(No Model.) 2 Sheets—Sheet 1.

J. A. SECOR.

ENGINE.

No. 398,456. Patented Feb. 26, 1889.

Fig. 5

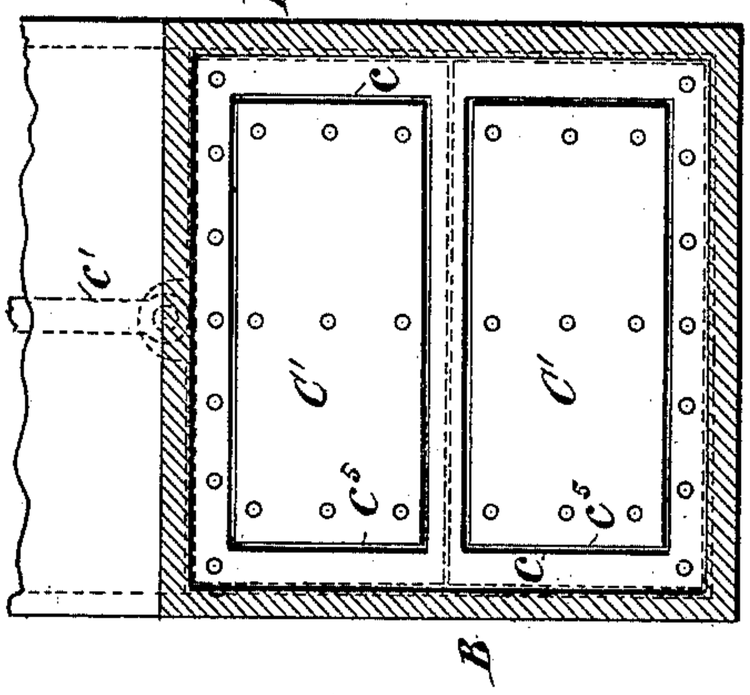


Fig. 6

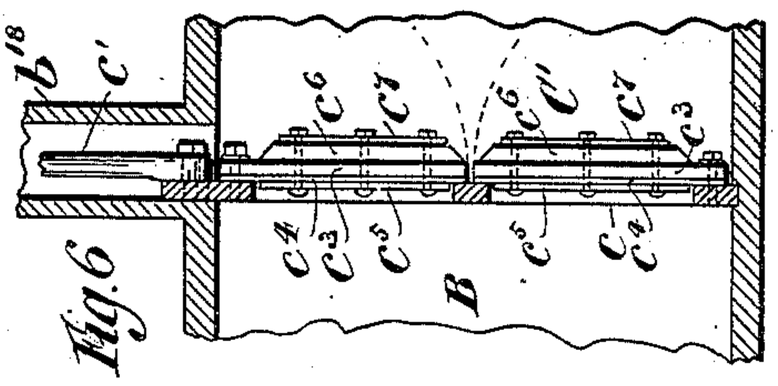
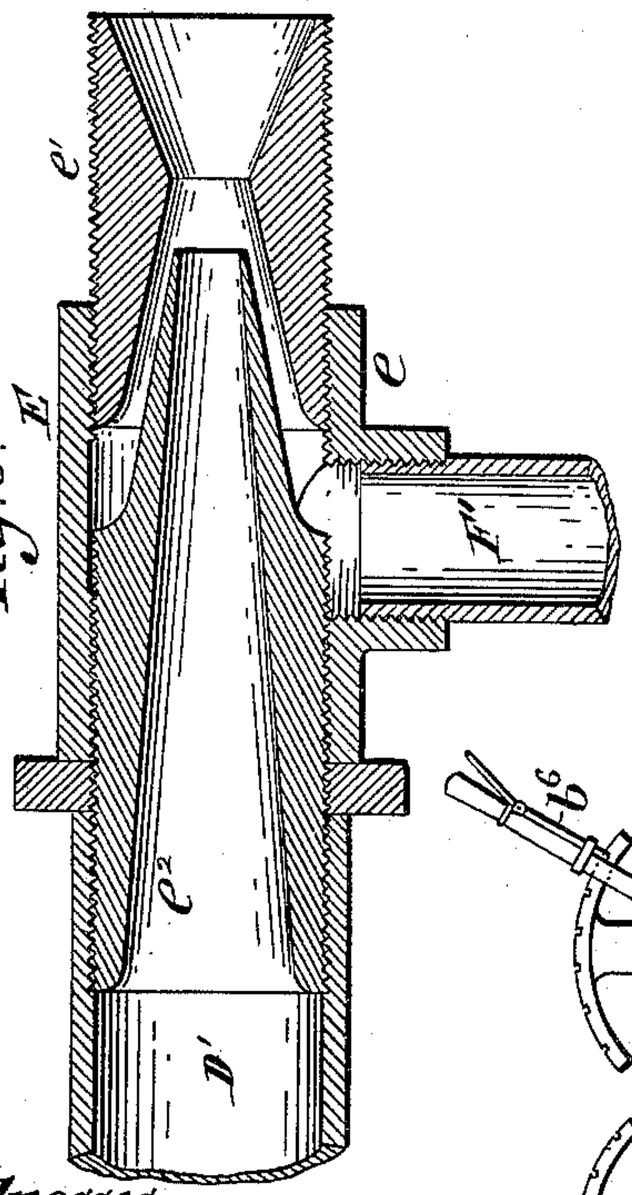
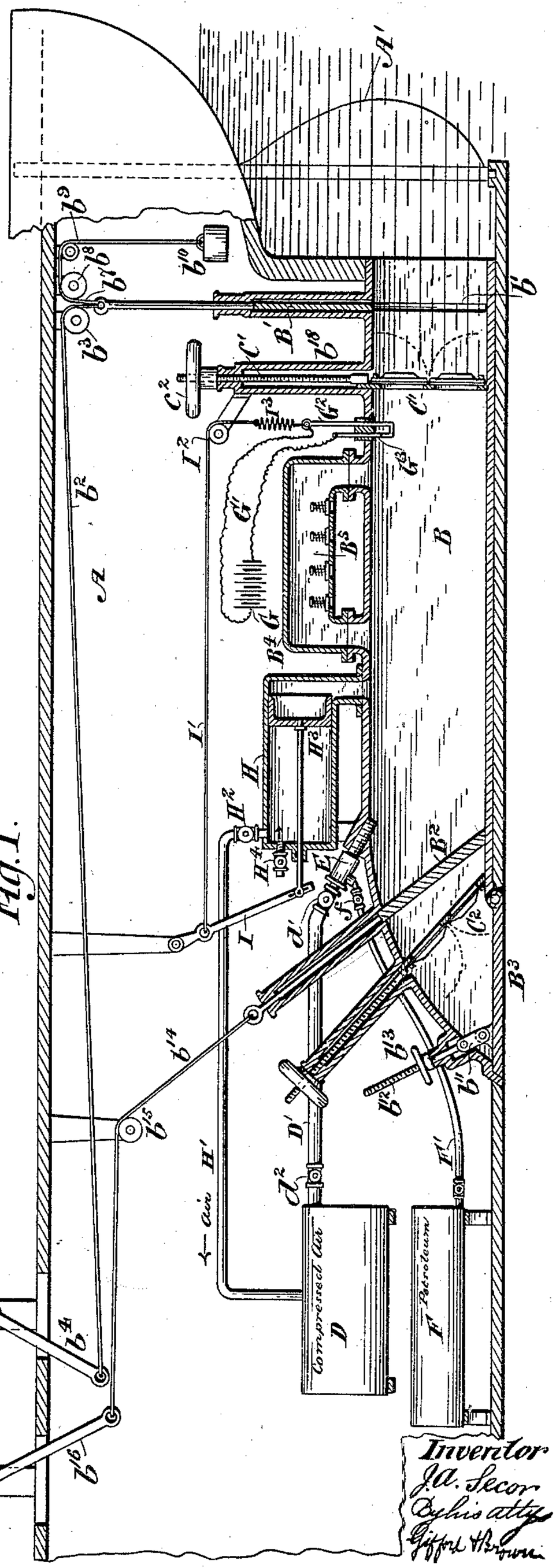


Fig. 3.



Witnesses
Geo. Wadman
Maurice J. Roach.

Fig. 1.



Inventor
J. A. Secor
by his attys
Gifford & Brown

(No Model.) 2 Sheets—Sheet 2.

J. A. SECOR.

ENGINE.

No. 398,456. Patented Feb. 26, 1889.

Fig. 4.

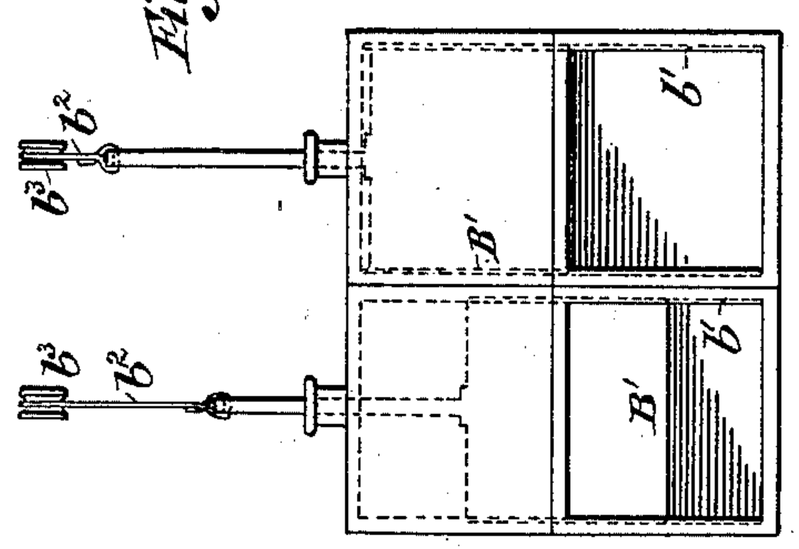
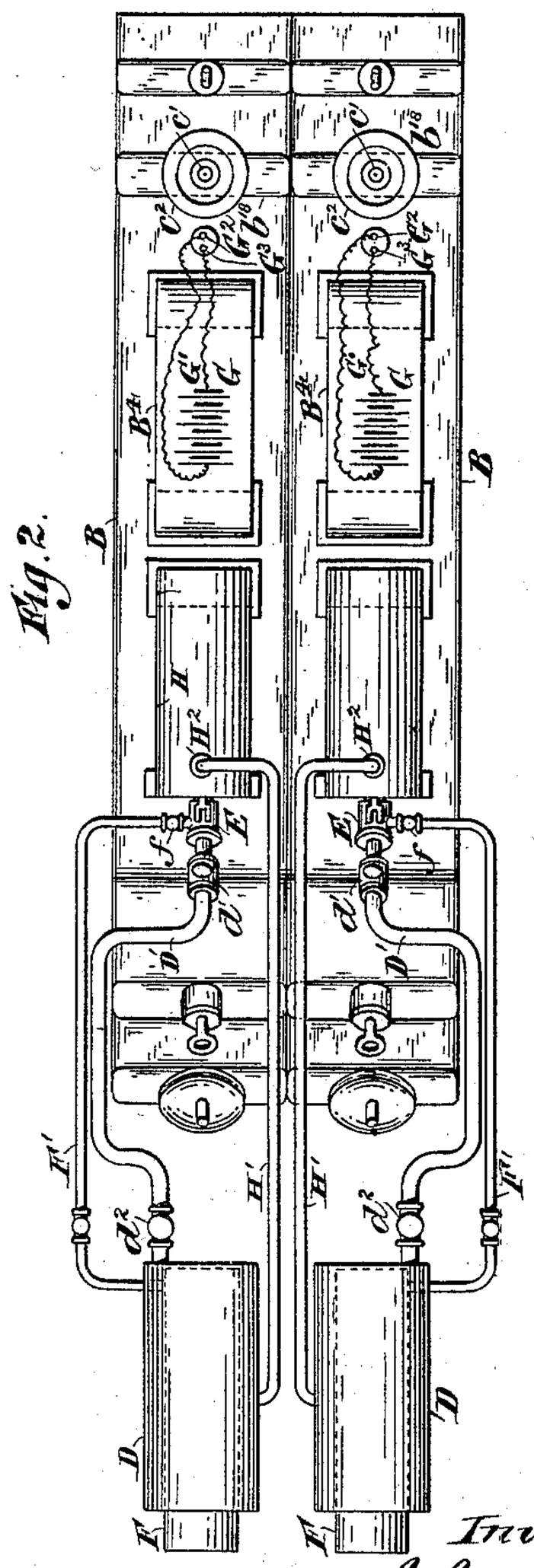


Fig. 2.



Witnesses
Geo. Wadman
Maurice J. Roach.

Inventor
John A. Secor
By his attorneys
Gifford & Brown

UNITED STATES PATENT OFFICE.

JOHN A. SECOR, OF BROOKLYN, ASSIGNOR TO THE SECOR MARINE PROPELLER COMPANY, OF NEW YORK, N. Y.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 398,456, dated February 26, 1889.

Application filed November 11, 1887. Serial No. 254,940. (No model.)

To all whom it may concern:

Be it known that I, JOHN A. SECOR, of Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Engines, of which the following is a specification.

My invention relates particularly to engines employed for the propulsion of vessels, but is not confined in this application to such engines.

I will describe an engine embodying my improvement, and then point out the various novel features in claims.

In the accompanying drawings, Figure 1 is a vertical longitudinal section of an engine embodying my improvement, and of a portion of a vessel containing such engine. Fig. 2 is a plan or top view of the engine. Fig. 3 is a central longitudinal section of a device for spraying a hydrocarbon employed in the operation of the engine. Fig. 4 is a face view of valves controlling the operation of the engine, said view including certain appurtenances of said valves. Fig. 5 is a face view of an automatically-operating valve which is included in the engine, and this view also includes certain appurtenances of this valve. Fig. 6 is a vertical longitudinal section of certain parts of the engine, including this automatic valve.

Similar letters of reference designate corresponding parts in all the figures.

A designates the stern portion of a vessel, which may be of any suitable type.

A′ designates the rudder thereof.

B designates a chamber, which may be made of any suitable metal, and which is arranged in the lower part of the stern portion of the vessel. In the chamber B explosions are repeatedly made, and the force produced by these explosions is caused to act upon the water adjacent to the vessel, so as to effect the propulsion of the vessel. This chamber B is approximately rectangular in the cross-section. The rear end extends through the stern of the vessel. The front end is bent or extended downwardly and opens through the bottom of the vessel. At the rear end this chamber has combined with it a valve, B′. At the forward end it has combined with it a similar valve, B^2. When it is desired that the vessel shall be propelled forwardly, the valve B^2 must be closed and the valve B′ opened.

The valves B′ B^2 may be operated through the agency of any suitable mechanism. I have shown the valve B′ fitted in a slideway, b', so that it can be adjusted vertically therein. Part of this slideway is made in the form of a trunk extending above the chamber B. The valve B′ is provided with a rod, which extends up through a stuffing-box with which the trunk is provided. This rod is shown as connected to a cord or chain, b^2. This cord or chain passes around a pulley, b^3, and thence extends to the lower end of a lever, b^4. The lever b^4 is fulcrumed to a stand, b^5, and is provided with a locking-catch, b^6, whereby the lever may be locked in different positions to the stand. The valve-rod is also attached to a cord or chain, b^7, which passes around pulleys b^8 b^9, and is attached to a weight, b^{10}. This weight partially counterbalances the valve B′, so as to reduce the labor of operating the lever b^4.

The lever b^4 may be arranged in the pilot-room of the vessel, and it is intended to be represented as in a position accessible to the pilot. It may, however, be arranged elsewhere, if preferred. This mechanism provides for opening and closing the valve B′ at pleasure.

The valve B^2 is shown as operated in the same manner as the valve B′, it having connected to its rod a cord or chain, b^{14}, which passes around a pulley, b^{15}, and is connected to a lever, b^{16}. The lever b^{16} is combined with a stand, b^{17}, and locking-piece b^{19}. The lever b^{16} is intended to be arranged close to the lever b^4.

I have shown at the forward extremity of the chamber B a gate, B^3, which is hinged at the rear end to the chamber and connected at the forward end by a link, b^{11}, with a screw-rod, b^{12}, that extends upwardly into the vessel through a stuffing-box with which the chamber is provided. A nut, b^{13}, is combined with the screw-rod, so that by rotating this nut the gate B^3 may be lowered or raised to open or close the forward end of the chamber B. The forward portion of the chamber B is so bent or extended that, in conjunction with the gate B^3, when lowered at an angle to the

vessel, it will direct the force produced by explosions within the chamber B properly to effect a rearward motion of the vessel. The gate B^3, instead of being operated by the mechanism described, might be operated by a cord or chain and lever in a manner similar to the valves B′ B^2.

The valves B′ B^2, which I have already referred to, are, as it will have been understood, intended to operate solely at the will of an attendant. The chamber B has also combined with it valves C′ C^2, which are intended to operate automatically. The valves C′ will operate only when the valve B′ is open, and the valves C^2 will operate only when the valve B^2 and gate B^3 are open. The object of the valves C′ C^2 is to permit of the force of an explosion to be exerted upon the water at either end of the chamber B, and yet to prevent the subsequent influx of water into the chamber. Therefore these valves C′ C^2 open outwardly under the influence of the force produced within the chamber, and close inwardly when acted upon by the force of the water outside the chamber.

The construction of the valves C′ C^2 is somewhat peculiar. As the valves C′ C^2 are alike in construction, it will be necessary to describe but one in detail, and this may be done best by reference to Figs. 5 and 6, where the valves C′ are shown on an enlarged scale. *c* designates a frame, preferably made of metal and composed of two upright rails and three cross-rails, two of which connect the ends of the upright rails, and the third of which extends between the upright rails equidistant from their ends. The frame therefore has two rectangular openings. This frame *c* fits at the edges in recesses in the side walls and the bottom wall of the chamber B. It also extends upwardly into a trunk, b^{18}, with which the chamber is provided. A screw-rod, *c′*, is connected to the frame *c* and extends through a stuffing-box, with which the upper part of the trunk b^{18} is provided. Above the stuffing-box a nut, c^2, is located. This nut engages with the screw-rod, so that by manipulating the nut the screw-rod may be made to raise the frame *c* wholly into the trunk, if desired, and to lower it into its normal position.

The valves C′ are connected to the frame *c*. The upper valve C′ is connected at its upper edge to the top rail of the frame *c*. The lower valve C′ is connected at its lower edge to the lower rail of the frame *c*. Both of the valves C′ close against the middle rail of the frame *c*. Each of the valves C′ is composed of a thick sheet of india-rubber, c^3, a sheet of leather, c^4, arranged adjacent to that side of the sheet of india-rubber c^3 which is next the frame *c*, a plate of sheet-iron, c^5, arranged against the piece of leather, a block or piece of wood, c^6, arranged adjacent to the other side of the sheet of india-rubber, and a plate of sheet-iron, c^7, arranged against the outer side of the piece of wood. The plate of sheet-iron c^5 is of such size that it will not come in contact with the frame *c*, but may pass into an opening thereof when the valve of which it forms part is closed. I have found that this combination of materials is of great importance in making the valves C′ C^2 for my engine. The rubber, through its elasticity, saves the other parts. The leather protects the rubber, and the rubber, by preventing the leather from receiving concussions of the violence to which it would otherwise be subject, renders the leather durable. The sheet-iron and the wood stiffen the valves, besides protecting the surfaces of the leather and rubber. The various parts composing each of these valves may be secured together by means of screw-bolts and nuts or other analogous devices.

D designates a compressed-air reservoir. It is connected by a pipe, D′, with an injector, E, that communicates with the chamber B. As shown, this pipe extends from one end of the reservoir D to the injector E, and the latter communicates with the upper portion of the chamber B. The pipe D′ is provided near the chamber B with a check-valve, *d′*, which opens toward the chamber B, but closes in the reverse direction, so that any force or pressure of gas which may be generated will close the valve and cut off the pipe D′ from the chamber. The pipe D′ is also provided with a hand-cock, d^2, whereby it may be closed when the engine is out of use.

F designates a receptacle containing a hydrocarbon—such, for instance, as kerosene. It is connected by a pipe, F′, to the injector E. This pipe is shown as extending from the lower portion of the receptacle F to the injector E, and as being provided near the injector E with a check-valve, *f*, which will open toward the injector E and chamber B, but will close in the reverse direction, so as to exclude from the pipe F′ and receptacle F any force or pressure of gases which may be generated in the chamber B.

The injector E consists of a shell, *e*, a piece, *e′*, fitted in the end of the shell *e*, which is the farthest from the pipe D′, and a piece, e^2, fitted into the shell *e*. The piece *e′* is provided with two tapering portions which are largest at the ends of the piece, and which at their smaller diameters meet and communicate. The piece e^2 extends into one of the tapering cavities of the piece *e′*, and itself has a tapering hole throughout its length. It will be seen that the diameter of the outlet of the piece e^2 is less than the smallest diameter of the piece *e′*. The space between the piece e^2 and the tapering cavities of the piece *e′*, into which it extends, communicates with the pipe F′, leading from the hydrocarbon-receptacle F. The interior of the piece e^2 communicates with the pipe D′, leading from the air-reservoir D. The force of the compressed air will draw the hydrocarbon into the injector, and, owing to the peculiar construction of the piece *e′*, will dash the hydrocarbon into a spray. In the form of the spray the hydrocarbon enters the chamber B with the compressed air.

I will now describe an apparatus whereby the hydrocarbon and the air within the chamber B may be periodically exploded.

G designates a source of electricity. It may be a battery or a dynamo-electric machine.

G′ designates wires extending from the poles of the electric generator to two electrodes, G^2 G^3. These electrodes extend through the wall of the chamber B, and are adapted to contact with each other within said chamber. They are insulated from the chamber and from each other. The electrode G^3 is stationary. The electrode G^2 is, however, vertically movable, in order that its inner end, which is bent upwardly toward the inner end of the electrode G^3, may be made to contact with the electrode G^3, or may be separated from the latter, as occasion may require. It is intended that normally the electrodes shall be in contact, and that they shall be separated at the proper times to produce sparks, whereby the air and sprayed or vaporized hydrocarbon within the chamber B may be ignited. I will defer a description of the means whereby the separation of the electrodes and their subsequent contacting are effected until after I shall have described certain other parts which produce the movements of the shifting electrode.

H designates a cylinder connected at one end by a pipe, H′, with the compressed-air reservoir D. The pipe H′ is provided near the cylinder H with a check-valve, H^2, which will open toward the reservoir D, but will close so as to prevent the passage of compressed air from the reservoir to the cylinder.

Within the cylinder H a piston, H^3, is arranged. One end of the cylinder communicates with the chamber B, and whenever an explosion occurs in the chamber the piston H^3 is forced thereby toward the end of the cylinder which is the farthest from the chamber. The movement of the piston in this direction compresses the air which is in advance of it and forces it through the pipe H′ into the reservoir D. After the force created by an explosion in the chamber B shall have been expended in the propulsion of the vessel, and the pressure within the chamber shall have been very greatly reduced in consequence thereof, an inlet-valve, H^4, with which the cylinder is provided in the end farthest from the chamber B, will open, and the air at atmospheric pressure, thus permitted to flow into the cylinder, will force the piston toward the other end of the cylinder. The piston, in the manner described, reciprocates once for each explosion that may occur in the chamber B. The piston is provided with a rod passing through a stuffing-box arranged at one end of the cylinder. The piston-rod is connected outside the cylinder with a lever, I. This lever will be vibrated once for each reciprocation of the piston. A cord or chain, I′, is connected at one end to the lever I, passes around a pulley, I^2, and is connected to one end of a spring, I^3. The spring I^3 at the other end is connected to the outer end of the movable electrode G^2 of the igniting apparatus. The spring I^3, as shown, is of helical form. When the lever I is vibrated by the piston H^3 of the air-compressing engine in one direction, it will allow the movable electrode G^2 to descend and break contact with the fixed electrode G^3, and when the lever I is vibrated in the reverse direction the movable electrode will be raised into contact with the fixed electrode.

The movable electrode requires but a short movement. The piston of the air-compressing engine has a much greater movement than is necessary for the movement of the movable electrode. Consequently the piston of the air-compressing engine is connected to the lever I as far as possible from the fulcrum of the lever, and the cord or chain I′ is connected to the lever close by its fulcrum.

The spring I^3 will be kept under tension during almost the entire operation of the lever I; but just before the lever shall have completed its movement in one direction the spring will have been relieved of tension, and during the remainder of this movement of the lever the movable electrode will be allowed to fall. The parts have been represented in Fig. 1 in the positions which they occupy just before the final movement of the piston of the air-compressing engine in one direction, whereby the movable electrode is lowered.

When an explosion occurs in the chamber B, the valves C′ or C^2, according as they may be in operation, will open outwardly and permit the force generated by the explosion to act upon the water adjacent to said valves. Immediately after the force of the explosion shall have been expended the valve will close and prevent the ingress of water into the chamber.

The chamber B is provided with what I term an "air-inlet," B^4. This consists of a passage or conduit arranged above but communicating at the ends with the chamber B. It has perforations in one wall, and combined with these perforations are valves B^5, which are held to their seats by springs and by whatever pressure there may be within the chamber, but which open under the influence of the atmosphere outside of the chamber whenever the pressure within the chamber shall be reduced below atmospheric pressure.

I have described the various parts as though there were but one propelling-engine. I desire it to be understood that there may be any number of these propelling-engines. In Fig. 2 I have shown two arranged side by side. These two engines are arranged one on each side of the central longitudinal line of the vessel. Each will preferably be provided with independent mechanism for operating the valves B′ B^2 B^3. When so provided with independent valve-operating mechanism, the vessel may be steered by the engines with or without the aid of a rudder. For instance, if it is desired to turn the vessel to port, the

starboard engine would have its valves opened and be rendered operative, and the port engine would have its valves closed and be rendered inoperative, or else would have its valves adjusted and be rendered operative to force the vessel backward. To turn the vessel to starboard, the engines would be operated just the reverse of the operation just described.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a marine vessel, the combination, with a chamber opening to the water, of a compressed-air reservoir communicating therewith, a receptacle for a hydrocarbon, also communicating with the chamber, a cylinder communicating at one end with the chamber and at the other end with the compressed-air reservoir, a piston in the cylinder, and an apparatus for igniting the contents of the chamber, substantially as specified.

2. In a marine vessel, the combination, with a chamber opening to the water, of a compressed-air reservoir communicating therewith, a receptacle for a hydrocarbon, also communicating with the chamber, a cylinder communicating at one end with the chamber and at the other end with the compressed-air reservoir, a piston in said cylinder, an electric apparatus for igniting the contents of the chamber and comprising two electrodes, one of which is movable, and a connection between the movable electrode and the said piston, substantially as specified.

3. The combination, with a chamber opening to the water, of an air-inlet therefor, a receptacle for hydrocarbon communicating with the chamber, an air-compressing engine communicating at one end with said chamber, an electric apparatus for igniting the contents of the chamber, and comprising two electrodes, one of which is movable, and a connection between the movable electrode and the air-compressing engine for moving said electrode, substantially as specified.

4. The combination, with a chamber, of a compressed-air reservoir, an injector communicating with the compressed-air reservoir and with the chamber, and a receptacle for hydrocarbon communicating with the injector, the said injector having an outlet having two reversely-arranged communicating tapering cavities, one receiving a nozzle which receives air from the compressed-air reservoir and the other opening into the said chamber, the diameter of the outlet of said nozzle being less than the smallest diameter of said outlet for the injector, substantially as specified.

5. In a marine vessel, the combination, with a chamber opening to the water, of an air-inlet, a hydrocarbon-inlet, igniting apparatus, an air-pump open at one end to the chamber, and a valve located at one end of the chamber and controlling communication with the water, said valve being capable of opening outwardly when subjected to excessive pressure within the chamber, and of closing inwardly under pressure of the water, substantially as specified.

6. In a marine vessel, the combination, with a chamber opening to the water, of a compressed-air reservoir, an inlet from the compressed-air reservoir to the chamber, a hydrocarbon-inlet, igniting apparatus, openings for establishing communication between the said chamber and the atmosphere, and valves which will open upon a reduction of pressure below atmospheric pressure inside the chamber to allow atmospheric air to enter the chamber, substantially as specified.

7. In a marine vessel, the combination, with a chamber opening to the water, of a valve located at one end of the chamber and operating to exclude water from the chamber, an air-inlet for the chamber, valves connected with said air-inlet and opening inwardly under the influence of atmospheric pressure when pressure within the chamber is reduced below atmospheric pressure, a hydrocarbon-inlet, and igniting apparatus, substantially as specified.

JOHN A. SECOR.

Witnesses:
GEO. WADMAN,
W. A. RABAN.