

REPORT

OF THE

SECRETARY OF THE NAVY;

BEING PART OF

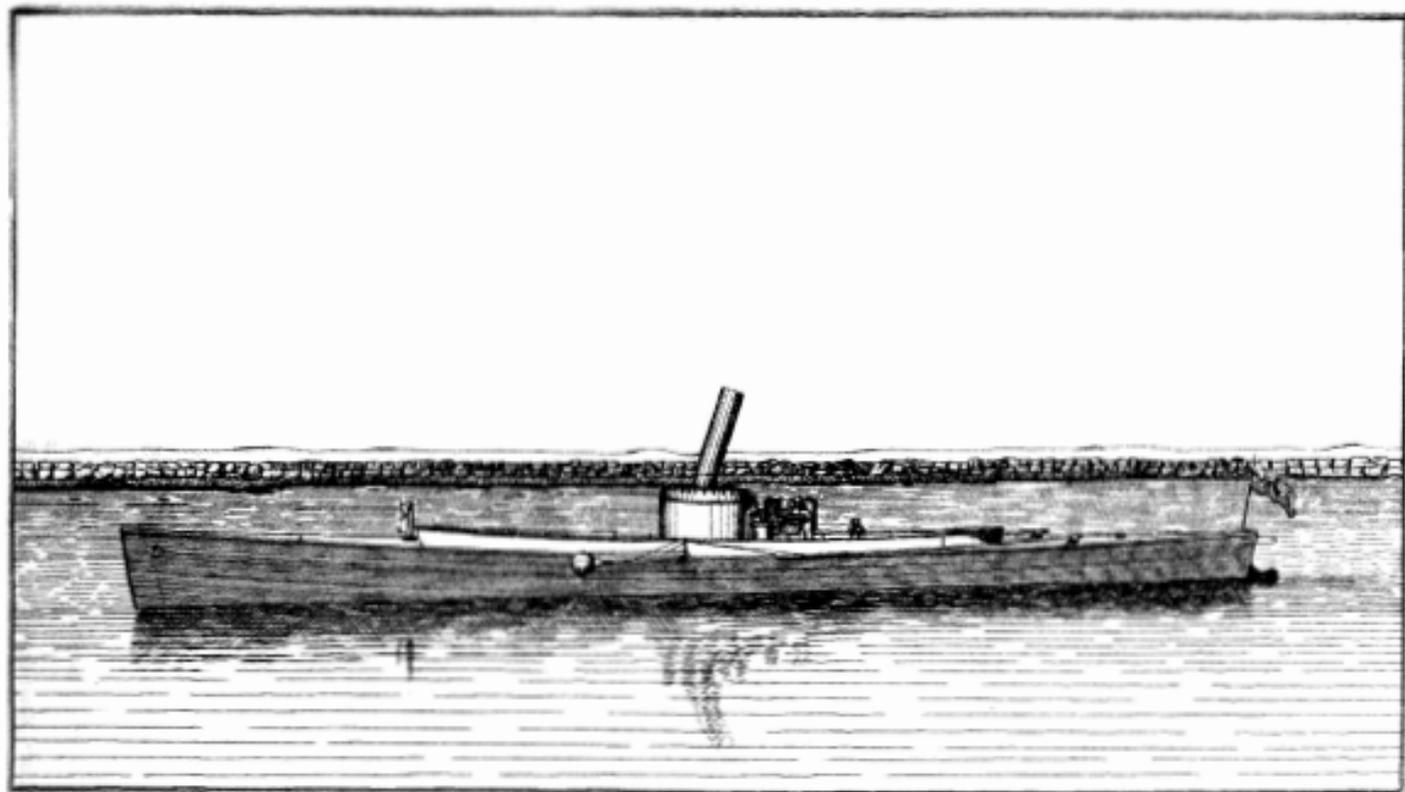
THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

TWO HOUSES OF CONGRESS

AT THE

BEGINNING OF THE SECOND SESSION OF THE FORTY-FOURTH CONGRESS.



TORPEDO STATION,
Newport, R. I., November 23, 1876.

SIR: I have to forward herewith the report of Lieut. G. A. Converse, United States Navy, on the fast torpedo-launch Lightning, and beg leave to add what he has omitted, that the method of carrying the spars and the torpedo is of his device, and that the many improvements of the boiler and its appurtenances were made at his suggestion and under his direct superintendence.

Respectfully, your obedient servant,

K. R. BREESE,
*Captain United States Navy,
Inspector of Ordnance, in charge of Station.*

Capt. WILLIAM N. JEFFERS,
*United States Navy,
Chief of Bureau of Ordnance, Washington, D. C.*

UNITED STATES TORPEDO STATION,
Newport, R. I., October 25, 1875.

SIR: In accordance with your orders, I have been to witness the performance of Herreshoff's engine and safety coil-boiler, and have become very much impressed with them for naval purposes in boats. For cheapness, lightness, and doing away with fresh water, they seem to me unsurpassed, and I know of no other boiler upon which steam can be raised so rapidly, and, so far as I can understand, with so much safety. After a trial-trip in a boat propelled by this engine and the safety coil-boiler, which was most satisfactory, we stopped at the wharf, leaving the boat with one hundred pounds of steam, with no one to watch it or care for it. On returning, after an hour or more absence, there was no steam on, and a fair fire. The boat was shoved from the wharf, and a few strokes of a hand-pump in less than five minutes gave as much steam as was desired—80 pounds—steam enough being formed with al-

most the first stroke of the pump to start the engine. I was so much impressed with what I saw that I asked Mr. Herreshoff to submit in general terms a proposal of what he would do for a torpedo-boat, capable of greatest speed, to carry a torpedo either on bow or abeam, with a double engine, and separate engine to drive an electric machine two thousand revolutions per minute, as this would comprise a picket and torpedo boat. I have the honor to submit his estimates.

The reputation of Mr. Herreshoff is of the very highest, and his success as a yacht and boat builder well established. * * *

Very respectfully,

K. R. BREESE,

Captain and Inspector of Ordnance, in charge of Station.

Capt. WILLIAM N. JEFFERS,

United States Navy, Chief of the Bureau of Ordnance.

BRISTOL, R. I., October 22, 1875.

DEAR SIR: We will build you a steam-launch, suitable for a torpedo-boat, as follows: Boat to be 55 feet long, 6 feet 3 inches wide, fitted with our safety-coil boiler, and a pair of engines with the combined capacity of 60 horse-power, which will run the boat 19 miles an hour.

The boat will also be furnished with a steam-pump for boiler, and one 12 horse-power engine suitable to run an electric-light machine.

The boat and machinery to be constructed in the strongest manner and with the least weight, yet boat strong enough to sustain the machinery, when it is hoisted out of water, without any strain on it.

Said boat to be delivered at Newport on or before April 1, 1876, for the sum of \$5,000.

Should the Department decide to get us to build as proposed, we will send specification in detail.

Yours, truly,

JOHN B. HERRESHOFF,

Agent Herreshoff Manufacturing Company. S. H.

Captain BREESE.

[Indorsement.]

In conversation, Mr. H. states will run for half an hour at the rate of 19 miles an hour, 16 to 16½ steadily.

K. R. B.

Specifications for building torpedo-boat for Bureau of Ordnance.

Dimensions of hull: Length over all, 55 feet; beam, 6 feet 3 inches; depth, 3 feet 3 inches.

Keel, stem and stern posts to be of white oak; keel to be sided 4½ inches.

Frame to be of white oak, steamed and bent; molded 2½ inches, and placed 11 inches apart from centers.

Outside planking to be of yellow pine ⅞ inch thick.

Ceiling and floor to be of yellow pine; ceiling ¾ inch, floor ⅞ inch.

Shear-streak to be of oak, ¾ inch thick.

Clamps and deck-frame to be of yellow pine; clamps ¾ inch, deck-frame 2½ inch, molded.

Deck to be of white pine, $\frac{9}{16}$ inch thick.

Space in center of boat to be left open 28 feet, with high wash-board around same.

Machinery to be as follows:

To have two 5 by 10 inch engines, and one Herreshoff safety-coil boiler of sufficient size to run said engine 400 turns per minute with 140 pounds steam, following $\frac{3}{4}$ strokes.

Boat also to have all gauges, valves, and pipes necessary for said engines and boiler, and one steam-pump and one feed-pump connected to engines.

Propeller-shaft to be of steel, after end of which is to be covered with bronze.

Propeller-wheel to be of bronze.

Rudder to be of yellow metal, with steel rudder-stock.

Fastenings: Hull of boat to be fastened with galvanized iron, and all materials used in hull and machinery to be of first quality.

Boat to be built in our best manner, and well painted with two coats of paint.

Boat also to be furnished with one engine, attached to boiler, to run an electric machine, and to be capable of developing 12 horse-power.

The coil in boiler to be made of best-quality 2-inch exterior lap-welded steam-pipe $\frac{1}{8}$ inch thick.

Jacket to be doubled, of sheet-iron and brass.

Boiler to have a drum, so that salt water can be used as well as fresh without injury to boiler.

Engines to be constructed of best materials. All studs, bolts, and shafts to be made of Ulster iron; rods, pins, and keys to be made of steel. To be furnished with the Herreshoff cut-off valves.

The boat to be properly braced.

Screw-bolts to be used in place of rivets.

We agree that the boat shall run 19 miles an hour, and that she can carry two torpedo-poles of 38 feet length each, one on each side; said poles to be worked from the boat with 100-pound steel-cased torpedoes on each.

The price to be \$5,000 dollars, payable as follows: \$1,250 when the frame of hull is up; \$1,250 when hull is ready to be painted; \$1,250 when the boiler and engines are completed; \$1,250 when the boat, with its machinery, is completed and tried.

The boat and machinery subject to inspection, and to be satisfactory before the payments are made.

JOHN B. HERRESHOFF,

Agent Herreshoff Manufacturing Company.

Witness to signature: In presence of—

J. BUMSTEAD.

BUREAU OF ORDNANCE, NAVY DEPARTMENT,
Washington City, November, 4, 1875.

SIR: Your letter of the 2d instant, inclosing specifications and contract for building one torpedo-boat, has been received.

The bureau approves and accepts the same, but with the following modifications, viz: The speed to be 19 miles per hour for *one hour*, using salt water, and desire you to commence the work without delay.

I inclose you a tracing from a sketch of one of Thornycroft's fast steam torpedo-launches, which has made 21 miles per hour, developing 130 horse-power.

I am, sir, your obedient servant,

WILLIAM N. JEFFERS,
Chief of Bureau.

Mr. JOHN B. HERRESHOFF,
Agent Herreshoff Manufacturing Company, Bristol, R. I.

BUREAU OF ORDNANCE, NAVY DEPARTMENT,
Washington City, November 5, 1875.

SIR: The bureau forwards copy of the contract of the bureau with Mr. Herreshoff for the construction of the torpedo-boat.

When Mr. Herreshoff reports that the boat is ready for the several inspections, you will detail an officer to make them, whose certificate will be the voucher for the several payments.

The bureau sends you, for the files of the torpedo-station, a copy of a general sketch of Thornycroft's last fast torpedo-launch, with his arrangement for using the poles abeam or on either side, which, from comparison with a photograph, the bureau believes to be substantially correct.

Thornycroft told Captain Ramsay that one of the main things in the construction of these fast torpedo-boats was to see that they were thoroughly braced, as vibration killed the speed.

I am, sir, your obedient servant,

WILLIAM N. JEFFERS,
Chief of Bureau.

Capt. K. R. BREESE,
Inspector of Ordnance, Torpedo Station, Newport, R. I.

Official trial of torpedo-boat.

NARRAGANSETT BAY,
Wednesday, 24th May, 1876.

Course.—From Usher's buoy, Bristol Harbor, to Bishop's Rock buoy, Coaster's Harbor, and return.

Distance.—From Usher's buoy to Bishop's Rock buoy, 10½ statute miles; total distance, 20½ statute miles.

Coal.—English cannel.

Number of persons on board, 5.

Started fires at 9^h 41^m.

Steam, 80 pounds, at 9^h 46^m 45^s.

Time required to raise steam, 5^m 45^s.

At 9^h 46^m 45^s started up Bristol Harbor.

At 9^h 48^m stopped to set up packing of feed-pump.

At 10^h 4^m headed down for Usher's buoy.

Record of trip.

Object.	Down trip.			Elapsed time.	Return trip.			Elapsed time.
	Time passed object.				Time passed object.			
	A.	M.	S.	M.	S.	A.	M.	S.
Usher's buoy.....	10	09	00	5	04	11	56	26
Southwest Point buoy.....	"	14	04	4	51	51	04	6
Sandy Point light.....		18	55	5	47	44	54	7
Dyer's Island, southwest buoy.....		24	45	11	03	37	30	14
Bishop's Rock buoy.....		35	45			33	30	20
Time over course.....		36	45	36	45	32	56	26

Distance..... 10.12 statute miles. Time..... 26^m 45^s down trip.
 Distance..... 10.12 statute miles. Time..... 32^m 58^s return trip.

Total distance. 20.24 statute miles. Total time. 59^m 43^s

DOWN TRIP.

Sea.—Smooth.

Tide.—Ebb.

Wind.—Light ahead.

Steam.—Steady at 140 pounds.

Engines.—Working as well as could be desired. No parts of the machinery showed the slightest signs of heating.

Boiler.—Working well.

NOTE.—Finding that the quantity of coal on board would not be sufficient to last for the return trip, it was deemed best to continue course to torpedo-station and get more. It was the first time any of the people on board had used English coal, and the consumption was much greater than on previous occasions when American coal was used.

RETURN TRIP.

Sea.—Smooth.

Tide.—Strong ebb.

Wind.—Moderate breeze astern.

Steam.—Average about 100 pounds.

Engines.—Worked as well as could be desired. No parts of machinery showed the slightest signs of heating.

Boiler.—Made steam freely and worked well.

NOTE.—When a short distance above Bishop's Rock buoy the pipe connecting with after steam-gauge blew out at joint with steam-drum. Plugged hole with pine stick without stopping. Plug blew out three times. Carried low steam while repairing. Average during return trip, not over 100 pounds.

Very respectfully, your obedient servant,

G. A. CONVERSE,

Lieutenant, and Assistant Inspector of Ordnance.

To Capt. K. R. BREERSE, U. S. N.,

Inspector of Ordnance, in charge of Torpedo Station.

Record of times noted during trial-trip of steam torpedo-launch, May 24, 1876, by Lieut. A. R. Couden, at Bishop's Rock buoy, and Ensign A. L. Case, at Usher's buoy:

Passed Usher's buoy, from Bristol, at.....	10 ^h 09 ^m 11 ^s	
Passed Bishop's Rock buoy, from Bristol, at.....	10 ^h 35 ^m 55 ^s	
Elapsed time.....		26 ^m 44 ^s
Passed Bishop's Rock buoy, to Bristol, at.....	11 ^h 23 ^m 48 ^s	
Passed Usher's buoy, to Bristol, at.....	11 ^h 56 ^m 45 ^s	
Elapsed time.....		32 ^m 57 ^s
Total time from Usher's buoy to Bishop's Rock and return..		59 ^m 41 ^s
Passed Usher's buoy, at.....	10 ^h 09 ^m 11 ^s down.	
Passed Usher's buoy, at.....	11 ^h 56 ^m 45 ^s up.	
Elapsed time.....		1 ^h 47 ^m 34 ^s
Passed Bishop's Rock at.....	10 ^h 35 ^m 55 ^s down.	
Passed Bishop's Rock at.....	11 ^h 23 ^m 48 ^s up.	
Time off course.....		47 ^m 53 ^s
Time on course.....		59 ^m 41 ^s

Very respectfully, your obedient servants,

A. R. COUDEN,
Lieutenant, and Assistant Inspector of Ordnance.
 A. L. CASE,
Ensign, and Assistant Inspector of Ordnance.

To Capt. K. R. BREESE, U. S. N.,
Inspector of Ordnance, in charge of Torpedo Station.

[Telegram.]

WASHINGTON, D. C., May 25, 1876.

Captain BREESE,
Newport, R. I.:
 Telegram received. Accept Lightning.

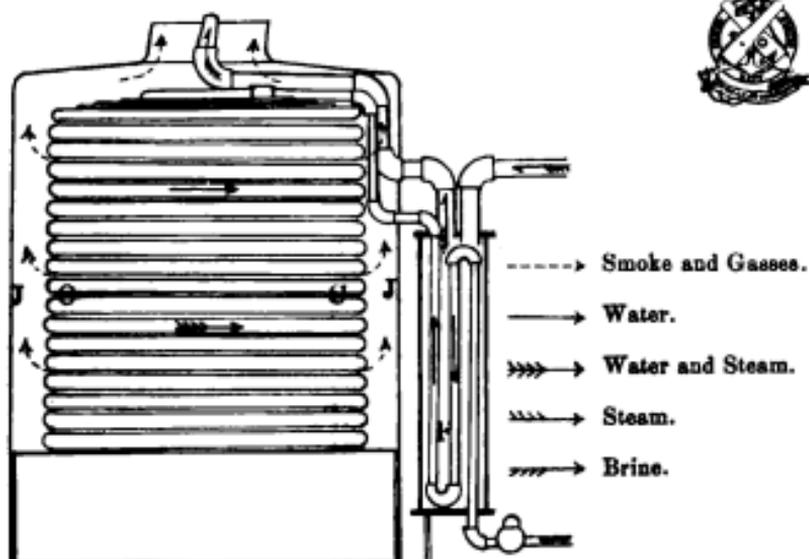
JEFFERS,
Chief of Bureau.

The boat, having been accepted by the bureau, was delivered at this station on the 1st of June, 1876.

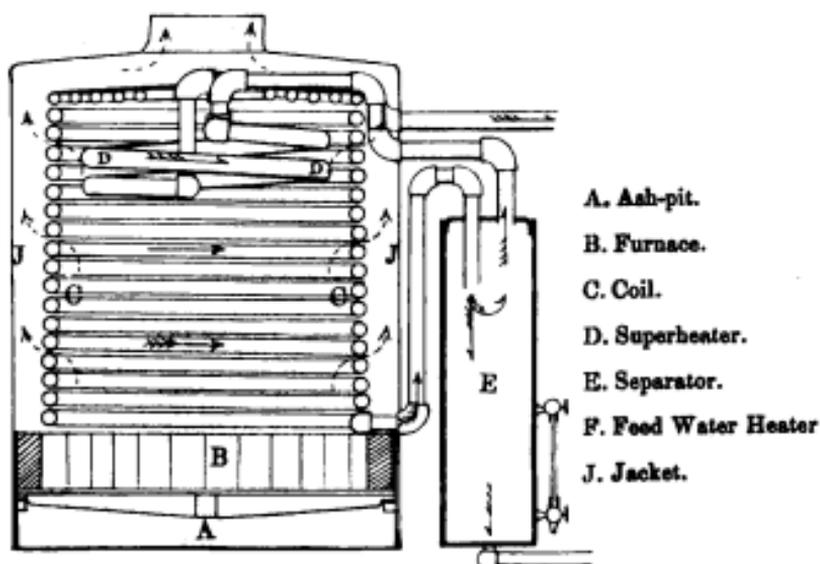
Since the boat arrived several changes have been made in it with the view of making the piping of the boiler and connections with the engines more compact, and hence better suited for the special use for which it is designed. Modifications in the furnace, and form of exhaust-pipe, have also been made, and hard coal is now habitually used with most satisfactory results.

The torpedo-fittings have been made and put in place, and a dynamo-electric machine and electric lamp and attachments are also fitted. The boat is thus completed for service either as a torpedo or picket launch.

Boiler of Steam Torpedo Launch "Lightning."



Jacket of Boiler removed—Section through Feed Water Heater.



Section through Boiler and Separator, showing Superheater.

A number of experiments have been made with it during the past summer. The result of these experiments has been quite satisfactory, fully realizing all anticipations in regard to speed and the general fitness of the boat for the special use for which it was designed.

Arrangements have been made for having an extended trial for the purpose of determining the consumption of coal, capabilities of machinery, &c.; but the protracted unfavorable weather, and the small number of men employed at the station during the past two months, have rendered it necessary to postpone the trial for the present.

Detailed description of boat.

Hull.—Length over all, 58 feet; beam, 6 feet 3 inches; depth of boat, 3 feet 2 inches; draught forward, 14 inches; aft, 22 inches; dimensions of timber, &c., keel, oak, sided, $4\frac{1}{2}$ inches; boiler or bilge kelsons placed in wake of boiler and machinery; frames, oak, molded $2\frac{1}{2}$ inches, and placed 11 inches apart from centers; intermediates half-frames in wake of boiler and machinery. Planking, pine, $\frac{1}{2}$ inch thick; ceiling, pine, $\frac{3}{8}$ inch thick; floor, pine, $\frac{3}{16}$ inch thick; shear-streak, oak, $\frac{1}{2}$ inch thick.

Deck.—Extends 14 feet from bow and 14 feet from stern; wash-board, 8 inches high around open space.

Weight of hull, 2,800 pounds.

Boiler.—Herreshoff's patent safety coil-boiler, fitted with a feed-water heater and a separator for using salt water. Height, 5 feet 2 inches; diameter, 4 feet 2 inches; heating-surface, 130 square feet; grate-surface, 9 square feet; weight, 1,500 pounds.

Engines.—Double, direct acting; cylinders, 5 inches diameter, 10 inches stroke; fitted with Herreshoff's patent cut-off valves; shaft, rods, studs, and bolts of Ulster iron; pins and keys of steel; weight, 1,040 pounds.

Propeller shaft.—Steel incased in brass; length, 27 feet; diameter, steel, $1\frac{1}{2}$ inches; brass, $\frac{1}{2}$ inch thick; total diameter, $1\frac{1}{2}$ inches; weight of shaft and bearings, 340 pounds.

Propeller.—Bronze, two blades, placed abaft rudder; diameter, 38 inches; mean pitch, 60 inches; length, 6 inches; weight, 52 pounds.

Auxiliary pump.—Knowles, size No. 0; weight, (estimated,) 200 pounds.

Engine for electric light.—Single, direct acting; cylinders, $3\frac{1}{2}$ inches diameter, 7 inches stroke; fitted with Herreshoff's patent cut-off valves; fly-wheel, 20 inches in diameter; drives electric machine 2,000 revolutions per minute; weight, 250 pounds.

Total weight of boat, with permanent fittings, 6,900 pounds.

General description of boiler.

As the boiler is a novel feature of the boat, the following general description and method of operating it are given:

Description.—The boiler consists of a flat, spiral coil of 1-inch steam-pipe, the exterior diameter of the coil being 42 inches. The turns of this coil are wound as close together as possible, and the outer end connects to the upper end of a vertical spiral coil of 2-inch steam-pipe, the diameter of this coil being 42 inches and height 3 feet 4 inches. The turns of the vertical coil are separated $\frac{3}{16}$ of an inch, and the lower end is connected to the upper end of the separator.

The bottom of the vertical coil is placed about 10 inches above the grate-bars, resting on fire-brick, which forms the outside of the furnace, and being firmly secured by upright braces. The interior of the coil

thus forms a large combustion-chamber, the smoke and heated gases escaping through the spaces between the turns of the vertical coil, egress through the top being prevented by the closeness of the coil and a shade or cover placed over it for this purpose.

The whole is inclosed by a jacket, which serves to confine the smoke and heated gases and conveys them to the smoke-pipe, a space being left between the outside of the coil and inside of the jacket.

The separator is a cylinder made of $\frac{3}{4}$ -inch boiler-iron, 12 inches in diameter and 3 feet high, placed on end abaft the boiler. The pipe leading from the lower end of the boiler-coil enters the top of the separator, and projects about 8 inches inside. A pipe called the bottom blow-pipe, fitted with a suitable valve, connects to the bottom of the separator and leads overboard. On one side of the separator, near the bottom, is fixed a glass water-gauge.

The feed-water heater is a cylindrical chamber, made of iron $\frac{1}{8}$ of an inch thick, 8 inches in diameter and three feet high, placed on end abaft the boiler, and near the separator. The exhaust-steam from the cylinders of the engine enters this chamber, and then escapes through the exhaust-pipe up the smoke-stack. From the bottom of the chamber there is a small pipe leading overboard, through which the water condensed from the steam escapes. Inside the chamber are several short pieces of 1-inch steam-pipe, joined at the ends so as to form one continuous length. One end of this group of pipes connects to the inner end of the flat spiral coil of the boiler; and the other end is connected to the engine-feed pump, and also to the auxiliary steam and hand pump.

Method of operation.—After the fires have been started and the pipes have become warm, water is forced into the coil of the boiler by means of the hand-pump. The water enters the coil at the top, which, being farthest from the fire, is coolest.

As it descends in the spiral coil it gradually gets hotter, and a part of it is converted into steam. The unconverted water and steam are both discharged into the separator, the water or brine falling to the bottom.

The steam rises to the top of the separator and escapes through the pipes leading to the separator and main steam-pipe, from which it is taken to the main engines, steam-pump, auxiliary engine, and ejectors.

After steam commences to form, the steam-pump can be used, or the main engines started, to feed the boiler.

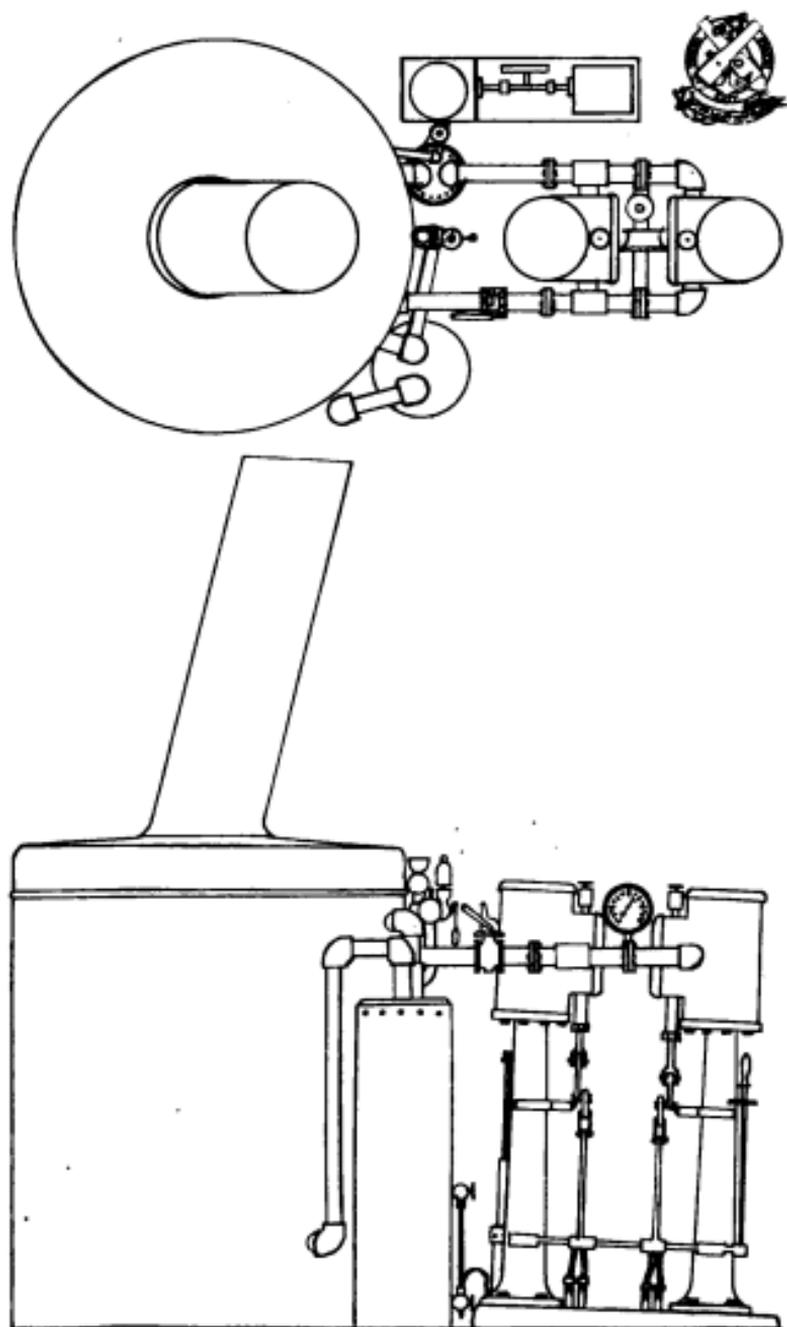
The unconverted water, or brine, in the bottom of the separator, is allowed to escape through the bottom blow-pipe, the valve of which is always left slightly open. The quantity of water which comes over unconverted can be ascertained by the glass water-gauge attached to the separator.

In the *Lightning* the bottom blow-valve is usually left open $\frac{1}{2}$ of one turn, and the supply of feed-water regulated so that the brine shall stand from two to six inches high in the glass gauge.

Should the amount of water in the gauge increase, the supply of feed-water should be reduced, as too great a quantity of water will cool the coil and lower the steam-pressure.

Should the water decrease in the glass gauge, the quantity of feed-water should be increased, as the steam may become so highly superheated as to be injurious to the engines, being liable to cut them when used for a long time.

For short spurts with the boat, however, the water has frequently been allowed to disappear from the gauge and the bottom blow-valve has been entirely closed, the cylinders of the engine being constantly



Boiler and Engine of Steam Torpedo Launch "Lightning."

lubricated. By this device the steam-pressure has been raised from 100 pounds to 160 pounds in less than two minutes.

Under ordinary circumstances the bottom blow-valve is first opened $\frac{1}{2}$ of one turn, and the supply of feed-water regulated to keep the water about two inches high in the glass gauge. All salt and mineral substances are then carried over in the unconverted water as a strong brine, and are ejected through the bottom blow-pipe. Crystals of salt appear about the glass gauge, while not the slightest trace of it can be detected about the engine.

On first raising steam it is desirable to let the coil get quite hot before injecting water. The coil expands under the influence of the heat, and any scale or deposit that may be on it becomes detached. If the bottom blow-valve be opened wide, and the water then injected, the scale and dirt are forced overboard, thereby preventing small particles from going through the engines and injuring them.

By treating the boiler of the Lightning in this manner no scale or deposit was found in the coil of the boiler after having been run for four months, and using salt water during all the time it was under steam.

Torpedo fittings.

The boat is supplied with two torpedo-spars, designed to be used on the broadsides. The heel-fittings are placed well aft on the quarters of the boat, and the spars and torpedoes are carried on the rail. When eased off, the spars swing aft, and the outer ends descend to the proper depth, 10 feet; the torpedoes then being 20 feet horizontally from the boat's side. The spars are prevented from going too far aft by a forward guy.

The spars are eased off from the rail by means of slip-ropes, and can be rigged out when going ahead at moderate speed.

When out, the effect of a single spar and torpedo on the steering of the boat is comparatively small.

The torpedoes are made to contain 30 pounds dynamite or other violent explosive, and are to be exploded on contact or at will.

When the explosion takes place the forward guy is carried away and the spar trails aft.

Heel-fittings.—Steel; weight, 130 pounds each.

Torpedo-spars.—Steel; length, 22 feet; exterior diameter, 2 inches; thickness of steel, $\frac{1}{2}$ inch; displacement, 16 pounds; weight, 34 pounds. (Spars are trussed for 12 feet from outer end.)

Torpedoes.—Steel; spherical in shape; diameter, 12 inches; weight empty, 11 $\frac{1}{2}$ pounds; capacity, 30 pounds dynamite; weight, filled, 42 pounds; displacement, 38 pounds.

Forward guys.—Wire-rope, $\frac{3}{8}$ inch diameter.

Electric-light machine and lamp.

Machine.—A small-sized Gramme electric machine has been put on board temporarily. When driven at 2,000 revolutions per minute (the usual speed) it produces a light equivalent to about 500 candles. It is proposed to have a more powerful machine, of Farmer's patent, built for the boat.

Lamp.—The lamp used is one of Farmer's non-automatic carbon lamps, inclosed in a suitable lantern. It is situated on the forward deck, just in front of the wheel, and can be worked by the person who steers the boat.