(No Model.) 3 Sheets—Sheet 1.

# H. BERDAN.

## OPERATING SUBMARINE GUNS.

No. 478,215. Patented July 5, 1892.

*Fig. 1.*

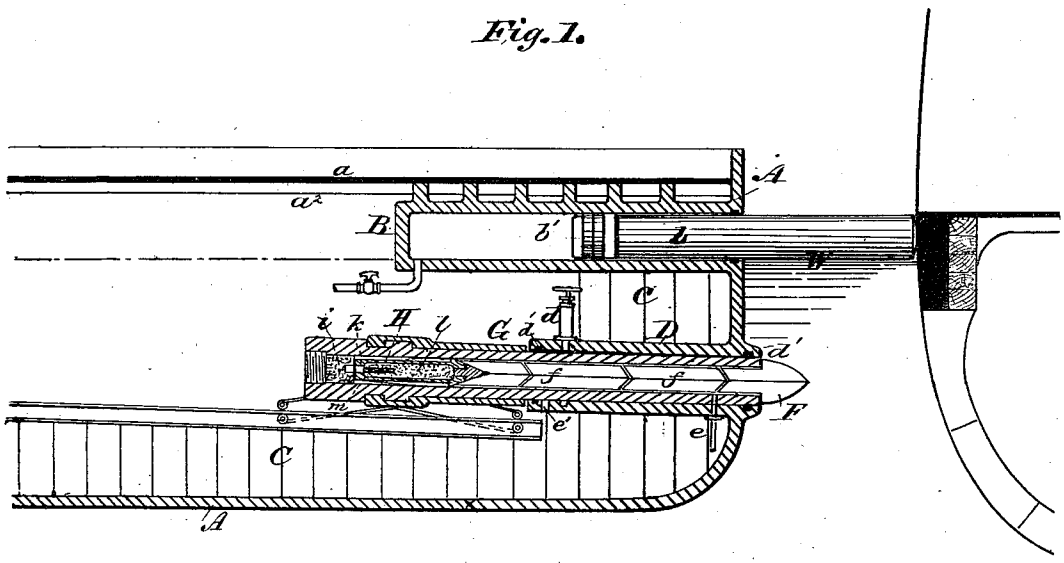



*Fig. 2.*

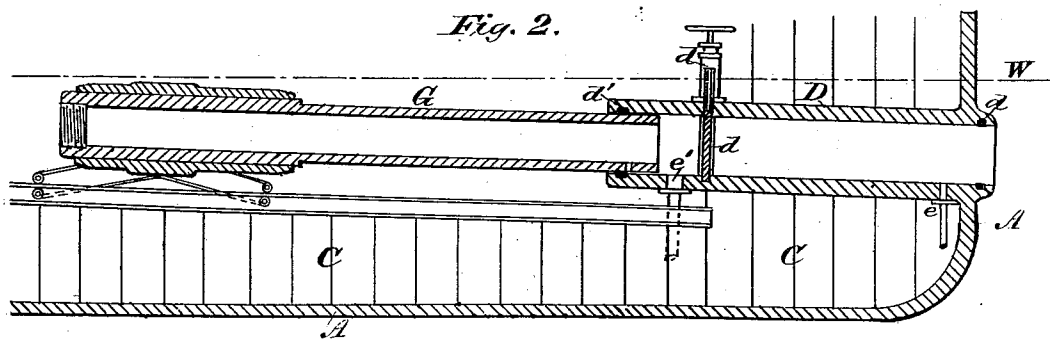
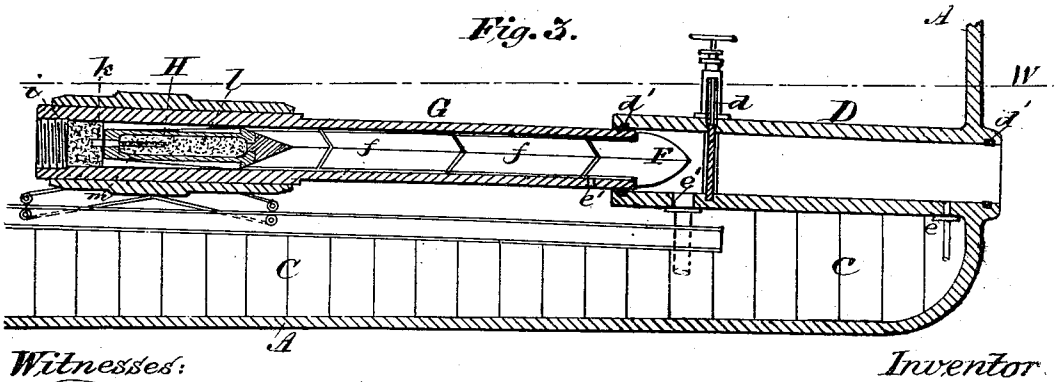



*Fig. 3.*




Witnesses:

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(No Model.) 3 Sheets—Sheet 2.

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## OPERATING SUBMARINE GUNS.

No. 478,215. Patented July 5, 1892.

*Fig. 4.*

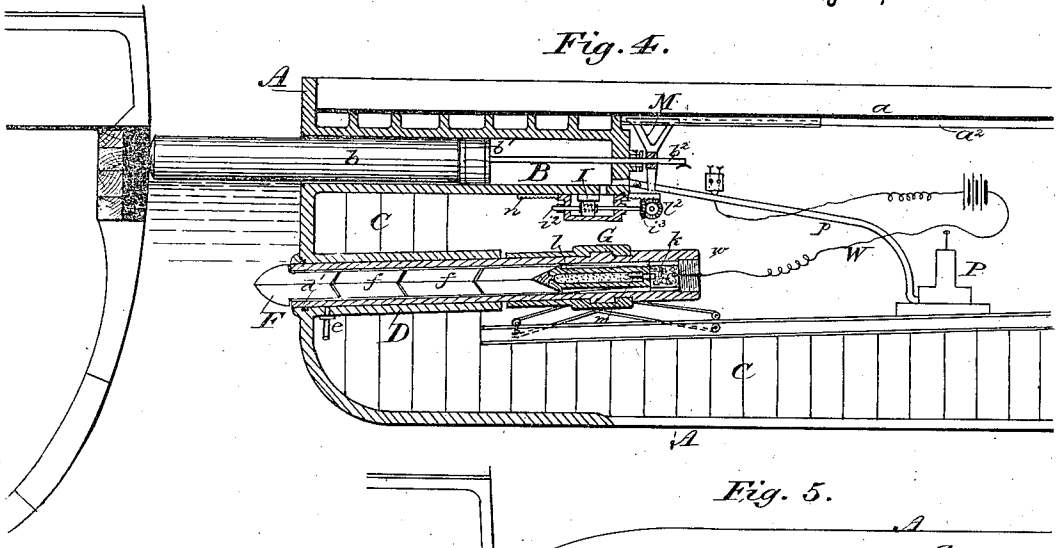



*Fig. 5.*

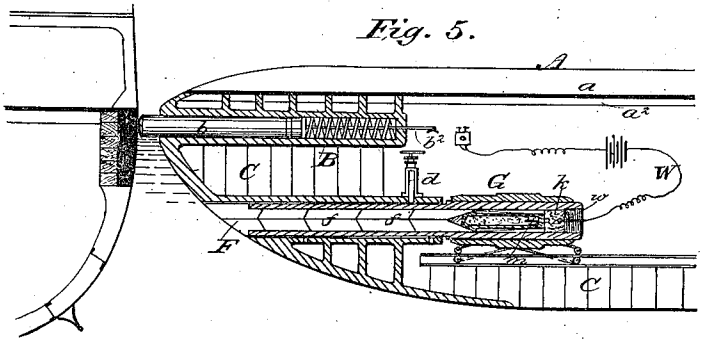



*Fig. 6.*

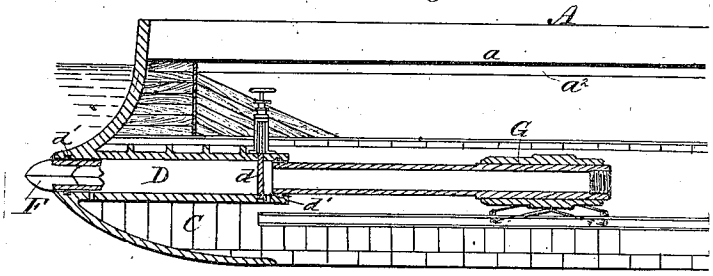
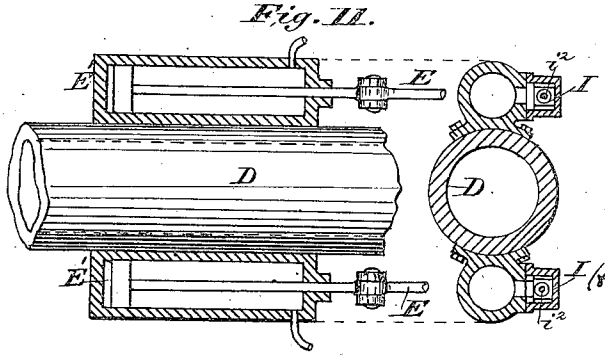



*Fig. 11.*

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(No Model.) 3 Sheets—Sheet 3.

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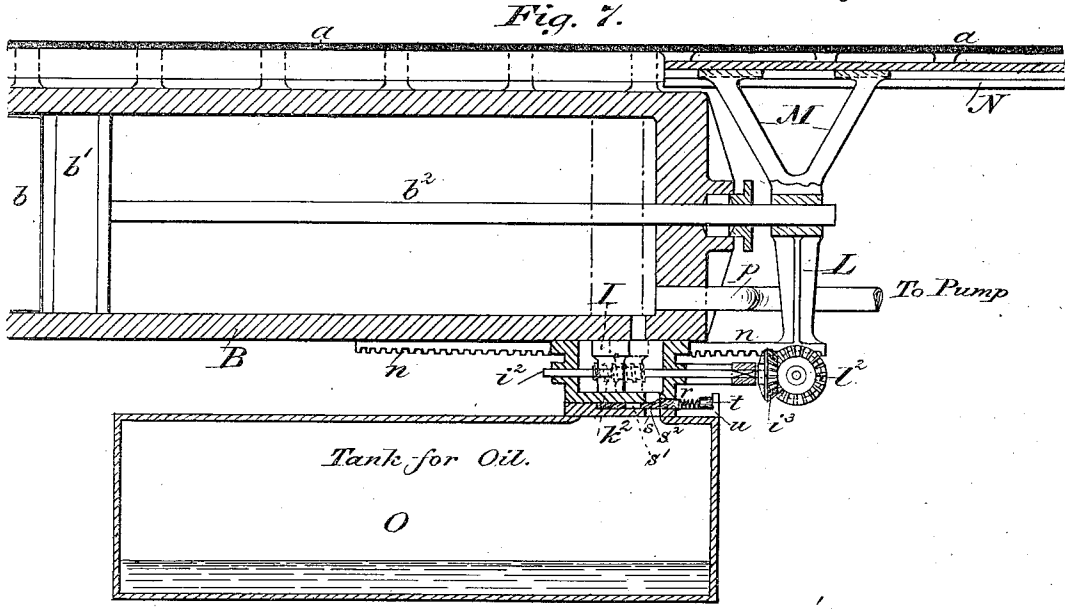
## OPERATING SUBMARINE GUNS.

No. 478,215. Patented July 5, 1892.

*Fig. 7.*



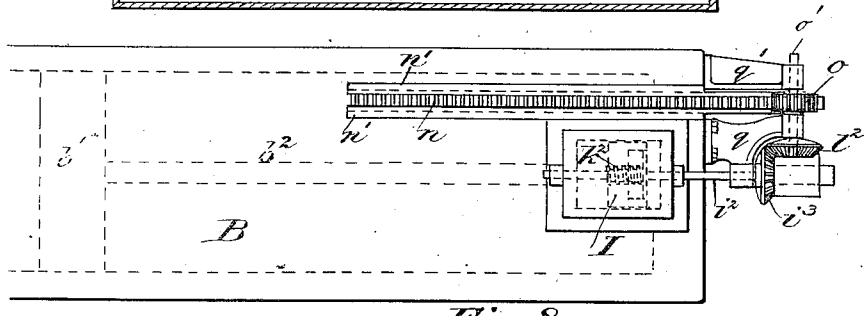




*Fig. 8.*

*Fig. 9.*

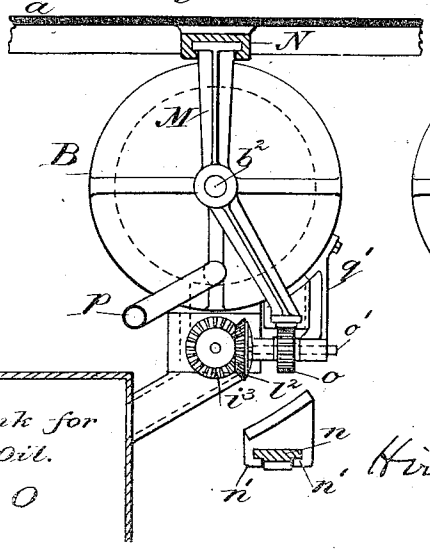
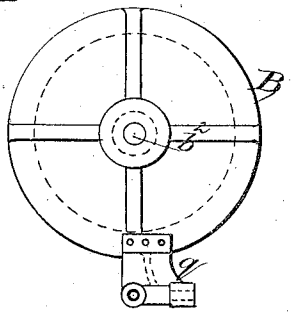



*Fig. 10.*

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# UNITED STATES PATENT OFFICE.

HIRAM BERDAN, OF WASHINGTON, DISTRICT OF COLUMBIA.

## OPERATING SUBMARINE GUNS.

SPECIFICATION forming part of Letters Patent No. 478,215, dated July 5, 1892.

Application filed March 22, 1892. Serial No. 425,987. (No model.)

*To all whom it may concern:*

Be it known that I, HIRAM BERDAN, a citizen of the United States, residing at Washington, in the District of Columbia, have invented certain new and useful Improvements in Operating Submarine Guns; and I do 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, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

The object of my invention is to fire a shell from a submarine gun through the side of a ship below her belt of armor, into her hold, and explode the same with a time-fuse, in place of exploding the shell by contact with the outside of the ship, as heretofore, where the gas does much less injury to the ship, especially to the bulk-heads.

The nature of my invention consists in so combining a war-vessel that has a low-armored deck for deflecting shots with a bow that is so constructed that the vessel can strike the side of a ship without injury to the vessel, in combination with a submarine gun that is so located in the bows of the vessel as to enable the gun to fire a shell into a ship below its armor when part of the vessel is in contact with the ship, whereby a short and uniform range is invariably secured that the firing charge may be graduated so as to invariably force the shell through the first side of the ship, but never through the opposite side of the ship, as well as secure the required accuracy, which is impossible when the shell has to be fired through the water at different distances with the same charge of powder, as the weight of the shell, when strong enough to penetrate the side of the ship with its low velocity, caused by the great resistance of the water, will cause the shell to form a quick curve downward in spite of any hydrostatic valve and rudder that can be applied; also, for the reason that the shell would move so slowly that it would be deflected by the waves and currents, to say nothing of the inaccuracy that would be caused by the pitching of the vessel. Attempts have heretofore been made to accomplish this all-important result by the use of pneumatic guns or by mortars for dropping the projectile through the deck; but they have never succeeded, save by accident, owing to the almost total want of accuracy when either the ship or the attacking vessel is in motion. It has also been attempted to do the same thing with the ordinary guns for penetrating the side of the ship at the water-line, but without effect, in consequence of the thickness of the armor.

My invention further relates to some automatic firing arrangements and improvements in operating the valve for regulating the pressure on the pistons of the hydraulic buffers for vessels and guns. The importance of these improvements will be self-apparent when it is considered that it is now impossible to destroy an "iron-clad" in the time that it would take it to burn a sea-coast city, if at all, with any means now known, in consequence of the heavy armor and torpedo-nets now in use.

Having fully stated the object and nature of my invention, I will now by the aid of the annexed drawings give a full and detailed description of the devices I employ, with some of the many modifications that can be employed without departing from the essential characteristics of my invention, like letters referring to like parts.

Figure 1 represents a longitudinal section of the bow of my vessel and the submarine gun therein with what I hereinafter designate as my "hydraulic buffer" in position against an iron-clad ship. Fig. 2 is an enlarged longitudinal sectional view of the lower part of the vessel and the submarine gun, showing the gun drawn back preparatory to loading. Fig. 3 is a view similar to Fig. 2, but showing the gun loaded and in position to be moved forward. Fig. 4 represents a longitudinal section of the vessel, showing devices for operating the hydraulic buffer and devices for firing the gun automatically by electricity. Fig. 5 represents a modification of Fig. 1, with a spring for operating the buffer or plunger and devices for firing the gun automatically by electricity. Fig. 6 is a modification showing a different form of ram or prow. Fig. 7 is an enlarged sectional view of the devices for operating the hydraulic buffer. Fig. 8 is a bottom view

of the same. Fig. 9 is an end view of the same. Fig. 10 is an end view of the same, showing the hanger for the shafts for operating the valve. Fig. 11 shows a hydraulic buffer for taking up the recoil of the gun, the same arrangements being employed for operating the valves as shown in Fig. 4.

In the drawings, A represents the bow of a boat which I prefer should be about two hundred and sixty feet long, forty feet beam, sixteen feet draft, with corresponding displacement of about two thousand four hundred tons, with engines capable of developing at least seven thousand five hundred horse-power and a corresponding speed of not less than twenty knots.

W represents the water-line, and *a* the armored deck, which is constructed of steel two inches thick in the center and four and five inches on the side, where the curve is quickened, and strongly supported by girders or the ribs of the vessel, and on the girders *a'* is attached an inner skin or deck $a^2$ for the purpose of conducting the drippings from the outer deck to the large wrecking-pumps in the event of the joints of the upper deck being opened by shot from the enemy's gun.

B represents the tube to the hydraulic buffer, in which the piston *b* moves, and C represents the frame-work of the ship, which connects the tube with the armored deck and keel. The diameter for the piston for this size boat should be about four feet and the movement should be about ten feet. Behind the piston *b* is arranged a head *b'*, provided with any suitable packing to prevent the oil or other fluid employed from passing, and in the chamber back of that piston is oil or other suitable fluid employed for the purpose of easing up the momentum of the vessel, and for the purpose of equalizing this pressure a valve I, which is shown in detail in Fig. 7, is employed in order to insure a uniform pressure—say five thousand pounds to the square inch—during the entire movement of the piston. This valve I contains an opening to correspond with the opening into the cylinder of the hydraulic buffer, through which the oil has to pass into the tank O. This valve is made to slide across the hole through which the oil is to pass from the cylinder and is operated automatically by means of the screw $k^2$ by the movement of the piston *b* through the arm M, connected therewith, with its feet sliding in grooves N, and the lower end attached to the rack *n*, which operates the pinion *o* on shaft *o'*, (said shaft being supported by brackets *q* and *q'*,) and thereby turning the bevel-wheel $l^2$, which rotates the shaft $i^3$, on which is the screw $k^2$. The piston *b* is pushed forward by means of a hydraulic pump, forcing oil into the cylinder through the pipe *p*, and during this operation the oil is prevented from passing through the valve I by means of a second valve *s*, placed lower down.

*s'* represents the opening in this valve.

*r* represents the spiral spring, and *t* the tube by which this spring is held into position.

$s^2$ represents a shoulder for the oil to press against when the buffer *b* is shoved back by coming in contact with the ship, and thereby bringing the opening *s'* to correspond with the opening in the valve I. The spring *r* has sufficient strength to prevent this valve from sliding backward under the pressure necessary to force the piston *b* forward; but when the greater pressure of, say, five thousand pounds to the square inch comes against this shoulder $s^2$ by means of the piston *b* being shoved back this valve moves and allows the oil to pass out under the pressure into the tank O, thereby securing a mean pressure of, say, five thousand pounds to the square inch during the entire movement of the piston *b*. It will be seen that by this arrangement of valve it is only necessary to employ the hydraulic pump P to force the piston into position and the piston will open the valves by means of the shoulder $s^2$ automatically, and that this valve will cut off the orifice when the pressure is off.

I sometimes dispense with the upper valve I, together with the small piston $b^2$ and the machinery for operating this valve, and regulate the pressure on the piston *b* by the valve *s*, as above stated, until the head of the piston has cut off the opening in the cylinder through which the oil passes and before the packing in the head *b'* has reached the opening in the cylinder. The main advantage of this modification is that it is less expensive and less liable to get out of order.

I am aware that valves have been used for adjusting the outflow of liquids for hydraulic buffers or the hydraulic arrangements for absorbing the recoil of guns, but they have been regulated by springs of the required strength to take the direct pressure on the piston employed; but where so much fluid has to pass in so short a time and under such a heavy pressure the spring would have to be equal to several hundred tons, which would be quite impracticable as compared with the sliding valve and the small shoulder or ledge for the oil to act against in moving the slide against the springs which are adjusted to the pressure required.

The tube D, attached to the frame-work and keel of the vessel, has a gate *d* arranged for the purpose of shutting off the water when the gun G is in the position as shown in Fig. 2. After the gate has been closed the water that is in the gun is drawn off through the pipe *e'*. The pipe *e* is for the purpose of taking any water that may pass the tampion F down to the pumps. The gun is then drawn entirely out of the tube D and is loaded preparatory to being shoved forward, as shown in Fig. 3, after which the gate *d* is then raised and the gun is shoved forward in position ready for firing, as shown in Fig. 1.

The gun is fired automatically by the hydraulic buffer, by electrical connection, by means of the piston $b^2$ making the necessary connection during any part of its movement. The firing charge is ignited by means of fulminate of mercury placed in the firing-charge and the wire *w*, connected therewith.

The tube D contains packing-rings *d'* at both ends. Attached to the tube D are bridles or connecting-rods E, which lock onto the trunnions of the gun to prevent the gun from recoiling into the ship and which are provided with hydraulic buffers, as shown in Fig. 11. These buffers are constructed with cylinders E and cylinder-heads E' with piston-rods that are connected with the bridles E, as shown in Fig. 11.

The valves are arranged and operated in all respects the same as in Fig. 4 for the hydraulic buffer. The location of the valves is as shown in cross-section.

The tampion F is employed to keep the water out of the gun, and the air-cylinders *f* are sometimes employed to prevent the air when compressed by the projectile from expanding the muzzle of the gun.

Fig. 5 shows the bow of one form of ram with a small piston, the movement of which can fire the gun automatically in all respects the same as in Fig. 4. It will be seen that the frame-work is very strong and would stand the shock if the speed of the vessel is not too great and the armor of the ship to be struck not too strong; also, that the projectile has a short and uniform distance to pass through the water, and yet is free to leave the muzzle of the gun before the point strikes the ship. It will be seen, also, that with this modification, like the device shown in Fig. 1, the gas presses against the rear end of the shell in the gun until the point of the projectile has reached the side of the ship in place of throwing the projectile through the water by its momentum, as heretofore. The tampion F in this modification will be shaped to conform to the shape of the boat at that point in order to offer no additional resistance to the water.

In the modification shown in Fig. 6 it will be seen that the bow is constructed on the principle of the ordinary well-known ram, with the gun placed inside the tube D, which forms the spur, so that when the spur has entered the ship a small charge of powder, so regulated as not to send the shell through the ship, will yet throw the shell into the hold of a ship. The gun is fired automatically by the employment of a plunger, as shown in Fig. 5. It will be seen, also, that the tampion forms the extreme point of the spur in order to lessen the resistance of the water. This tampion of course is shoved farther into the gun when the spur strikes the ship and is shoved out into the ship by the projectile. This system could be more easily applied to the rams now in use; but the objection to it is the liability of the shell being unable to clear the muzzle of the gun, either by reason of the spur or gun, or both, being bent by a ship passing across the bows of the vessel or on account of striking some obstruction in the ship, such as the frame-work or the boiler-machinery, in either of which cases the shell would remain in the gun, and the fuse being lighted would explode therein, causing the damage to the attacking vessel rather than to the enemy. This shows the importance of the main feature of the system—that the shell must have a short and uniform distance to pass through the water, short enough to secure the required accuracy, and yet not too short for the shell to clear the muzzle of the gun before the point enters the side of the ship. While, therefore, this latter modification would be a saving in money, I do not particularly recommend it.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. As a means for firing projectiles under water and also for checking the momentum of a vessel, a gun located in said vessel at the bows and under the buffer and a chamber at or near the water-line, provided with a buffer sliding therein, said chamber being filled with oil or other suitable fluid at the rear of the buffer to absorb the momentum of the vessel when impacted against an external object, and suitable electric connections between the chamber and the breech of the gun, whereby while the buffer is being pushed in the gun is fired by means of said connections, substantially as and for the purpose described.

2. As a means for firing projectiles under water, a vessel provided with a gun located therein at its bows and under the buffer, in combination with an open chamber at or near the water-line and having therein and projecting therefrom a sliding buffer, and suitable electric connections between the said buffer and said gun, whereby while the buffer is being moved by external impact the gun is fired by means of said connections, substantially as and for the purpose set forth.

3. As a means for firing projectiles under water, a vessel provided with a submarine gun and a buffer-chamber located above the gun, said chamber being provided with a buffer sliding therein and oil or other suitable fluid, and a valve mechanism connected with the chamber and with suitable electrical connections between said mechanism and the gun, whereby while the buffer is being moved by external impact the oil or other fluid is compressed to operate the valve mechanism and electrical connections whereby the gun is fired, substantially as and for the purpose set forth.

4. As a means for firing projectiles under water, a vessel provided with a gun located therein at its bows and under the buffer and a chamber located above the gun and having extending therefrom and sliding therein a buffer provided with a suitable rear extension, in combination with electrical devices connected with the gun, whereby said buffer

while being moved rearward is brought in contact with said devices to complete the circuit and fire the gun, substantially as described.

5. As a means for firing projectiles under water, a vessel provided with a gun located under the buffer at the bows of said vessel in a tube that is connected with the frame-work of the vessel, in combination with an open chamber at or near the water-line and having therein and projecting therefrom a sliding buffer and suitable electric connections between the said buffer and said gun, whereby while the buffer is being moved by external impact the gun is fired by means of said connections, substantially as and for the purpose set forth.

6. The combination, with a vessel, of a collision-buffer sliding in a suitable chamber, said chamber being provided with the valve I, which is operated by the movement of the piston *b*, operatively connected with the rack *n*, the pinion *o* on the shaft *o'*, the bevel-wheel $l^2$ thereon, the bevel-wheel $i^3$, meshing with $l^2$ and carrying the screw $k^2$ to operate the valve, substantially as and for the purpose herein set forth.

7. The combination, with a war-vessel, of a hydraulic collision-buffer provided with suitable pressure-regulating devices, said devices consisting of a sliding valve provided with a small projection $s^2$, operating against the spring *r* to adjust itself to the desired pressure, substantially as and for the purpose herein described.

8. As a means for firing a projectile under water, a vessel provided with a hydraulic cylinder having a piston moving therein, a sliding bracket connected with said piston, a rack attached to said bracket, a transverse shaft connected with the cylinder and carrying a pinion and a bevel-wheel, the former of which meshes with the rack and the latter with a bevel-wheel, operating a screw-threaded shaft to operate a valve, whereby the pressure of the fluid in the cylinder is equalized during the entire stroke of the piston, as set forth.

9. As a means for firing projectiles, a vessel provided with a hydraulic cylinder having an opening therein and a valve attached thereto, said valve having also an opening therein and a small ledge against which the fluid acts, a spring counteracting the pressure of the fluid against said ledge, all operatively connected and combined substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

HIRAM BERDAN.

Witnesses:
JOSEPH H. HANNEN
T. C. BRECHT.