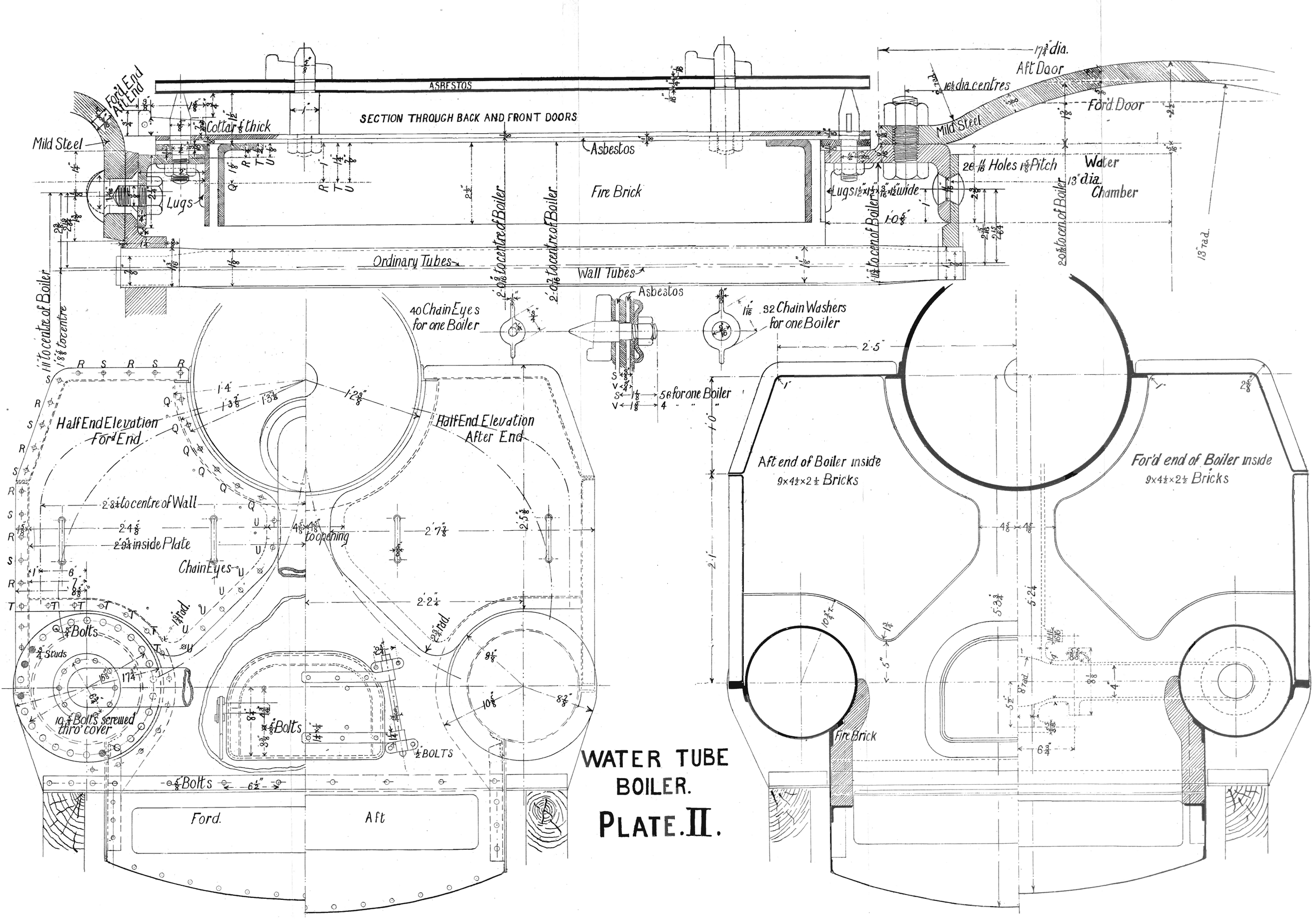

WATER TUBE BOILER.

PLATE. II.

Side Casings.—No brickwork is provided for the side casings, it being assumed that the wall tubes will absorb the greater part of the heat left in the gases, after passing through the nest of tubes. Insulation is however obtained by means of asbestos millboard and air spaces.

The casing plates, sides and top are of $\frac{1}{8}$ in. steel, flanged where they connect with each other and with the front and back plates, the insulation being obtained with $\frac{1}{4}$ in. asbestos, kept in place by $\frac{1}{16}$ in. plate, a $\frac{3}{4}$ in. air space, and then $\frac{1}{4}$ in. asbestos held between two $\frac{1}{16}$ in. plates. (See Plates I. and II.)

The side plates are stiffened by means of 2 $1\frac{1}{4}$ in. $\times$ $1\frac{1}{4}$ in. $\times \frac{3}{16}$ angles, the air casing plates being arranged between them, and kept in place by means of gas pipe ferrules and $\frac{3}{8}$ in. bolts.

The upper portion of the casing is provided with $\frac{1}{8}$ in. asbestos inside the casing, kept in place and protected by $\frac{1}{8}$ in. steel plate, and the air space is arranged to lead into the funnel casings, thus ensuring a good circulation of air between the plates. The air space plates are provided with $\frac{1}{4}$ in. asbestos between 2, $\frac{1}{16}$ in. plates, as far as the deck casing plates.

The top casing plates are attached to the steam drum, by $\frac{1}{2}$ in. bolts, 3 in. pitch, screwed through a 2 in. $\times$ 2 in. $\times$ $\frac{1}{4}$ in. angle running fore and aft the drum, and screwed to it by $\frac{5}{8}$ in. rivets, about 6 in. pitch.

The side plate connection to the water drum is by means of a flat bar $1\frac{7}{8}$ in. $\times$ $\frac{3}{8}$ in. which is bolted to three angle lugs 2 in. $\times$ 2 in. $\times$ $\frac{1}{4}$ in. $\times$ $5\frac{1}{2}$ in., secured to the drums by 3 $\frac{5}{8}$ rivets in each, the joint of the casing plate on the flat bar being made by $\frac{1}{2}$ in. bolts, about 3 in. pitch.

The joint between top and side plates is formed by flanging the plates, and using $\frac{1}{2}$ in. bolts, about 3 in. pitch.

The back casing plates is set outwards at the edges, at an angle of $1\frac{1}{4}$ in. to the foot, so that the side plates can be easily put into place.

Furnace Side Plates.

The side plates for the furnace are made of $\frac{3}{16}$ in. plate, attached to the lower drums by means of three angle lugs, 2 in. $\times$ 2 in. $\times$ $\frac{1}{4}$ in. $\times$ $5\frac{1}{2}$ in. long, and to the front plates, at the corners, by means of $1\frac{3}{4}$ in. $\times$ $1\frac{3}{4}$ in. $\times$ $\frac{3}{16}$ in. angles, joggled over the water tube end plate as required.

The insulation of the sides of the furnace is by means of a $2\frac{1}{2}$ in. firebrick with $\frac{1}{8}$ in. asbestos at the back of it, inside the $\frac{3}{16}$ in. plate, and by $\frac{1}{4}$ asbestos and $\frac{1}{16}$ in. plate outside. The bricks are supported on a $2\frac{1}{2}$ in. $\times$ 2 in. $\times$ $\frac{1}{4}$ in. angle bar, secured to the side plates. The ends of the front and back grate bar bearers also rest on this angle. All the plates below the level of the water drums are galvanised.

Front and Back Casing Plates.

These are made $\frac{3}{16}$ in. thick, and are cut out in front of the tubes so as to give openings for inspection and cleaning. The plates are secured by means of $\frac{1}{2}$ in. bolts, about 3 in. pitch (the heads of these bolts being made so as to take a cotter for fastening the doors where

necessary) to the side plates, and also to a $2\frac{1}{4}$ in. × 2 in. × $\frac{1}{4}$ in. angle, which is secured to the steam drum by $\frac{5}{8}$ in. set screws, screwed into rivets in the circumferential seam of the drum, these rivets being made $1\frac{1}{16}$ in. diameter, instead of $1\frac{3}{16}$ in. and set of $\frac{1}{8}$ in. off the regular pitch line; $\frac{1}{2}$ in. bolts also connect the front and back plates to the water drum ends and the bottom casing plate, which is of $\frac{3}{32}$ in. steel, flanged to meet the sides and end plates. To form a stiff edge for the door, and also a boundary for the brickwork, an angle $2\frac{1}{2}$ in. × $2\frac{1}{2}$ in. × $\frac{5}{16}$ in. is bolted to the front plate, by the cotter bolts. The boundary for the remainder of the firebrick and fireclay is formed of $\frac{1}{8}$ in. plate $2\frac{1}{2}$ in. wide, secured to the angle on the steam drum, and the end plates of the water drums, by angle lugs $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{3}{16}$ in. which are flush riveted on.

The outer insulation of the front and back casing plates, is by means of an air space $1\frac{1}{4}$ in. at front and $1\frac{1}{2}$ in. at back, and then $\frac{1}{4}$ in. asbestos between 2, $\frac{1}{16}$ in. plates. At the back end, between the doors, the plate is stiffened by means of a vertical channel $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in., and between the water drums, horizontally by an L bar $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in.

At the back end the angle forming the outer foot for the bearers, is run right across the boiler, the inner foot, and those at the front end being formed of 2 in. × 2 in. × $\frac{1}{4}$ in. × 6 in. angle secured to the water drum end plates by $\frac{5}{8}$ in. bolts.

Furnace.—The furnace is lined on front, back, and sides, with $2\frac{1}{2}$ in. firebrick backed with $\frac{1}{8}$ in. asbestos, the bricks being 9 in. × $4\frac{1}{2}$ in. × $2\frac{1}{2}$ in., each secured to the plates by $\frac{3}{8}$ in. bolts, with heads sunk into the bricks and covered with fireclay. At each side a row of special firebrick lumps is put, shaped so as to cover the water drums up to the tubes. The side bricks rest on angles as before stated, and the bricks on front and back, rest on the firebar bearers, which are formed of $\frac{3}{8}$ angle, bent to suit the ends of the firebars, and forged down at the ends so as to rest on the side angles. These bearers which are perforated by $\frac{3}{8}$ in. holes between the bars are secured to the front and back plates by $\frac{5}{8}$ bolts. The brickwork, back and front is set, so as to leave a $\frac{1}{2}$ in. air space at the back of it, for about five courses up; air is admitted to this space, by $\frac{3}{4}$ in. holes in the bearers and openings are left in the brickwork to admit this air to the furnace above the fire.

The firebars are formed of $2\frac{3}{4}$ in. × $\frac{5}{16}$ in. to $\frac{1}{8}$ in. firebar iron, and are riveted up in sets of three, so as to give $\frac{5}{8}$ in. spaces between the bars. These bars are hooked at the centre on to bearers, formed of 3 in. × $\frac{1}{2}$ in. bar, resting in brackets of $\frac{3}{8}$ in. plates, secured by $\frac{5}{8}$ in. bolts to the $\frac{3}{16}$ in. side plates, and having a $\frac{3}{16}$ in. doubling plate outside, covering the side angles, and are free to slide on the front and back bearers.

The air is admitted to the under side of the fire through the light hinged doors, which are made of $\frac{1}{16}$ in. plate provided with $\frac{1}{2}$ in. corrugation. These doors are made $7\frac{1}{2}$ in. deep at the front end and $6\frac{1}{2}$ in. deep at the back end, extending in width right across the boiler, and are arranged to swing inwards, being opened by the air pressure (which is equivalent to about $\frac{1}{10}$ lb. per square inch) so that in the event of a burst tube or back draft, fire and steam may not be forced into the stokehold.

A light galvanised steel ash pan ($\frac{3}{32}$ in. steel) is fitted resting on $\frac{5}{8}$ in. × $\frac{5}{8}$ in. × $\frac{1}{8}$ in. angle, so as to keep it off the bottom plate, which is also $\frac{3}{32}$ in. steel.

The ash pan has to be of such a width that it will pass through the air doors, and to ensure the ashes falling into it, detachable deflecting plates are fitted, reaching well under the sides of the grate bars. In working, water is always kept in this pan.

Fire Doors.—The frame for the firing hole is 18 in × 12 in. and is formed of $4\frac{1}{2}$ in. × $\frac{1}{4}$ in. plate, having a strip 1 in. × $\frac{1}{4}$ in. riveted round it to act as a distance piece and slip to a 2 in. × $1\frac{1}{4}$ in. × $\frac{1}{4}$ in. angle, by which the frame is held to the front plate by $\frac{5}{8}$ in. bolts passing through ferrules.

The door is formed of $\frac{3}{16}$ in. plate, and is double baffled by $\frac{1}{8}$ in. plates, which are so arranged that air coming from under the grate, between the 2 in. × $1\frac{1}{4}$ in. × $\frac{1}{4}$ in. angle and the front plate (holes being drilled in the distance strip to admit it) is caused to traverse the face of the door, by $1\frac{3}{4}$ in. space, and the inside baffle by $1\frac{1}{4}$ in. space, passing by perforations in the bottom edge of this baffle to the top of the fire. A $\frac{1}{4}$ in. baffle plate is bolted to this inner baffle, to save the burning of it at the perforations. The baffles are secured by four $\frac{5}{8}$ in. bolts, passing through ferrules of the necessary length.

The door is swung (so that it will always tend to close) on skew hinges forged from $1\frac{1}{4}$ in. × $\frac{1}{4}$ in. bar, with a $\frac{3}{4}$ in. hinge pin, and is latched by a tilt catch fastened to the front plate, engaging a $1\frac{1}{4}$ in. × $\frac{1}{4}$ in. bar riveted to the door. The tilt cam is attached to the door, swinging on an extension of the latch bar.

Funnels.—The area of the funnels will be $\frac{1}{7}$ of the grate area, giving

$$\frac{12{\cdot}5}{7} = 1{\cdot}75 \text{ sq. feet} = 256 \text{ square ins. say.}$$

In accordance with the usual practice with this type of boat and simplifying construction, two funnels are fitted, and to give a good appearance in profile, they are made lozenge shape. Two funnels, 16 in. × 9 in. with semi-circular ends will give the required area.

They are constructed of $\frac{1}{8}$ in. plates, having $\frac{3}{4}$ in. air space and $\frac{1}{16}$ in. casing plates, and are attached to boiler by an angle ring $1\frac{1}{2}$ in. × $1\frac{1}{2}$ in. × $\frac{1}{4}$ in., secured to the boiler casing by sixteen $\frac{1}{2}$ in. bolts screwed through the top plate. The funnels are 11 ft. 6 in. high above grate, and where they pass through the deck plating weathering hoods are fitted.

Boiler Mountings.

1 pair of 2 in. dia. spring safety valves.
1 3 in. dia. screw down main stop valve.
1 $1\frac{1}{4}$,, ,, ,, auxiliary stop valve.
1 $\frac{3}{4}$,, ,, ,, valve for whistle.
2 $1\frac{1}{4}$,, ,, ,, main feed check valves.
1 $1\frac{1}{4}$,, ,, ,, auxiliary feed check valve.
1 $\frac{3}{4}$,, ,, ,, blow down valve.
1 $1\frac{1}{2}$,, ,, ,, filling valve, with hose attachment.
2 Water gauges. Deurance patent asbestos packed, fitted with glass protectors.
2 Pressure gauge cocks. Deurance patent asbestos packed.

A zinc block 18 in. × 6 in. × ½ in. is fitted in the steam drum, attached to the manhole door, and two blocks 18 in. × 2½ in. × ½ in. are fitted in each water drum. These are to arrest corrosion.

The water gauge cocks are mounted on blocks which are riveted into the dished end, to form a flat true seating for them.

The main steam valve has an internal pipe fitted of brass, 3½ in. dia. with fifty slots, $\frac{1}{16}$ in. wide, on its upper surface. This runs nearly the full length of the steam drum and no slots are cut in it where it passes under the opening to the safety valve.

The auxiliary steam valve, also has an internal pipe, 1½ in. dia. with twenty-five slots $\frac{1}{16}$ in. wide.

Results.

Weight of Boiler.

The finished weight of boiler, complete	3 tons 14 cwt.
Water in boiler	14 cwt.
Total	4 tons 8 cwt.

Performance of Boiler under Test.

Duration of test	3 hours
Grate surface, 12·5 sq. ft. Heating surface	500 sq. ft.
Air pressure	2 in. water
Steam pressure	185 lb. per sq. in.
Feed temperature	60° F.
Total weight of water evaporated in 3 hours	15,450 lb.
Total coal burnt in 3 hours	2,016 lb.
Water evaporated per square foot of heating surface, per hour	10·3 lb
Water evaporated per square foot of grate surface, per hour	412 lb.
Water evaporated per pound of coal	7·7 lb.
Coat per square foot of grate per hour	54 lb.
Equivalent evaporation per pound of coal (from and at 212° F.) per hour	9·3 lb.
Equivalent evaporation per sq. ft. of heating surface per hour, from and at 212° F.	12·5 lb.
Equivalent Evaporation per sq. ft. of grate surface	500 lb.

Performance of Boat.

On a displacement of about 17·5 tons with the engines indicating 214 h.p. at 530 revolutions per minute, with steam at 185 lb. per square inch, under an air pressure of from 2 in. to 3 in. of water, a mean speed of 14·6 knots per hour was obtained, the boiler working without priming, and steaming easily.

On a displacement of about 17·5 tons, engines indicating 267 h.p. at 560 revolutious per minute with steam at 185 lb. square inch, air pressure 4 in. to 5 in., a mean speed of 16·7 knots per hour was obtained.

WATER TUBE BOILER

PLATE III