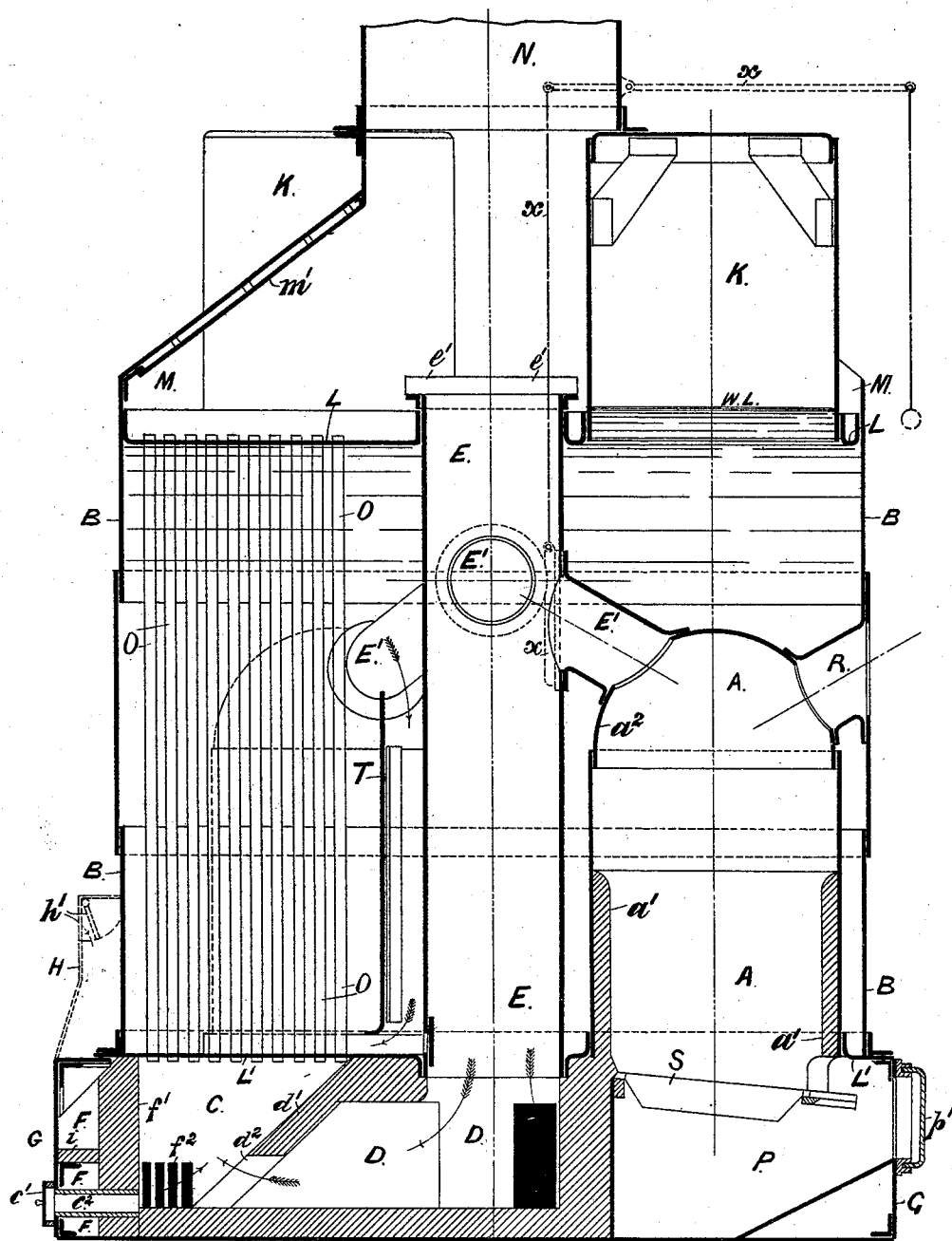


J. JACKSON.
STEAM GENERATOR.

No. 455,623.

FIG. 1. Patented July 7, 1891.



WITNESSES

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(No Model.)

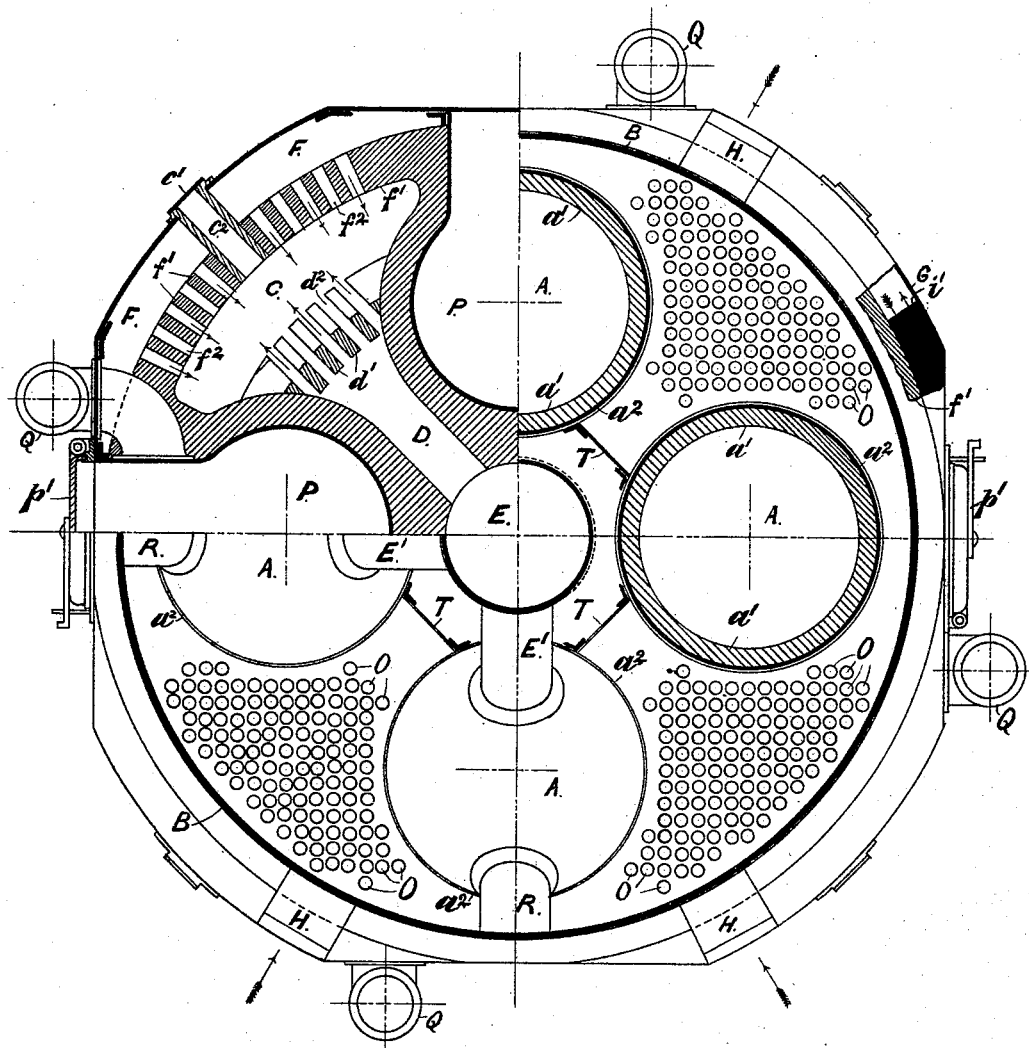
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FIG. 2.



WITNESSES

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4 Sheets—Sheet 3.

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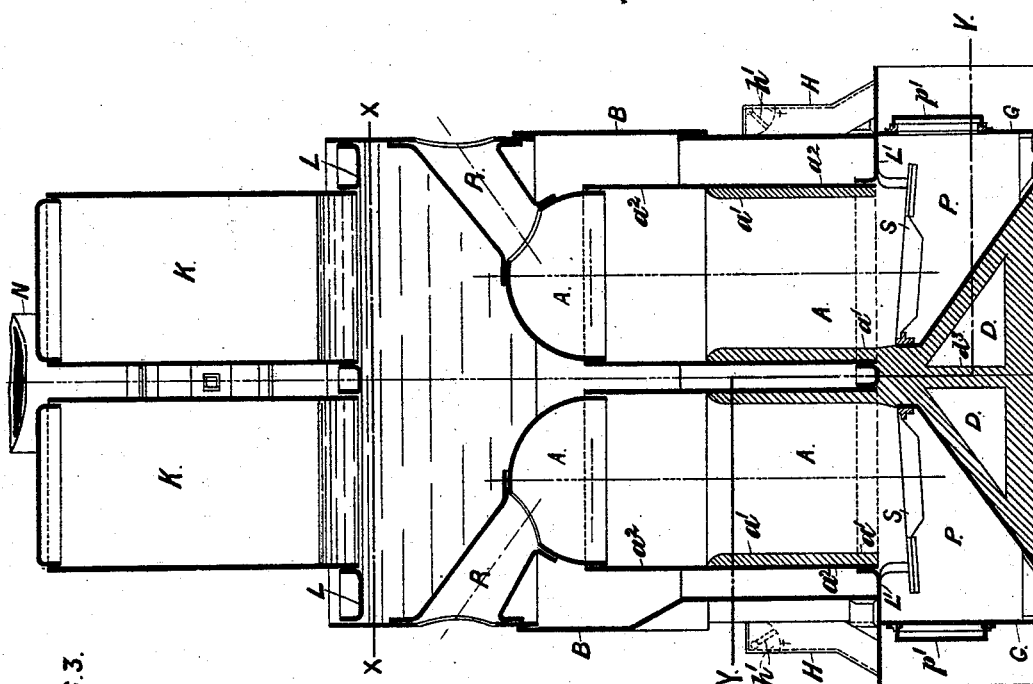
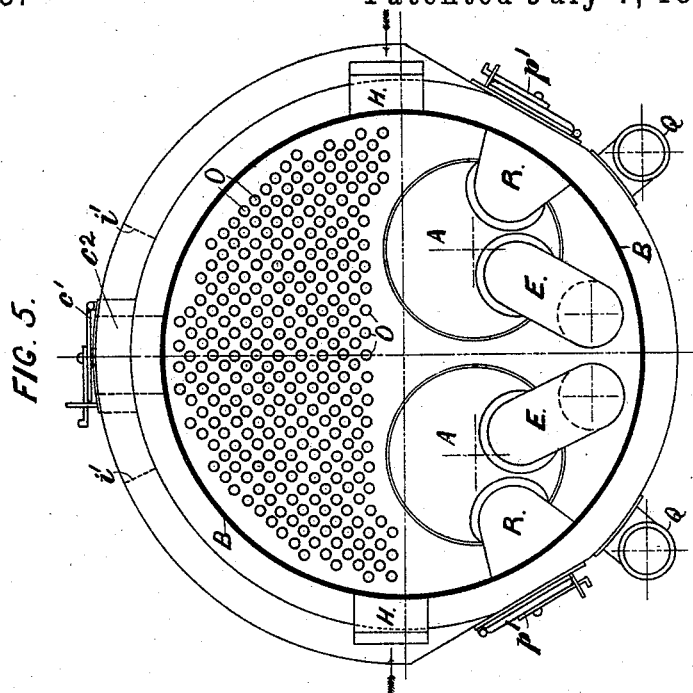


FIG. 3.

WITNESSES

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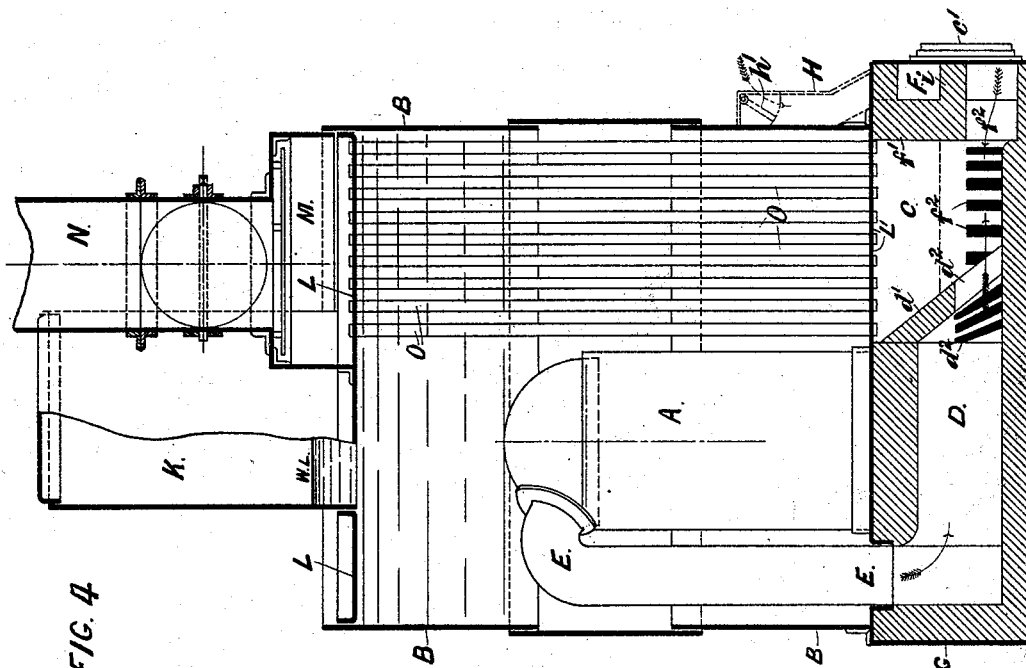
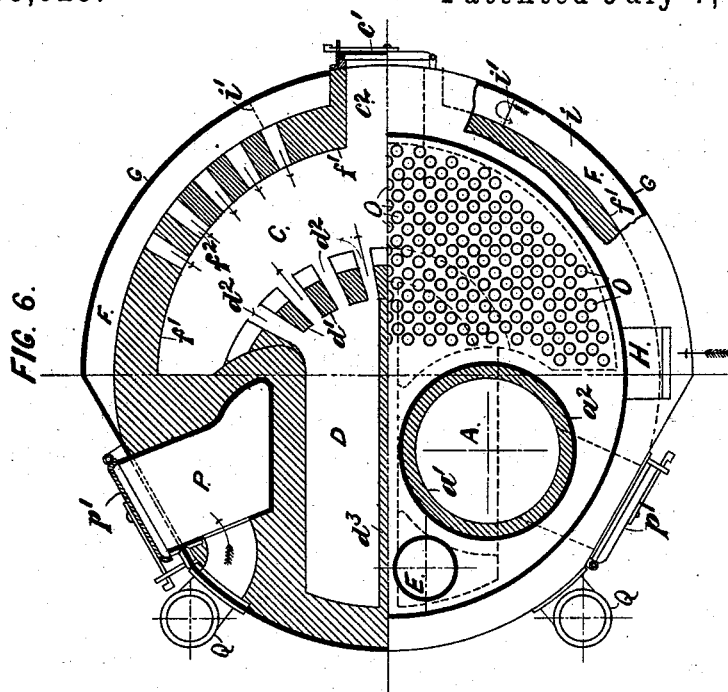
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UNITED STATES PATENT OFFICE.

JOHN JACKSON, OF LIVERPOOL, ASSIGNOR TO THE JACKSON (FOREIGN PATENTS) COMPANY, LIMITED, OF LONDON, ENGLAND.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 455,623, dated July 7, 1891.

Application filed March 14, 1891. Serial No. 385,085. (No model.)

To all whom it may concern:

Be it known that I, JOHN JACKSON, a subject of the Queen of Great Britain and Ireland, residing at Liverpool, England, have invented certain new and useful Improvements in or Connected with Steam-Generators; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

This invention has reference to that class of steam-generators consisting as a whole of a combined gas-producing portion, combustion-space, and water and steam containing space or vessel, forming practically one structure.

To set forth the invention clearly and exactly, I will describe it by the aid of the accompanying drawings, which illustrate two examples of generators involving improvements according to this invention.

In the drawings, Figure 1 is a sectional elevation of a generator according to the invention, having four gas-producing furnaces and a corresponding number of combustion-chambers and nests of tubes; and Fig. 2 is a plan in section taken partly above the level of the gas-producers, partly through the gas-producers, and partly through the combustion-chambers. Fig. 3 is a sectional elevation of a steam-generator according to this invention, in which the two gas-producing furnaces are arranged. Fig. 4 is a sectional elevation of the generator shown in Fig. 3, viewed at ninety degrees from that given in said Fig. 1. Fig. 5 is a plan in section taken at the line X X, Fig. 3. Fig. 6 is a sectional plan of the generator, taken at the line Y Y, Fig. 3.

In all the figures the same letters of reference are used to denote the same or like parts wherever they occur.

With reference to the drawings, and particularly to Figs. 1 and 2, A are the gas-producer furnaces, which are arranged and disposed wholly within the water and shell of the generator (*i. e.*, above the combustion-chamber and lower tube-plate) and eccentrically and close to such shell. B is the said generator-shell.

C are the combustion-chambers, disposed below the level of the gas-producers and directly underneath the lower tube-plate.

D are conduits to which the gas produced in the furnaces A is conveyed prior to delivery into the combustion-chamber C.

E is the downtake pipe or tube common to all the furnaces A, and by which said gases are conveyed from the gas-furnaces by way of the connecting-tubes E' to the gas chambers or conduits D.

F are conduits to which the heated air used to support combustion of the gas is conveyed prior to its introduction into the combustion-chamber.

f' is a wall which separates the combustion-chamber C from the air-heating conduits F, and d' is a wall which separates the gas-conduits D from the combustion-chamber C.

d² and f² denote apertures provided in the walls d' and f', respectively, by which the flow of gas from D and the flow of air from F, respectively, issue into the combustion-chamber C, and by which such air and gas in their flow into the combustion-chamber are caused to meet one another and become thoroughly mixed and complete combustion facilitated.

G is the case inclosing the whole of the lower structure of the generator, comprising the combustion-chamber C, passages F, gas-conduits D, and ash-pits P, all of which parts are mainly composed of fire-brick and other refractory material, and the whole of which parts lie entirely, as will be seen, below the gas-producing furnaces, nests of tubes, and lower tube-plate.

H are air-inlet conduits having valves h', by which the air to the air-heating conduits F is controlled, and i is a horizontal partition by which the air-heating passages F are separated into an upper and lower one and the air caused first to flow in one direction horizontally, then down and round in the reverse direction horizontally to the lower chamber F, the air-inlet conduits H being disposed at one end of the upper passage F.

With regard to the upper parts of the generator, K are the steam domes or vessels. L is the upper and L' the lower tube-plates. M is the waste-gas chamber or "smoke-box."

N is the funnel, and O designates the heating-tubes. It will be seen, with reference to Figs. 1 and 2 of the drawings, that the tubes are arranged in four nests, and that the gas-producers lie close to the shell of the generator and between said nests.

The gas downtake-tube E, it will be seen, runs from the top to the lower tube-plates and is connected at its ends to such tube-plates. These constitute a central stay, as well as a means for conveying gas from the gas-producing furnaces to the combustion-chamber. The top of the tube E is covered by a slab or stopper e' . The smoke-box M is disposed above the tube-plate and incloses partially the steam-domes K, the roof of the chamber M being constructed mainly of ordinary hinged smoke-doors m' . By opening these doors access is at once had to the whole of the tubes, which from this point can be swept, repaired, removed, or inserted; and also through these doors access can be had to the lower portion of the generator through the tube E by removing the cover or slab e' . Access to the gas-producing furnaces for similar purposes may be had in three directions—namely, by way of the central tubes E and branch tubes E' , or the feeding-chutes R, or the ash-pit door p' .

The steam-domes K are disposed directly above the gas-producing furnaces A, and are consequently four in number, while the chimney or funnel is centrally located.

The gas-producing furnaces A, it will be seen, have semispherical domes and fire-brick or other refractory linings a' , and it will be further seen that these gas-producing furnaces lie wholly within the shell B of the generator—that is to say, the casing a^2 , of which the combustion-chambers are made, is joined to the lower tube-plate L' at the bottom, and is surrounded and in contact with the water within the generator, the grate S (which is of the ordinary door kind) being practically on a level with the lower tube-plate L' , a small space, however, at one side nearest the ash-pit door p' being provided, and the grate arranged slightly lower than such tube-plate to allow of the fuel upon the grate being stoked or worked through the doorway of the door p' .

A door c' and passages c^2 are provided at the bottom of the base of the generator, by which ready access may be had to the combustion-chamber C from outside for the purpose of inspection and removal of dust or other matters from the floor thereof.

It will be seen that this construction of generator, like that described in my application for Letters Patent filed of even date herewith, Serial No. 385,084, provides for having the heating-tubes O entirely covered with water at all times, if desired—that is to say, by arranging the tube-plate L and the steam-domes K as shown, the water-level (which is designated W L) can be maintained at the point shown in Fig. 1—that is, within the domes K, and consequently the tubes will be

wholly surrounded or covered with water. If, however, it is desired to lower the water-level when steam is once up, the level of the water may be let down below the level of the upper tube-plate L, whereby a greater free surface of water for the liberation of steam is obtained.

To effect a good circulation, I provide direct- ing-plates T between the shells of the gas-producing furnace, as shown, the action of which is that a descending current will take place about the central pipe E, and will be guided by these plates T and a part of the shells of the producers A toward the bottom of the generator, where the plates T terminate and the current assumes a horizontal direction, sweeping outward radially over the surface of the lower tube-plate L' , and then ascending up the tubes O by the heat imparted to it by such tubes.

The air used to support combustion of the gas introduced into the combustion-chamber C is heated in passing through the horizontal passages F by coming into contact with and being subjected to the radiant heat of the hot walls f' thereof. The air after first passing through the upper passage F enters the lower passage F round the end of the horizontal division or partition i and i' , (shown more clearly and fully in Figs. 5 and 6,) at which point the partition i is stopped. In this lower passage F it receives additional heat, and from here it passes into the combustion-chamber by the oblong passages f^2 and is broken up and delivered into a number of comparatively thin streams and meets corresponding streams of gas, which also will be hot, issuing through corresponding apertures d^2 in the wall of the gas-conduits D. These divided streams of hot air and gas thereby assimilate and become thoroughly mixed and complete combustion results.

In the generator shown in Figs. 1 and 2 it will be seen that for each gas-producing furnace there is provided a combustion-chamber, and each combustion-chamber has its own air-heating passages F and inlet conduits and valves H and h' , and there may also be provided, either within the tube E or the branch tubes E' , suitable dampers or doors for controlling communication between the tube E and the furnace A. Such a damper, with its actuating rods and levers, for example, is shown in dotted lines in Fig. 1 and designated x , and similar dampers may be adapted to control the mouths of the gas-conduits D.

The steam-generators illustrated in the drawings are provided with suitable conduits Q, which in practice may be steam-jet blowers for supplying the air used to convert the solid fuel in the furnace A to a gaseous form.

In the generator shown in Figs. 3 to 6 two gas-producing furnaces are employed and each gas-producer has a downtake gas-conduit E and below separate gas chambers or passages D, such two chambers D being separated by a partition d^3 . These two, however,

have a common combustion-chamber C. In this example the gas-producing furnaces A are disposed at one side of the generator and near the shell thereof, and their fuel-feeding chutes R and downtake gas-tubes E are also disposed at this side near the shell, so that the furnaces, feed-chutes, and gas-tubes are disposed wholly on one side of the generator. Then on the opposite side of the generator are disposed the heating-tubes arranged in a nest. As regards the lower portion of the structure, the ash-pits P and gas conduits or chambers D are also disposed, mainly, at one side of the producer and directly below the gas-producing furnaces and gas-pipes E, while the combustion-chamber C is disposed or arranged on the opposite side of the generator and directly below the nest of tubes O. Thus my construction and arrangement of steam-generator in this instance are one wherein the conversion of the solid fuel to the gaseous form and its distribution are carried out wholly in the one half of the generator, while its combustion and the heating of the water take place in the opposite half of the generator.

It will be seen that in both arrangements, according to this invention herein described and illustrated, the gas-producing furnaces and the heating-tubes are arranged in the upper part of the generator—that is, within the shell and above the lower tube-plate—while the combustion-chamber and gas and air passages leading thereto are disposed below the gas-producing furnaces and tubes—that is to say, the steam-generators are constructed so that the solid fuel is converted into gas in a gas producer or producers constructed in the upper part or shell of the generator and the combustion chamber or chambers is or are disposed underneath said producers—i. e., beneath such producer and the ground or floor.

In the examples shown in Figs. 3 to 6 the distribution of gas and air and the heating of such air to support combustion of the gases made are carried out practically in the same way as that specified with reference to Figs. 1 and 2.

In the above-described steam-generators I provide a type of generator which is particularly adapted to give a constant production of steam, and on this ground is more particularly suited for use as a marine steam-generator in cases where steaming is carried on constantly or for a lengthened period or for days together, in that by providing the generator with a plurality of gas-producing furnaces, as described, and arranging and working them as set forth it is possible to obtain an uninterrupted production of gas and consequent continuous generation of steam while one of the gas-producing furnaces is being cleaned, stoked, or out of operation for any other purpose or object.

It is to be understood that it is not intended to confine this patent strictly to the particular forms and dispositions of parts set forth with reference to the figures of the

drawings, nor to the number of gas-producers used; as these will naturally vary according to the various requirements and conditions under which the invention may be employed; also, the parts may be modified in different ways without departing from the controlling features of the invention. On the other hand, I make no claim, generally, to the use of separate gas-producers as such in "twin" or "duplex" form for the purpose of generating gas for use in the generation of steam, as I am aware that it has been proposed prior to my invention to employ such things; but

I declare that what I do claim in respect of the herein-described invention is—

1. In a steam-generator, the combination of a shell substantially vertically disposed, having end inclosing plates L L', two or more separate gas-producing furnaces disposed substantially wholly within the shell thereof, above the lower end plate and near the shell, a combustion-chamber in the lower part of the generator under said lower plate, tubes passing through the water-space within the shell and directly over said combustion-chamber, tubes connecting said furnaces with the combustion-chamber for conveying the gas thereto, and air-passages for conveying air to said combustion-chamber wherein the gases made in the producers are ignited or burn and distributed to the said heating-tubes, for the purposes set forth.

2. In a steam-generator, the combination of a substantially vertical cylindrical shell having upper and lower end inclosing plates, a plurality of gas-producing furnaces arranged within the shell of the generator, a plurality of nests of tubes passing through the water-space within the shell, a plurality of combustion-chambers, one being disposed directly below the tube ends of each of said nests of tubes, a plurality of air-inlet conduits, one being adapted to supply each of said combustion-chambers with air, and gas-conduits for conveying gas to each of said combustion-chambers, whereby to each gas-producing furnace is provided a separate combustion-chamber and nest of tubes, substantially as and for the purposes set forth.

3. In a steam-generator, the combination of a shell vertically arranged and having upper and lower end plates L L', two or more gas-producing furnaces within said shell and above the lower plate L', a gas downtake-conduit for conveying away the gas from said furnaces, valves or dampers controlling the aperture by which the gas flows from said furnaces into said downtake-conduits, a combustion-chamber underneath said lower plate L', and tubes O, passing through the water-space of said shell, substantially as and for the purposes described.

4. In a steam-generator, the combination of a cylindrical shell substantially vertical, having top and bottom plates L L', a plurality of gas-producing furnaces disposed within and close to the shell and connected to and stand-

ing above said lower tube-plate L', tubes disposed within said shell and running vertically therethrough, a combustion chamber or chambers below the lower tube-plate and level of
5 the bottom of the gas-producing furnaces and directly beneath the open ends of said tubes, and a centrally-disposed tube connecting said upper and lower tube-plates and communicating with the upper parts of said furnaces by
10 suitable conduits and by which the gas is conveyed down into the combustion chamber or chambers, substantially as set forth.

5. In a steam-generator, the combination of a shell substantially vertically disposed and
15 having upper and lower end plates, a plurality of gas-producing furnaces disposed within said shell, a nest or nests of tubes passing through the space within said shell, and steam-domes K on said upper plate of the shell and
20 disposed one directly over each of said gas-producing furnaces, substantially as and for the purposes set forth.

6. In a steam-generator, the combination of a shell comprising a cylinder vertically dis-
25 posed and upper and lower end inclosing plates and having a plurality of gas-producing furnaces and gas downtake-tube therein and running upward therethrough, a gas-

chamber adapted to receive and distribute the gas from said downtake, a plurality of
30 ash-pits P below said furnaces, and a plurality of separate combustion-chambers whereinto the gas produced in the gas-producing furnace and air is introduced and burned,
35 said chambers being disposed directly under the tube ends of said nests of tubes in the lower plate and delivered into the combustion chamber or chambers, substantially as set forth.

7. In a steam-generator, the combination of
40 the shell B, with its upper and lower tube-plates L and L', plurality of gas-producing furnaces A, gas-downtake E, connecting the upper part of said furnaces and the lower tube-plate L', tubes O, upwardly disposed, and di-
45 recting-plates T, disposed between said furnaces, adapted to operate substantially as set forth.

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

JOHN JACKSON.

Witnesses:

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JAMES ANDREW CONBROUGH,

Both of 15 Water Street, Liverpool.