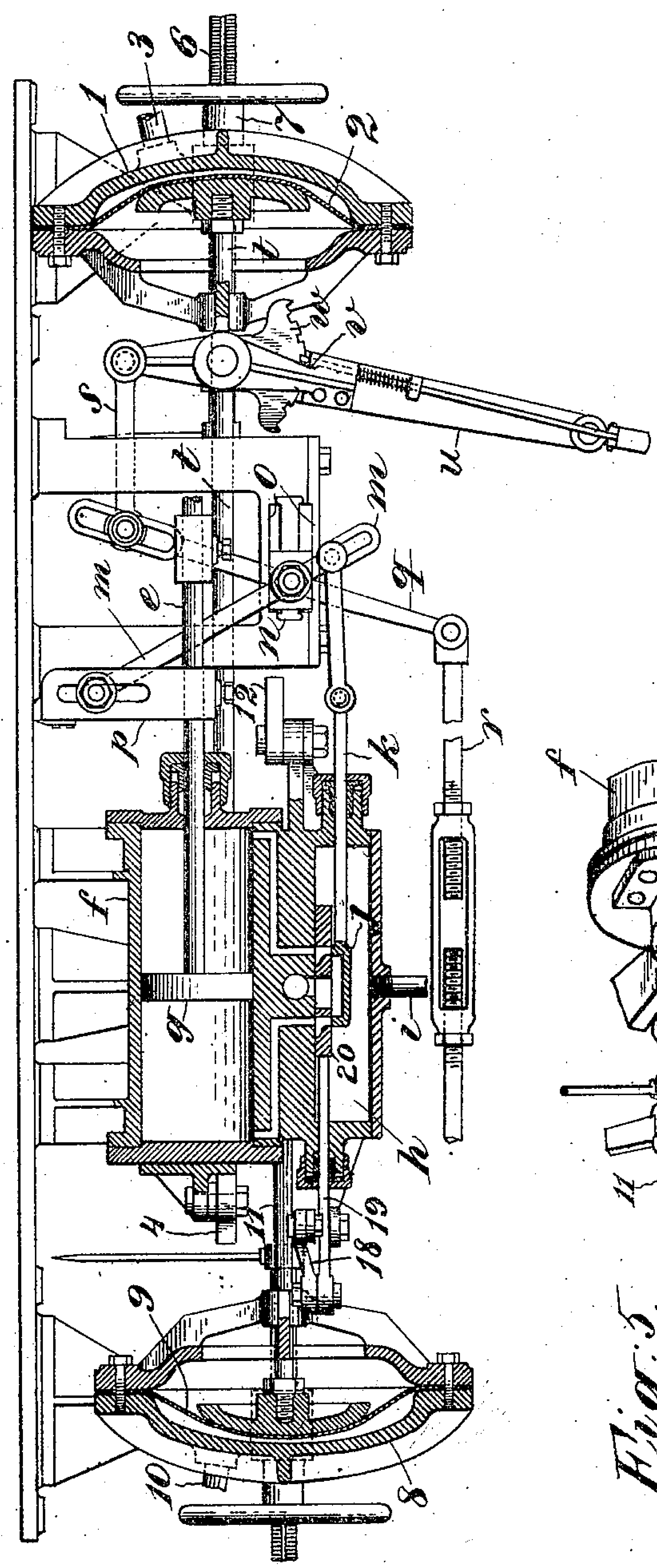

Fig. 4.

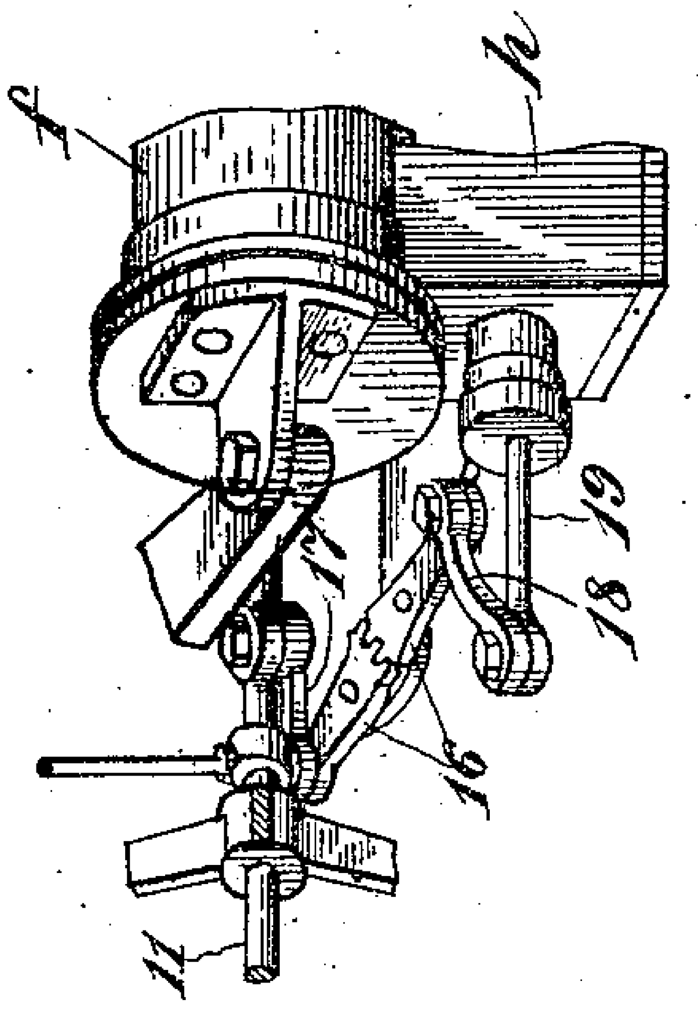

Fig. 5.

WITNESSES

F. W. Hinman

Peter A. Ross

INVENTOR

John P. Holland

BY Henry Connett

ATTORNEY

UNITED STATES PATENT OFFICE.

JOHN P. HOLLAND, OF NEWARK, NEW JERSEY.

AUTOMATIC DIVING MECHANISM FOR SUBMARINE BOATS.

SPECIFICATION forming part of Letters Patent No. 693,272, dated February 11, 1902.

Application filed August 13, 1901. Serial No. 71,883. (No model.)

To all whom it may concern:

Be it known that I, JOHN P. HOLLAND, a citizen of the United States, and a resident of Newark, in the county of Essex and State of New Jersey, have invented certain Improvements in Automatic Diving Mechanisms for Submarine Boats and the Like, of which the following is a specification.

In order that the present invention may be the better understood, it will be proper to state here that in the class of submarine boats, including also the class of automatically-operated boats known as "torpedoes," an engine is employed to actuate the diving-rudders, and the valve of this diving-engine is automatically operated and controlled, in order to cause the boat to dive to a predetermined depth, by a flexible diaphragm exposed on one side to pressure from the water in which the boat is submerged and on the other side to the pressure of a spring the tension of which is capable of regulation or adjustment. The diaphragm actuates a floating lever, which latter modifies the action of the valve of the diving-engine, thus controlling the diving-rudders. The water-pressure and the spring, acting automatically on opposite sides of the diaphragm, therefore control the movement of the boat in a vertical direction. When the boat is at the surface on a level keel and the diaphragm-spring is set for a predetermined depth of dive, this spring sets the diving-rudders over fully into their diving position, so that as soon as the boat is set in motion ahead it begins to dive, descending obliquely. As it continues to descend the hydrostatic pressure on the diaphragm opposing the spring increases with the depth until, at the predetermined depth, the two forces will exactly balance each other. The valve of the diving-engine will then be at the center of its travel, and the diving-rudders will be at "steady," or be alined with the axis of the boat. The path followed by the boat in its descent will be a curve of gradually-increasing radius, because the inclination of the diving-rudders is greatest when the boat is at the surface, and this inclination gradually decreases as the boat descends; but when the boat shall have reached the predetermined depth, and the diving-rudders are thereby brought into alinement with the axis of the boat, the boat's axis will not be horizontal, as it should be. In fact, said axis will cross the plane of predetermined depth at a very considerable angle, and the reverse curve necessary to bring the boat to a level keel must be described below the level or plane of predetermined depth until the boat rises again and traverses said plane from below at a considerable angle. The objection to this controlling means is that if the depth of water should not much exceed the desired depth of submergence at the point where the boat dives it is obvious that the latter will strike the bottom, and this will be almost certain to seriously disable the boat, particularly if the bottom be rocky.

In view of the above conditions the purpose of the present invention is to provide automatic means, operating in conjunction with the means above described, for confining the formation of the reverse curve in the boat's path downward to a depth not exceeding that of the predetermined submergence, whereby the diving boat will be brought to the plane of submergence with a level keel. This is effected by providing automatic means, operating in conjunction with but in a measure independently of the means above described, for giving to the diving-rudders a reversing inclination when the boat shall have descended to a depth which is such a fraction of the total depth of submergence as may be found by experiment suitable for a particular boat. The effect of thus reversing the inclination of the rudders is to cause the boat at the moment of reversal to change its direction and follow a curved path which is the reverse of that it was before following, the new curved path being tangent to the plane of predetermined depth of submergence, thus bringing the boat to a level keel at the proper depth and eliminating the danger due to the boat's descending materially below said depth.

In the accompanying drawings, which serve to illustrate an embodiment of the invention, Figure 1 is a diagrammatic view illustrating the path of the boat in diving. Figs. 2 and 3 are respectively an under side view or plan and a side elevation of the rear portion of a boat provided with the improved diving mechanism. Parts of the boat-body are broken away to show the mechanism. Fig. 4 is a sectional elevation of the diving-engine and mechanism on a larger scale. Fig. 5 is a perspective detail view.

Referring primarily to Fig. 1, x represents the water-line, y is the predetermined plane of submergence, and z is the bottom of the waterway. The boat a is represented in full lines as at the water-level ready for diving. By the ordinary means employed for controlling the diving-rudders the boat would follow the curved path indicated by dotted lines at x', eventually crossing the plane y, as indicated at a'. With the improved means which form the embodiment of this invention the boat will change direction at some point y', and follow the reversed curved path indicated by the dotted lines x'', and reach the plane y on a level keel. This diagrammatic view will suffice to illustrate the purpose of the invention, which will now be more particularly described with reference to the detail views.

In the views, a represents the boat or boat-body, and b the diving-rudders, usually secured on a common shaft c. d is an arm on said shaft from which an operating-rod e extends into the boat and there becomes the piston-rod of the diving-engine f, as seen in Fig. 2. It need only be said of this engine that g is the piston, secured to the rod e; h is the valve-chest; i is the inlet for the fluid under pressure which moves the piston, and j is a slide-valve which normally controls the ports of the engine. In the ordinary or known constructions of mechanisms for controlling the diving-rudders of a submarine boat, heretofore briefly described, the valve j or one similar thereto is employed alone to control the ports of the engine.

k is the stem of the valve j. This stem k is coupled by a link to the shorter arm of a lever m, fulcrumed on a block n, which slides in guides o on the frame parallel with the axis of the engine f. The longer arm of the lever m is coupled to a block p, secured to the piston-rod e. From this construction it will be noted that if the fulcrum-block n be held stationary the movement of the piston g of the engine will act through the lever m to shift or actuate the valve j. Another lever, q, is fulcrumed at the block n on the same axis with the lever m. One arm of this lever q is coupled to a rod r, which extends to the conning-tower of the boat or to some other point where this lever may be operated by hand for shifting the valve j, and the other arm of said lever is coupled, through a link s, to a diaphragm-rod t through the medium of a regulating device, which may be briefly described. The link s is coupled to a rocking lever u, mounted on the rod t, and carries a pawl v, which engages teeth on a quadrant-plate w, fixed on the rod t. By turning the lever u about its fulcrum and locking it in the new position, with the dog or pawl v engaging the teeth on the quadrant-plate w, the effect will be the same as to shorten or lengthen the link s, and thus vary the relations and positions of the operating parts. For the purposes of the present invention the link s will be or may be supposed to couple directly to the rod t, as it might do. The rod t enters a diaphragm-casing 1 and is fixed to a diaphragm 2 therein. This is the main diaphragm device for regulating the diving-rudders, and the diaphragm is always under pressure of the water of flotation, which is admitted to the casing 1 through an inlet-pipe 3. The rod t is coupled to a lever 4, fulcrumed at one end on the frame, and connected at its other end to a spring 5, which antagonizes or resists the pressure of the water on the diaphragm 2. The tension of the spring 5 is regulated by a screw 6 and nut 7 in a known way, and the screw may carry a pointer or indicator 6^a to facilitate the regulation.

The above features are only illustrated herein as used conjointly and in operative combination with the novel features now to be described.

8 is a diaphragm-casing containing a diaphragm 9 and having an inlet 10 open to the water of flotation. This diaphragm has a rod 11, which is coupled to a lever 12, and a spring 13, coupled to this lever, antagonizes the hydrostatic pressure of the water on the diaphragm 9. The tension of this spring 13 is regulated by means of a screw 14 and nut 15, similar to the adjusting devices of the spring 5. A double knuckle-lever 16, Fig. 5, has one of its members coupled by a link 17 to the rod 11, and its other member coupled by a link 18 to the stem 19, Figs. 4 and 5, of an auxiliary slide-valve 20 in the valve-chest and between the cylinder-ports and the main valve j. The rods 11 and t play through a guide 21. (Seen in Fig. 2.) The diaphragm 2 and valve j may be called, for distinction, the "diving" diaphragm and valve, and the diaphragm 9 and valve 20 the "reversing" diaphragm and valve. The function of the former is to bring the rudders from the extreme inclinations to "steady," and the function of the latter is to shift the rudders quickly to an upward inclination and then leave them under control of the diaphragm 2. The tension of the spring 13 is so adjusted and set that it yields only when the boat shall have descended to the predetermined depth, at which the rudders are to be reversed or shifted to an upward inclination. It will be understood that when the boat is at the surface, as at a in Fig. 1, the parts will be in the position seen in Fig. 4—that is, the diving-rudders will be at "steady" or parallel with the boat's axis, and the piston g and valves j and 20 will be in the positions shown.

The operation is as follows: When the boat is to dive, the operator or steersman, through the medium of the rod r, operates the lever q and valve j so as to admit fluid or liquid (usually oil) under pressure to the cylinder of the diving-engine f, (to the left of the piston *g* as seen in Fig. 4,) thus moving said piston and its rod *e* so as to set the rudders *b* to the extreme diving position or inclination downward. The boat is then started ahead and it dives, descending in a downward curved path. The operator having shifted the valve *j* back again, the lower end of the lever *q*, where the rod *r* is coupled, becomes a fulcrum of the said lever, and as the boat descends the hydrostatic pressure acts on the diaphragm 2 to overcome the spring 5, and through the block *n*, the lever *m*. and the stem *k* to shift the valve *j* and admit liquid to the right-hand end of the cylinder, Fig. 4, thus bringing the rudders toward "steady;" but the movement of the piston and its rod acts on the valve-stem *k* through the lever *m*, which is coupled to said rod at *p* and fulcrumed at *n*, and tends to counteract this movement of the valve *j*, and the combined action of the two mechanisms results in the gradual shifting of the diving-rudders to "steady" by relatively slow increments. When, however, the boat shall have reached a predetermined depth, where the downward curve is to be reversed, as at *y'* in Fig. 1, for example, the hydrostatic pressure will act on the diaphragm 9 of the curve-reversing mechanism. The operation of this mechanism, which is seen at the left in Fig. 4 and in the perspective view, Fig. 5, will be explained. Let it be supposed that the piston *g* has traveled from the right-hand end of the cylinder in Fig. 4 about one-fourth of its entire travel and the valve *j* is just closing the ports in the auxiliary valve 20, which latter ports are always open to those of the cylinder. As the diaphragm 9 is pressed inward it acts, through the lever 16, the coupling-links, and the stem 19, to shift the valve 20 to the right in Fig. 4, the intermediate knuckle-lever or double lever 16 imparts to the valve 20 a movement in the same direction as the rod 11, and, of course, any means of coupling the rod 11 to the valve-stem 19 to produce this motion in the proper degree and to the proper extent will suffice. The shifting of the valve 20, as described, opens the port for the admission of the liquid to the right-hand end of the cylinder, and the piston is driven thereby fully to the left-hand end thereof, thus throwing the rudders upward and causing the boat to change its direction in a vertical plane by reversing the curve of its descent. The diaphragm 2 will now govern and bring the rudders back to "steady" when the boat reaches the predetermined depth on an even keel.

The invention herein claimed has been described as employed in connection with a diving mechanism not herein claimed, to which the new mechanism has been fitted, so as to act in conjunction therewith; but I do not wish to limit myself to the specific features of construction as herein shown, as I am well aware that these may be varied without departing from the spirit of my invention. For example, it is not material just how the spring 5 shall be disposed so long as it serves its purpose. The valves *j* and 20 have been arranged one under the other; but so long as they are so disposed as to perform their proper functions the specific arrangement is not very important. I should consider any diaphragm device adapted to automatically shift the diving-rudders at a predetermined depth, so as to reverse the curvature of the boat's downward path, and to again act automatically to leave them under control of the normal diving-diaphragm, as coming within the scope of my invention. Moreover, the diaphragm devices herein shown being old in themselves any equivalent device, as a piston in a cylinder, which is also well known, might be substituted therefor. The diaphragm device shown is selected merely because it has been found most satisfactory in practice.

Having thus described my invention, I claim—

1. A submarine boat having diving-rudders, an engine for operating the same, means for automatically controlling said engine to bring the said rudders to steady at a predetermined depth, and means for automatically shifting said rudders to an upward inclination at a predetermined depth in order to cause the diving boat to follow a path of reverse curvature, for the purpose set forth.

2. A submarine boat having an engine for operating its diving-rudders, a diaphragm device for automatically controlling said engine to bring the said rudders to steady, and a diaphragm device controlling said engine automatically and momentarily at a predetermined depth for shifting the diving-rudders quickly to an upwardly-inclined position, in order to change the curvature of the path of the boat, for the purpose specified.

3. In a submarine boat, the combination with the diving-rudder, the diving-engine and its main valve, the piston-rod of said engine being connected with said rudder for operating it, the main diaphragm device, and intermediate floating levers which control the said main valve normally in diving, of means for throwing up the diving-rudders above the axis of the boat at a predetermined depth of submersion, to reverse the curvature of the descending path of the boat, said means comprising an auxiliary valve for the diving-engine, for modifying the action of the main valve thereof, an auxiliary diaphragm mechanism, and mechanism between said diaphragm and auxiliary valve, whereby the former controls the latter.

4. In a submarine boat, the combination with the diving rudder or rudders, the diving-engine and its valve, the floating levers, and the diaphragm device which controls the rudders normally in diving, of means for throwing the diving-rudders up above the axis of the boat at a predetermined point in the submersion, to reverse the curvature of the de-

scending path, said means comprising an auxiliary valve 20, its stem 19, the auxiliary diaphragm device, and the double knuckle-lever 16, one member of which is coupled to said stem 19 and the other to the rod of the said auxiliary diaphragm device, substantially as set forth.

In witness whereof I have hereunto signed my name, this 9th day of August, 1901, in the presence of two subscribing witnesses.

JOHN P. HOLLAND.

Witnesses:

PETER A. ROSS,

K. M. CAPLINGEN.