8 Sheets—Sheet 1.

J. L. LAY.

Torpedo-Boat.

No. 211,303. Patented Jan. 14, 1879.

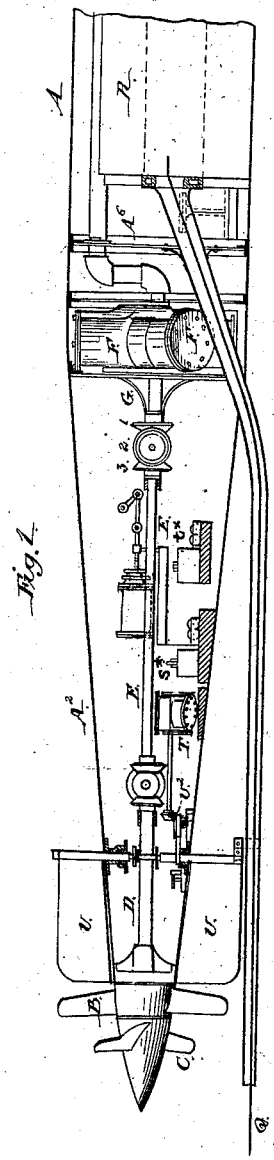

Fig. 1.

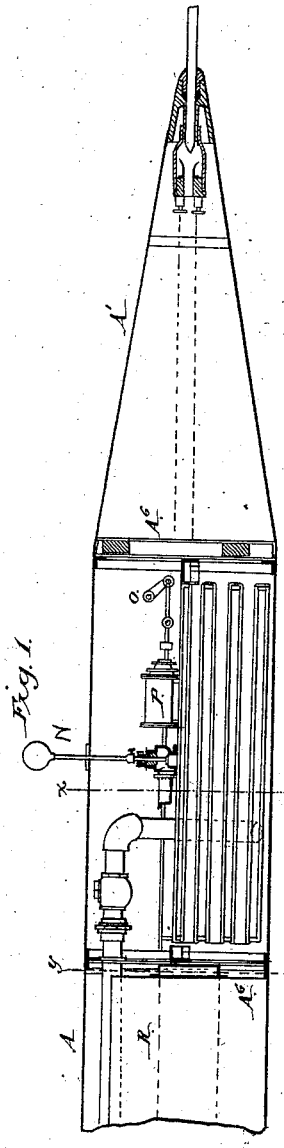

Fig. 1.

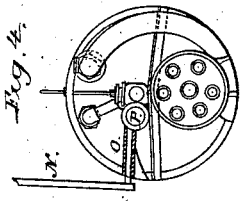

Fig. 4.

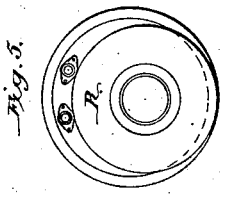

Fig. 5.

Attest:
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8 Sheets—Sheet 2.

J. L. LAY.

Torpedo-Boat.

No. 211,303. Patented Jan. 14, 1879.

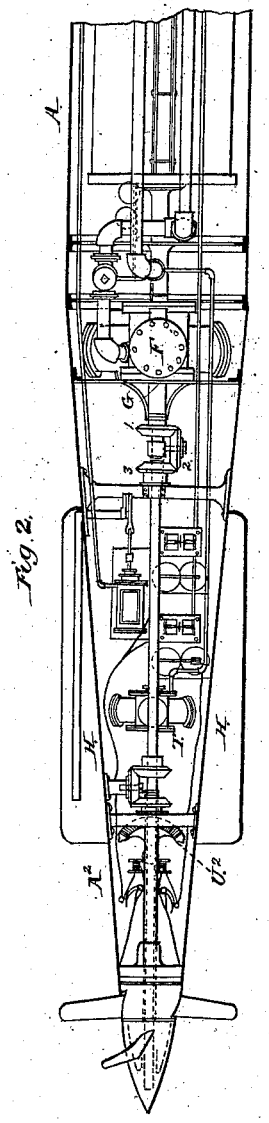

Fig. 2.

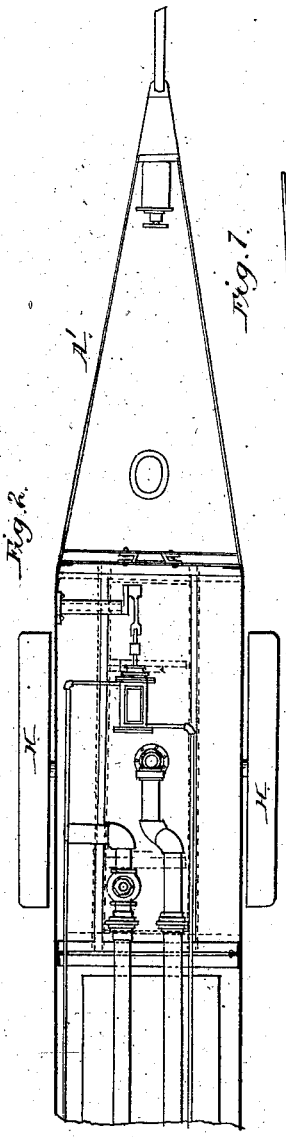

Fig. 2.

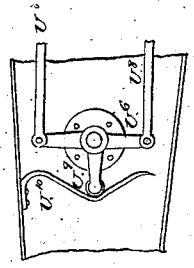

Fig. 7.

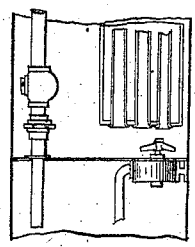

Fig. 6.

Attest:
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J. L. LAY.

Torpedo-Boat.

No. 211,303. Patented Jan. 14, 1879.

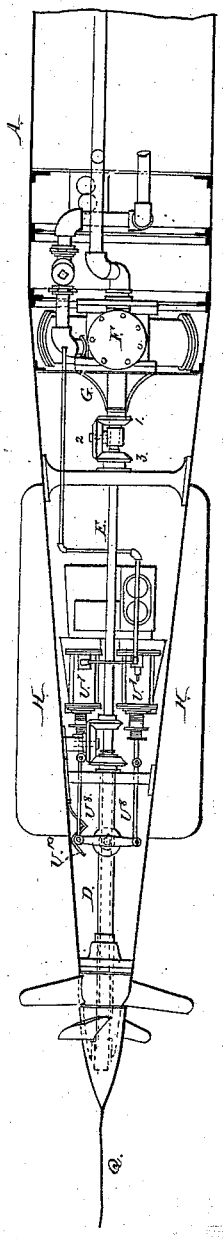

Fig. 3.

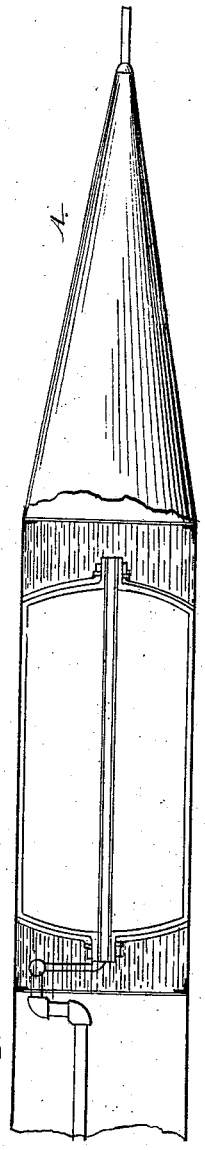

Fig. 3.

Attest:
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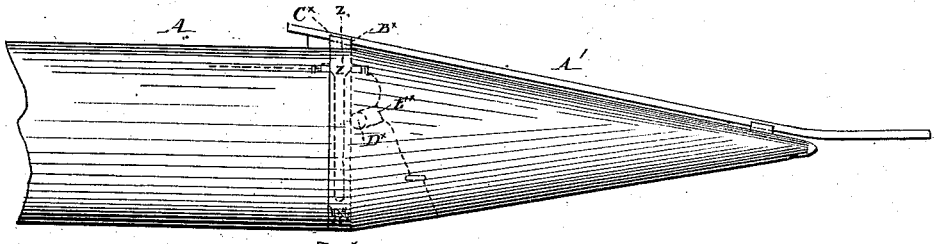
J. L. LAY.
Torpedo-Boat.

No. 211,303. Patented Jan. 14, 1879.

Fig. 12.



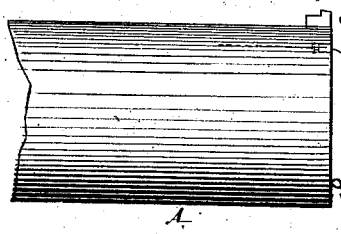


Fig 13.

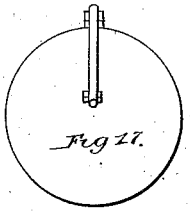


Fig 17.

Fig 18.

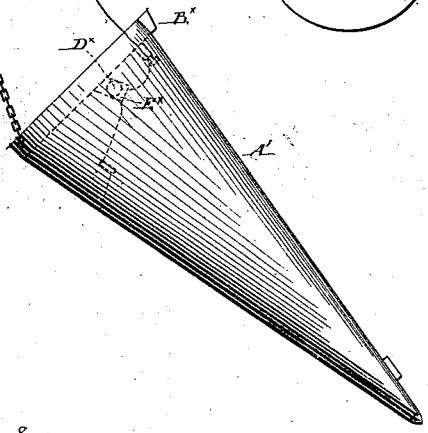
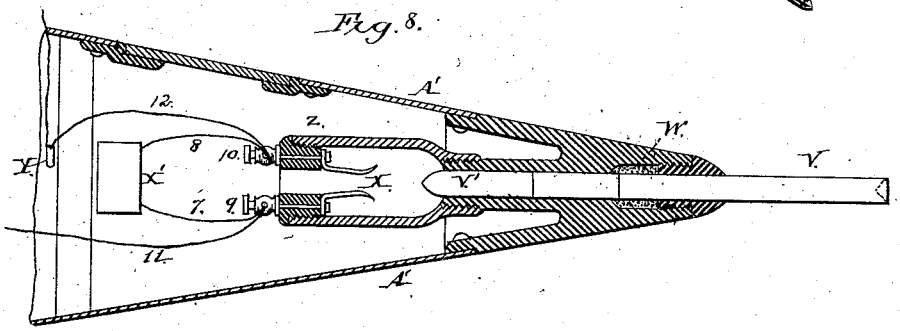


Fig. 8.



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J. L. LAY.
Torpedo-Boat.

No. 211,303. **Patented Jan. 14, 1879.**

Fig. 9.

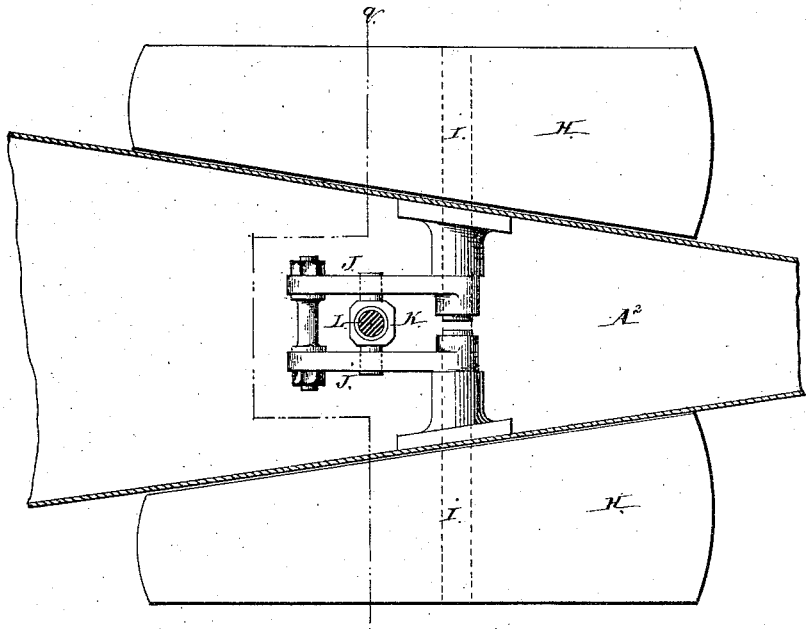


Fig. 10.

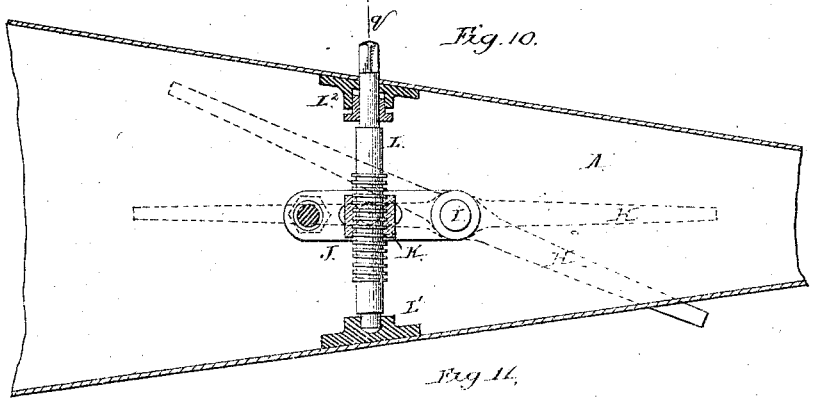
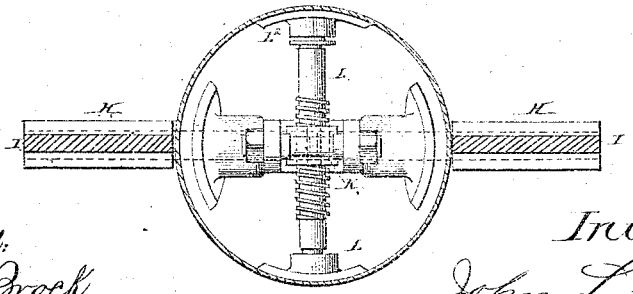


Fig. 11.



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8 Sheets—Sheet 6.

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Torpedo-Boat.

No. 211,303. Patented Jan. 14, 1879.

Fig. 14.

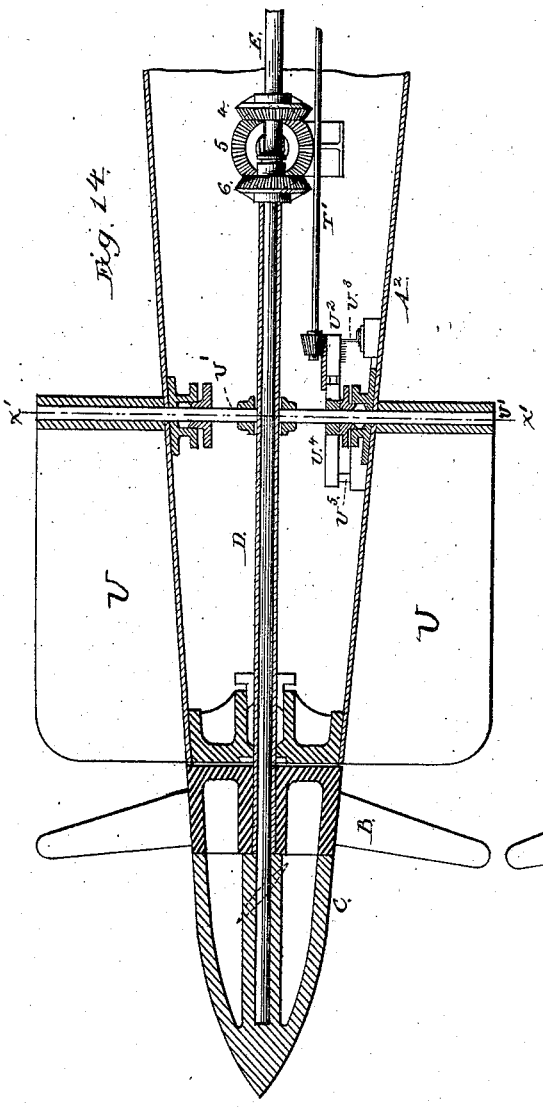
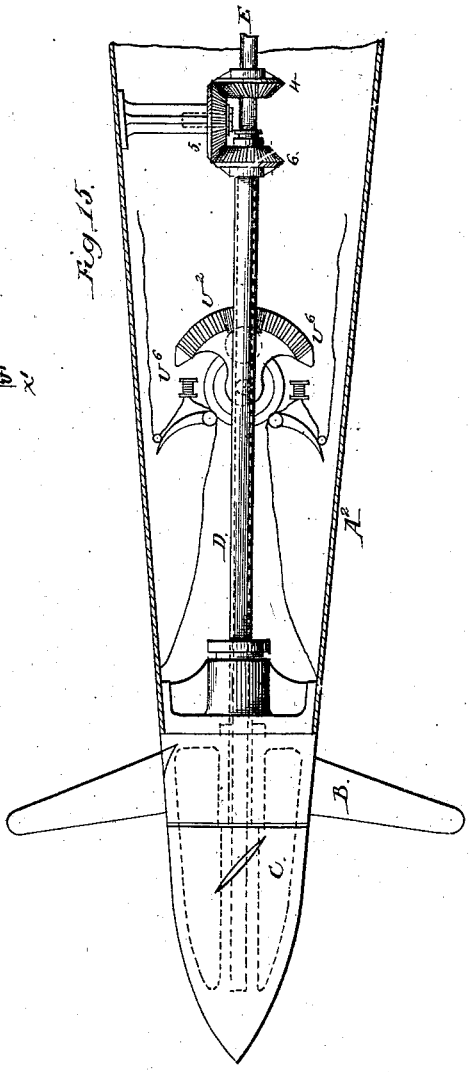


Fig. 15.



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J. L. LAY.
Torpedo-Boat.

No. 211,303. Patented Jan. 14, 1879.

Fig. 26.

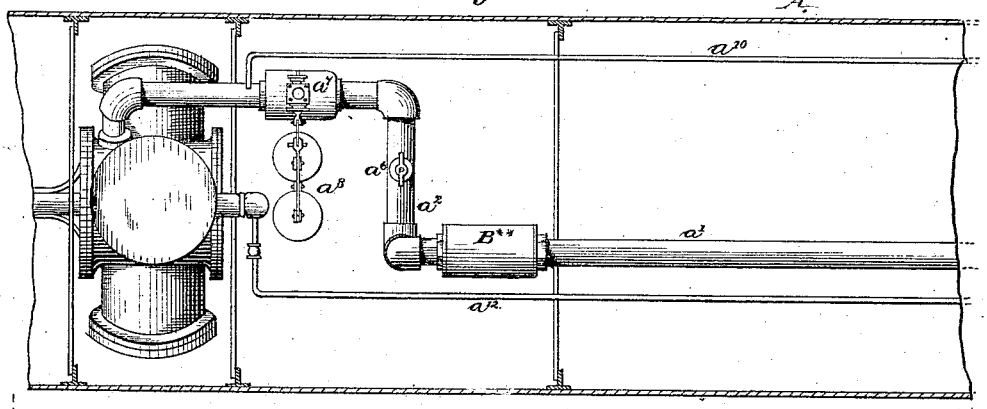


Fig. 26.

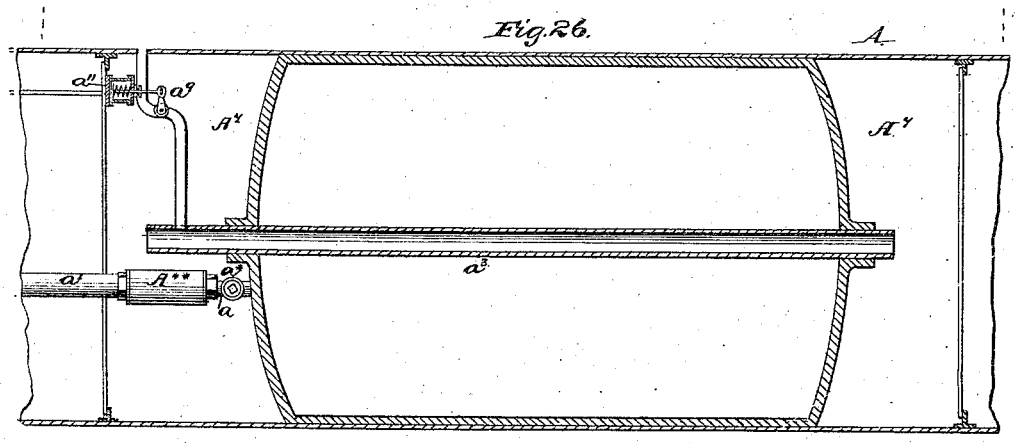
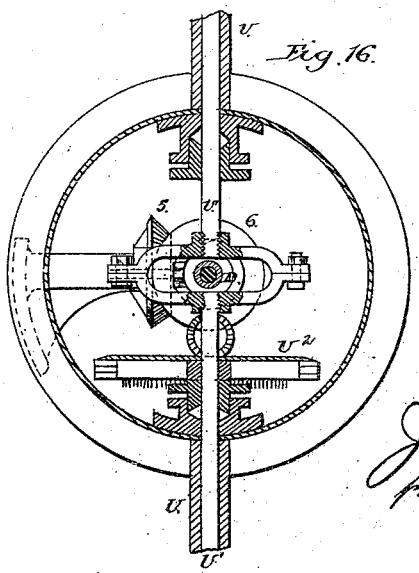


Fig. 16.



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8 Sheets—Sheet 8.

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Torpedo-Boat.

No. 211,303. **Patented Jan. 14, 1879.**

Fig. 19.

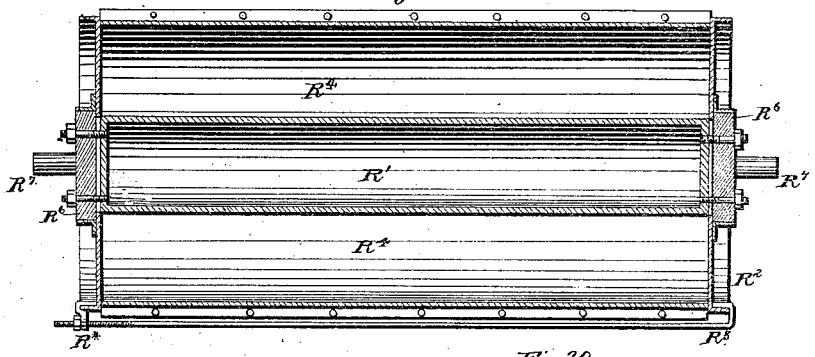


Fig. 20.

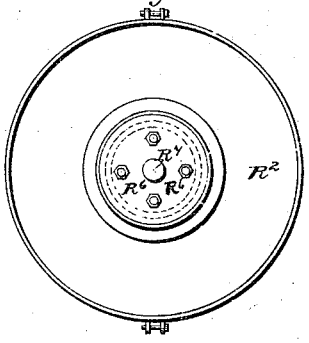


Fig. 21

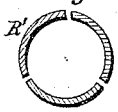


Fig. 22.

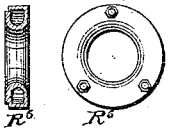


Fig. 23.

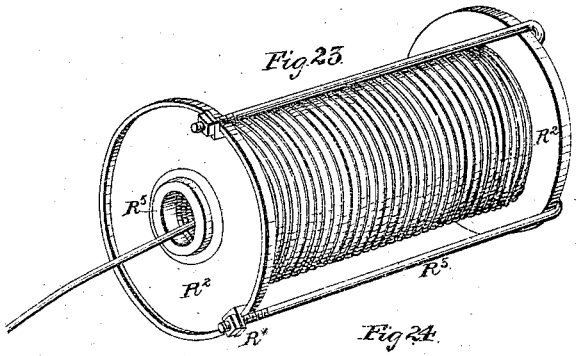


Fig. 24.

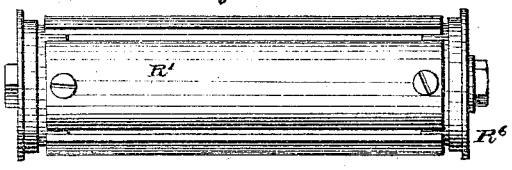
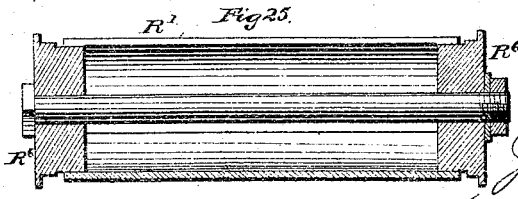


Fig. 25.



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UNITED STATES PATENT OFFICE.

JOHN L. LAY, OF BUFFALO, NEW YORK.

IMPROVEMENT IN TORPEDO-BOATS.

Specification forming part of Letters Patent No. 211,303, dated January 14, 1879; application filed July 17, 1878.

To all whom it may concern:

Be it known that I, JOHN L. LAY, of Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Torpedo-Vessels; and I do hereby declare that the following is a full and accurate description thereof, reference being had to the accompanying drawings, forming a part of this specification.

The said invention is designed to provide the means whereby a boat or vessel charged with suitable explosive materials—that is to say, a torpedo-boat—may be propelled by machinery contained therein, and at the same time may be kept fully under the control or management of an operator or staff of operators at a station on land or on board a ship or floating battery. After being launched from such station, vessel, or structure, the said torpedo-boat may be kept under observation and accurately guided or directed to an iron-clad ship or other object of attack, and may be fired or discharged at any desired moment, or may be caused to return to its station without being fired.

The manner in which I carry my said invention into practice is clearly illustrated in the accompanying drawings, which I will now proceed to describe.

Referring to the drawings, Figure 1 is a longitudinal vertical section (broken in two parts on account of the size of the drawing) of a torpedo-boat constructed and provided with controlling apparatus, and with means for propelling it by ammoniacal gas, according to my invention. Fig. 2 is a horizontal longitudinal section of the same, similarly broken. Fig. 3 is a horizontal longitudinal section, similarly broken, showing the same provided with means for driving it by carbonic-acid gas. Fig. 4 is a transverse section on the line *x x*, Fig. 1. Fig. 5 is a transverse section on the line *y y*, Fig. 1. Figs. 6 and 7 are modifications of certain parts hereinafter described. Fig. 8 is a longitudinal section of the stem of the said torpedo-boat, showing the mechanism for firing the same. Fig. 9 is a horizontal longitudinal section of a portion of the bows, showing the same provided with adjustable side wings or horizontal rudders. Fig. 10 is a vertical longitudinal section of the same. Fig. 11 is a transverse section on the line *q q*, Fig. 9. Figs. 12 and 13 are side views of the bow or stem of a torpedo-boat with a detaching magazine or torpedo, the same being shown in two positions. Fig. 14 is a longitudinal section of the stern of my torpedo-boat, showing the same with two propellers and steering apparatus. Fig. 15 is a horizontal section of the same. Fig. 16 is a transverse section on the line *x' x'*, Fig. 14. Fig. 17 is an end view of Fig. 12. Fig. 18 is a transverse section on the line Z Z, Fig. 12. Fig. 19 is a longitudinal section of the drum or reel on which the cable is coiled in the said torpedo-boat. Fig. 20 is an end view of the same. Fig. 21 is a transverse section of the barrel or core of the said drum. Fig. 22 shows a side view and transverse section of a thimble through which the said cable passes in paying it out. Figs. 23, 24, and 25 are views of a cable-reel and core slightly modified in construction.

Like letters indicate the same parts throughout these drawings.

A is the hull or body of the boat, which has conical ends A^1A^2, and is formed of thin plate iron or steel or other suitable metal. This hull is divided into sections or compartments for the various purposes hereinafter described. All of these compartments are separated from each other by air-tight bulk-heads A^6.

My torpedo-boat may be provided with a single screw-propeller, or with a double screw, or two screws or propellers, as shown in Figs. 1, 2, 3, 14, and 15. The propellers B C revolve in opposite directions. The shaft D of the propeller B is hollow or tubular, and the shaft E of the other propeller, C, passes through the same. The said screws or propellers B C are actuated by an engine. (Shown at F, Figs. 1, 2, and 3.) In the boat shown in Fig. 3 the engine is operated by the expansive force of carbonic-acid gas, while in the boat shown in Figs. 1 and 2 it is driven by ammoniacal gas; or I may use compressed air, or any other fluid which will be an equivalent for such gases. The connection of the engine with the two propeller-shafts is effected by two sets of bevel-gearing, or by other suitable means.

The said engine has a boss or projection, G, on which is fixed a bevel-wheel, 1. The en-

gine-shaft passes through this boss and fixed wheel, and is provided with a stud or finger fixed on it, and which carries a similar wheel, 2, that rotates freely on the said stud in gear with the wheel 1, and also with a similar wheel, 3, fixed on the screw-shaft E. In this arrangement of gearing the engine-shaft carries the wheel 2 around the fixed wheel 1, and thereby imparts rotation to the wheel 3 and shaft E with an increase of velocity of the screw-shaft in the ratio of two to one.

The shaft E also carries a bevel-wheel, 4, which gears with a similar wheel, 5, fitted to turn freely on a stud or shaft fixed in any convenient manner to the side of the boat. This wheel 5 also gears with a wheel, 6, on the tubular or sleeve shaft D, and thereby imparts motion to the same and the propeller B in a direction opposite to that of the revolution of the propeller C. This arrangement of gearing affords the means for obtaining very advantageously the required velocity of the two propellers in opposite directions.

The said boat or vessel is provided with a double set of side wings or horizontal rudders, H—two forward and two aft. These side wings or rudders are mounted on shafts or spindles I, passing transversely through the boat, as shown in Figs. 9, 10, 11. Attached to the shaft I are crank-arms J, which have slots for the reception of the ends of the cross-head K. The boss of this cross-head forms a nut, through which passes the vertical screw L, supported and kept from endwise movement by the bearings L^1 L^2; and by turning this screw to the right or left the cross-head K and shaft I are adjusted to set the said wings H vertically to any desired angle—that is to say, they may be set to escape a horizontal position—or more or less inclined in the proper direction, to cause the submerging of the boat by the action of the water on the said wings as the boat moves forward.

This screw L is operated from the outside of the boat by a key or wrench applied to the end of the screw L. These side wings or rudders are adjusted to the required angle for causing the necessary submergence, or partial submergence, of the boat before starting or leaving the station.

Two guide-rods, N, one aft and one forward, project up from the said vessel, to enable the operator to determine its position at any part of its journey, and in case of a night attack these rods are provided with lights; but as I have another application for sight-rods pending in the Patent Office, I do not deem it necessary to describe and claim them in this application.

In some instances I may employ hollow fixed rods or tubes, with balls of india-rubber or other like material at the upper ends of the same. These balls can be inflated with gas from the reservoir by means of a suitable valve, to render them visible to the operator, and when no longer required can be caused to collapse by exhausting the gas from them; or the pipes may be so short as not to project above the water, and open at top, or closed by valves opening outward, and a blast of air or gas from the flask will throw up a jet of water above these tubes, thus indicating the position of the boat.

The medium of communication between the said torpedo-boat and the land or other station occupied by the operator, and whereby the boat is started, stopped, and steered, and has her position ascertained, is an electric cable, Q, which is carried in the boat and paid out as the boat progresses.

The cable is preferably coiled on a reel or in a coil arranged longitudinally in one of the air-tight compartments of the boat, and passes out through a tube which projects beyond the rudder and propeller, so as not to be caught in or fouled by the propeller. One end of this cable is connected to a key-board at the station on shore or on board of the ship or other structure from which the torpedo-boats are controlled. This key-board is provided with a suitable battery or other means for generating the electric current. The said cable is composed of several wires, each of which is insulated from the others. One of these wires is connected with the mechanism for starting and stopping the boat, one is connected with the steering apparatus, one serves for indicating to the operator at all times the exact position of the rudder, one is connected with mechanism for elevating and depressing the said guide-rods, and one serves for firing the charge in the magazine.

The motive power for effecting the necessary movements of the mechanism or apparatus in performing the above operations is obtained from the aforesaid engines, which are provided with suitable valves arranged in combination with electro-magnets, shunts, and the devices connected with the said wires of the cable, as hereinafter set forth.

For placing the cable Q in the form of a coil in the said chamber, I prefer to use a reel constructed as shown in Figs. 19, 20, and 21—that is to say, it is provided with an inner core or barrel, R^1, and two flanges, R^2. The said flanges are connected or tied together at or near their periphery by rods or bars R^3, provided with hooks, which take hold of the rims of the flanges R^2.

The hook R^*, at one end of each rod, is loose, in order that it may be adjusted to fit over the said rim, and, when properly placed thereon, it is tightened on the said rim to bind the ends of the coil by a screw-nut, as shown.

The coil of cable is covered by a sheath, R^4.

The core or barrel R^1 is divided longitudinally into two or more parts, to permit it to be removed from the coil. While the cable is being coiled on the reel the said core and end flanges are secured by disks R^5, provided with necks or trunnions R^7. The said trunnions rest in bearings, and the reel turns therein while the cable is being coiled. When the cable is coiled on the said reel, the rod and end

pieces are removed. The core is then drawn out piece by piece.

The thimble or ring R^5, Fig. 22, is placed inside the end of the coil for the cable to pass through; and the inner end of the cable is taken through the ring, the said cable being thus paid out by commencing at the inside of the coil.

Fig. 23 is a perspective view of a modified form of reel, partly full of a coil of cable, with the outside securing-rods in place.

Fig. 24 is a view of this core, with the side plates secured to the end thimbles by screws.

Fig. 25 is a section of the core, with the thimbles held together by a central rod passing through them.

The coil is wound on the core, beginning at one end, and after a few turns of the coil about the core the screws holding the side plates may be removed, when the coil may be completed, the turns of the cable holding the side plates of this core in place. Other forms of collapsible core may be readily devised.

I may use an oval or flattened coil instead of a cylindrical one, by winding the cable on a core of suitable form. The oval or flattened coil may then be dropped into the compartment of the boat, the wires, pipes, &c., leading through the boat passing over the flattened side of the coil.

It will be observed that I place my coil or reel longitudinally in the boat, so that the turns of the cable surround the central axial line of the boat, and that I pay out the cable from the inside of the coil. Both these features I deem of much importance.

The thimble which I place in the end of the reel-head after the coil is wound and the core withdrawn has rounded edges, surrounding the central aperture, and the aperture is somewhat smaller than that in the reel-head; or one reel-head may be made with a central aperture smaller than the core, (which must then be withdrawn from the other end,) and the edges of the head may be rounded to allow the cable to run easily out of the reel.

The rudder is operated and controlled by means of a small auxiliary engine, (shown at T, Figs. 1 and 2,) which is started, stopped, and reversed by the electric current conducted through the said cable in connection with magnets attached directly to a valve forming part of the said engine. This valve is so actuated by the said magnets that when the current passes in one direction the engine will move the rudder to starboard, and when the current acts in the opposite direction it will turn the rudder to port.

The steering apparatus is most clearly shown in Figs. 14, 15, and 16. In these figures I have shown the boat provided with a double rudder or two rudders, one below and one above the boat, and both fixed to one shaft or stock, U^1, or two shafts united by a yoke, through which the propeller-shaft passes; but it will be readily understood that I may, if desired, use only one rudder.

On the rudder-stock U^1 is an arc or sector, U^2, which is connected by worm or bevel gearing with the engine-shaft T'. This arc or sector U^2 is provided with metallic pins or projections on its under side; and below this arc, and in the path of the same, I arrange a spring, U^3. When the rudders move, these teeth or points come in contact with the aforesaid spring, thereby closing the electric circuit.

On both sides of the rudder-stock U^1, I arrange a spring or arm, U^4, which, in its normal position, rests against a contact point or post, U^5, and these arms thereby complete the electric circuit; but this circuit is also completed through a resistance-coil. When the rudders U are hard a-port or hard a-starboard, the end of the arc or segment U^2, which is furnished with insulating-points U^6, will be brought into contact with the corresponding spring U^4, and will push the same out of contact with the said point or post U^5, and can then move no farther in that direction. This position of the rudder is indicated on the key-board through the electric cable by a suitable indicator.

In Fig. 7 I have shown a modification of my steering apparatus, in which a three-armed lever is fixed on the rudder-post, and is connected directly to the pistons of two engine-cylinders, U^7, Fig. 3, by rods U^8. The arm U^9 of this lever is provided with a friction-roller, which works upon the V-spring U^{10}. The latter is so formed that when the rudder is, by the action of the said pistons, moved either to port or starboard it tends to restore the said rudder to its central position by bringing the said friction-roller over either of its inclined surfaces into the central angle of the said spring, as shown. Or the spring U^{10} may be arranged at one side, and the central arm of the yoke dispensed with, as in Fig. 3.

The mechanism for firing the charge in the magazine A^1 is most clearly shown in Fig. 8, and operates as follows: Projecting from the front extremity or stem of the boat is a rod or pin, V, which extends through a suitable packing-box, W, into the said magazine or charge-chamber. When the boat strikes an object the said rod is forced inward into contact with the springs or points X, thereby closing an electrical circuit and igniting a cartridge (shown at Y) in the magazine. The charge in the magazine can also be fired at any moment by the operator on shore closing a circuit on the key-board, and thereby cutting out one of two resistance-coils placed in the circuit to prevent accidental or premature discharge—that is to say, there are two resistance-coils.

The battery is not sufficiently powerful to fire through both resistance-coils at the same time. When the boat strikes an object the resistance-coil in the magazine is cut out by the driving inward of the rod V, as above described. The battery then fires through the one on the key-board. On the other hand, if the operator desires to fire the torpedo-boat before she touches the object of attack, he ma-

nipulates the switch to cut out the coil in the key-board, the charge then being fired through the coil in the magazine. This arrangement of the two resistance-coils is very effectual in preventing accidents.

In order that the said torpedo-boat may be provided with material for maintaining the action of the motor-engines for a sufficient time, it is sometimes necessary that the reservoir or vessel containing the gas or fluid from which the motive power is generated should contain such gas or fluid under a pressure very much higher than that under which the same can be used in the engines. Therefore it is necessary to provide means whereby this pressure can be reduced in its passage from the said reservoir to the engine. For this purpose I employ a valve or valves so arranged as to greatly reduce the pressure of the gas as it passes to the engine from what it is normally in the flask or holder containing the gas under pressure or in liquid form.

In Fig. 26, which is a horizontal section broken in halves, I have shown a convenient arrangement of the pipes and valves in my improved torpedo-boat, the other parts of the apparatus being omitted to permit the said pipes and valves to be clearly seen. In this figure I have shown the reducing-valves last above described both arranged in the gas-pipes between the reservoir and the engines.

The valve A** first reduces the pressure from the very high degree in which it exists in the reservoir and pipe a to a comparatively moderate pressure on the pipe a^1, and the valve B** admits the gas, still further reduced in pressure, from the pipe a^1 to the pipe a^2, from which it passes to the throttle-valve to the engine. The pipe a^3, extending through the flask or reservoir, provides communication between the water-spaces A^7 at the ends of the same.

a^* is a valve for closing the pipe a, and which is opened from the outside of the boat before the same is started. a^6 is a safety-valve for relieving the engine and pipe a^2. a^7 shows the position of the aforesaid throttle-valve, which is controlled by the operator through the cable and the magnets a^8. a^9 is a small valve for admitting water to the spaces A^7 to compensate for the gas taken from the reservoir. a^{10} is a pipe, which conveys gas from the pipe between the engine and throttle-valve to a small cylinder, a^{11}. This cylinder is provided with a spring-piston, connected by a lever to the said valve a^9.

When the throttle-valve is open the gas overcomes the spring of the said piston and opens the valve a^9, thereby admitting water to the space A^7. When the throttle-valve is closed the spring forces back the piston and closes the valve a^9.

a^{12} is a pipe for permitting the escape of air from the spaces A^7 into the exhaust-pipe of the engine.

When ammoniacal gas is used ammonia in a liquid state is carried in a cylinder containing a series of tubes, and which is surrounded with water. The gas having exerted its power in the engine is exhausted into this water surrounding the aforesaid cylinder, and it is absorbed by the water, and during the absorption heat is developed, which is imparted to the ammoniacal gas in the cylinder, thereby maintaining a uniform pressure.

In Fig. 6 I have shown in this water-compartment a small fan or propeller, driven by a rotary engine, for the purpose of keeping the water in agitation, and thereby insuring this desired uniformity of temperature.

In some instances I make the magazine detachable from the hull of the boat, so that on striking an object it will descend or drop down in the water before exploding.

This modification of my invention is illustrated in Figs. 12, 13, 17, and 18. The magazine A^1 is attached at its lower side to the boat by a chain or other suitable connection. At its upper edge it is held by a rod, as shown in Fig. 12. This rod is fitted to slide in dovetailed bearings, as shown at $B^\times$, and when this magazine is in its place on the boat the said rod is engaged with a catch or stop, $c^\times$; but when the said rod is driven against any object it is forced back and released from the said catch or stop, and the magazine then drops, as in Fig. 13, and is fired.

To effect the firing, I prefer to use a ball, $D^\times$, placed in a tube containing two springs or plates, $E^\times$, and arranged in an upwardly-inclined position, as shown in Fig. 12, one of the said springs being connected with the cable, and the other with a wire that passes through the cartridge to the ground. While the magazine is in the position shown in Fig. 12 the circuit is incomplete; but when the magazine drops, the said ball falls into the position shown in Fig. 13. The circuit is then completed and the magazine is fired.

The electrical or electro-magnetic apparatus for generating, directing, and controlling the currents, whereby the above-described operations are effected, may be of any suitable kind.

For operating and controlling the above-described steering apparatus, and indicating the position of the rudder to the operator on shore, I use the following devices, in combination with the pole-changers on the key-board. These pole-changers are geared together by insulated toothed wheels, which are fixed on the spindles or axles of the said pole-changers so that the latter work accurately together and maintain the same relative positions to each other. One pole-changer is connected by one of the said insulated cable-wires with a shunt on board the boat, which shunt is connected with a set of magnets arranged in combination with the valve of the engine that drives the steering apparatus, and which valve is reversed or opened and closed by the reversal of the currents through the said magnets, as above described, and the said engine moves the rudder to port or starboard at the will of the operator. But in order that the operator may

know the exact position of the rudder at any moment, I employ the device hereinbefore described, consisting of a series of pins or projections fixed on an arc or other portion of the rudder-stock, and arranged in combination with an insulated spring projecting into the path of the said series of pins. This spring is connected by one of the cable-wires with a pole-changer on the key-board, which is geared with and moves in unison with the other pole-changer, so that the electric current that controls the steering-engine and the current that returns the indication of the rudder's position will both be reversed simultaneously. A separate battery is connected with the index on the said key-board, whereby a constant current is maintained between this index and the indicating apparatus on the boat. The current passing from the said spring to the shore is made to indicate the position of the rudder by the index on the key-board. Now, it will be obvious that when the rudder is turned in either direction, the pins on the sector U^2 will come successively in contact with the spring U^3, and at each contact and separation the circuit will be made and broken, and an impulse will be transmitted through the cable, whereby a corresponding movement will be transmitted to the said index finger or pointer on the key-board. A switch on the key-board is connected with another of the said insulated wires of the cable, which forms the circuit to the firing mechanism of the torpedo or magazine which includes the aforesaid two resistance-coils. By adjusting this switch the operator completes the circuit through the two resistance-coils, and then, but not till then, the charge can be exploded either by the operator or by the action of the firing pin or rod, when the same is driven in and cuts out the other resistance-coil, as above described.

By referring to Fig. 8, the arrangement of the resistance-coil and connecting-wires on the boat may be fully understood. The resistance-coil X′ is connected by the wires 7 8 to the binding-screws 9 10, which are insulated from the case or box Z, but are connected with the springs or points X. The wire 11 from the key-board battery is connected to the screw 9, and the wire 12 extends from the screw 10 through the cartridge Y to the ground. Now, when the operator, as aforesaid, cuts out the resistance-coil on shore by actuating the switch on the key-board, the current from the battery is sufficiently powerful to fire the said cartridge through the resistance-coil X′, and the operator can thus fire the charge at any moment; or he can await the contact of the boat with the ship or other structure to be attacked, when the charge will be fired automatically by the driving in of the rod V, as above described. When this rod is driven so that its inner extremity or point, V′, is in contact with the springs X the circuit is completed through the wire 11, springs X, the point V^4, and wire 12, and the charge is fired.

What I claim as my invention is—

1. The two propellers, one in rear of the other, the tubular propeller-shaft, the engine, and the system of gearing, all in combination, so that the screw-propellers move in opposite directions and with different velocities, as set forth.

2. A torpedo-boat having side wings or diving rudders, and mechanism, substantially as described, for adjusting said rudders to any desired angle prior to launching the boat and retaining them in that position, as set forth.

3. A pair of diving wings connected to a screw-shaft, one end of which projects through the side of the boat, as shown.

4. The combination, with the sight-rods of a torpedo-boat, of an elastic globe or target, which is inflated from the gas-flask, as shown and described.

5. The cable-reel having a detachable core, on which the cable is wound, which core is removed to permit the paying out of the cable from the inside of the coil, as set forth.

6. A skeleton cable-reel having end plates and side clamps and a round-edge delivery-orifice for the cable, as described.

7. The combination of the reel-plate R^2 and thimble R^5, as set forth.

8. A collapsible core, constructed substantially as described, in combination with the end plates and holding-rods of a reel, as set forth.

9. The combination of the reel ends R^2, having central apertures, with the clamping-rods R^3, for retaining a coil of cable.

10. The collapsible core of the cable-reel, consisting, essentially, of the side plates, R^1, end plates, R^6, or equivalent devices, to retain the end plates and side plates in their relative position.

11. The core of the cable-reel, consisting of side plates and end plates provided with trunnions, in combination with the end plates, R^2 R^2, of a cable-reel, all as set forth.

12. The combination of a skeleton reel for holding the cable, said reel having end plates and retaining-rods, with a torpedo-boat, when said reel is placed longitudinally of the boat in a compartment thereof, so as to pay out the coil of cable from the inside, as set forth.

13. The combination of the rudder and the electric indicator, to indicate the position of the rudder to the operator, as set forth.

14. A rudder stock or head provided with projecting pins, which, in the movement of the rudder, serves to open and close the electric circuit and indicate the position of the rudder through suitable mechanism, substantially as described.

15. The combination of sector U^2 on the rudder stock, its connecting and projecting pins, the spring U^3 and its connecting electric wires, and a suitable indicating device at the operating-station, whereby the position of the rudder is indicated to the operator.

16. The combination of the rudder and the engine by mechanism substantially as described, whereby the operator is enabled to

control the rudder and engine by a single electric circuit, substantially as set forth.

17. The combination, with the rudder-yoke, of safety-springs and resistance coils and wires connecting with the engine, as set forth.

18. The combination of the rudder-yoke or its equivalent, the electrical indicating device, and the safety-springs and wires connecting to the rudder-engine, whereby the engine is stopped automatically when it reaches its extreme position.

19. The combination of sector U^2 on the rudder-stock, having insulated points, the safety-springs, the connecting electric wires, and the magnets which control the rudder-engine, whereby the position of the rudder is indicated on the key-board by the electric current.

20. The combination, in a torpedo-boat, of a gas-engine, a compensating water-tank, and an automatic valve to control the admission of water to the tank, substantially as set forth.

21. A gas-containing flask, a pipe leading from this flask to the engine, and a pipe leading to a valve which controls the admission of water to the water-compartment, so that this water-valve is opened when the engine is in motion and closed when the engine stops, as set forth.

22. In combination, the gas-flask, pipes leading from the flask to the engine, a pipe connecting the engine to a cylinder which controls the inlet-valve, and the water-inlet valve and its pipe, all substantially as set forth.

23. The combination of the gas-pipe a^2, the throttle-valve operated by magnets a^3, gas-pipe a^{10}, and water-inlet valve a^9, substantially as described.

24. A torpedo-boat having the charge or magazine contained in a separate detachable section at the bow, which section completes and forms part of the boat proper.

25. The detachable prow of the boat, the retaining clasp, and the projecting rod which releases the prow, all in combination, as set forth.

26. The combination of the firing-rod with the electric current wires, whereby the circuit is completed and the torpedo fired by the electric spark on contact with an obstacle.

27. The combination of the firing-rod, the circuit wires and their projections X, and the resistance-coil X'.

28. The combination of two resistance-coils and connecting-wires and a firing-rod, arranged as described, so that the contact of the firing-rod with an obstacle serves to cut out one of the resistance-coils and fire the charge, as set forth.

29. The combination, with the ammoniacal-gas engine of a torpedo-boat, of a water-compartment to absorb the gas after use and an agitator to accelerate absorption.

30. A rudder-shaft projecting above and below the hull, and collared so as to pass round the propeller-shaft, as shown in Fig. 16.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

JOHN L. LAY.

Witnesses:
LEWIS SANDERSON,
ROWLAND GEO. BROWN