

(No Model.)

10 Sheets—Sheet 10.

S. F. HICKS.

MACHINE FOR FORMING SHEET METAL SKYLIGHT BARS.

No. 455,621.

Patented July 7, 1891.

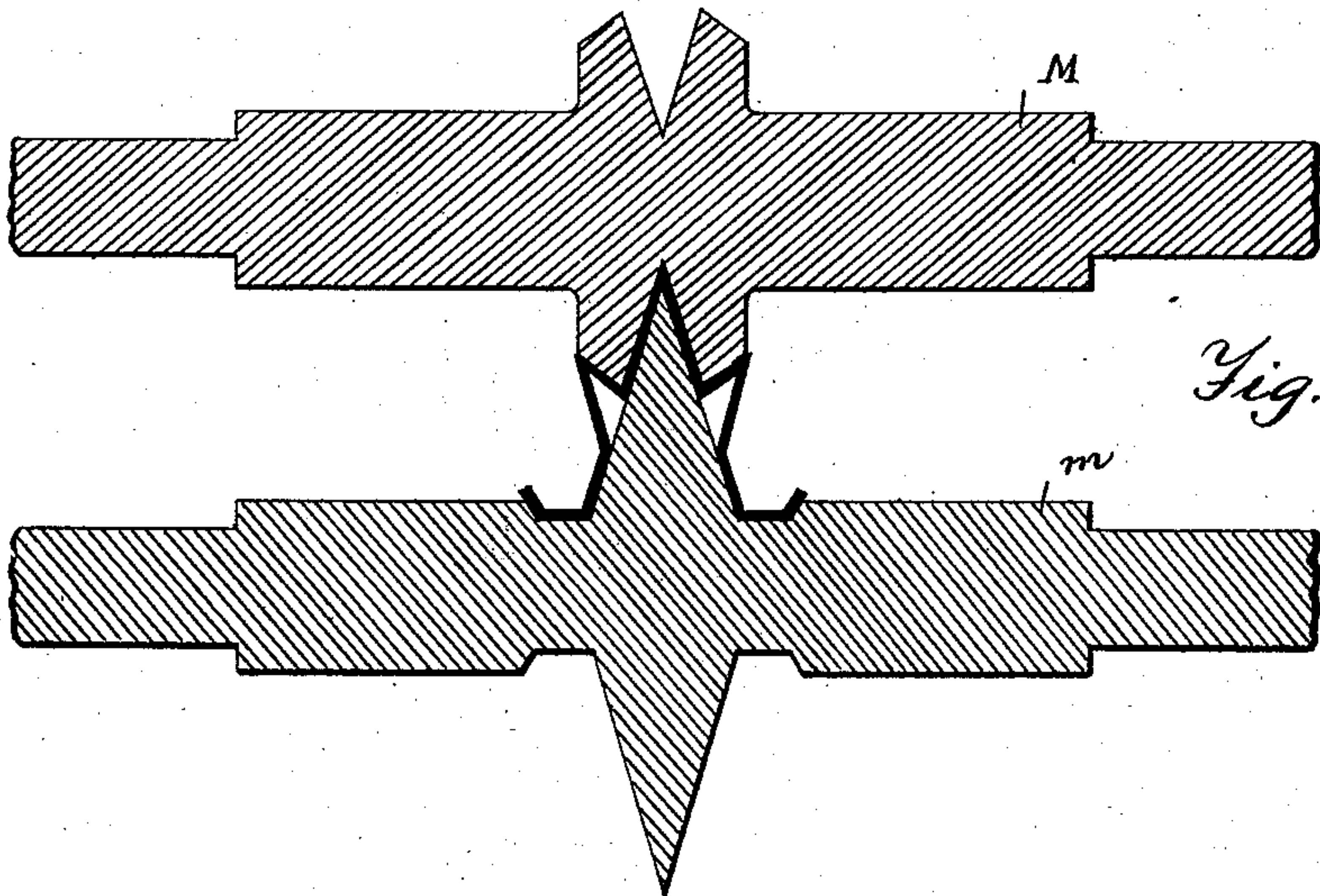


Fig. 19.

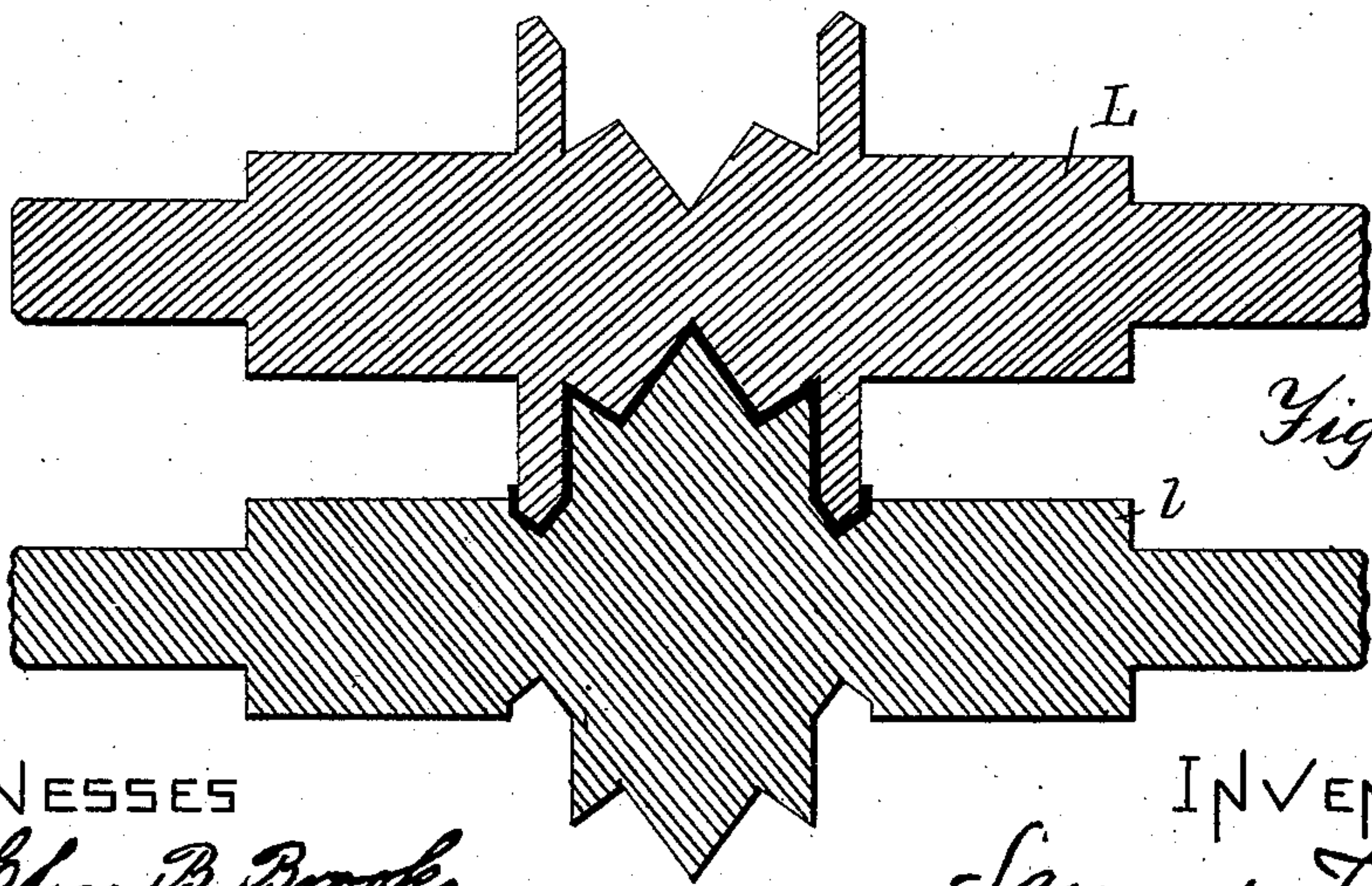


Fig. 18.

WITNESSES

Chas B. Brooks
Samuel T. Gay.

INVENTOR

Samuel F. Hicks
by *Alban Andrieu*
his ATTORNEY

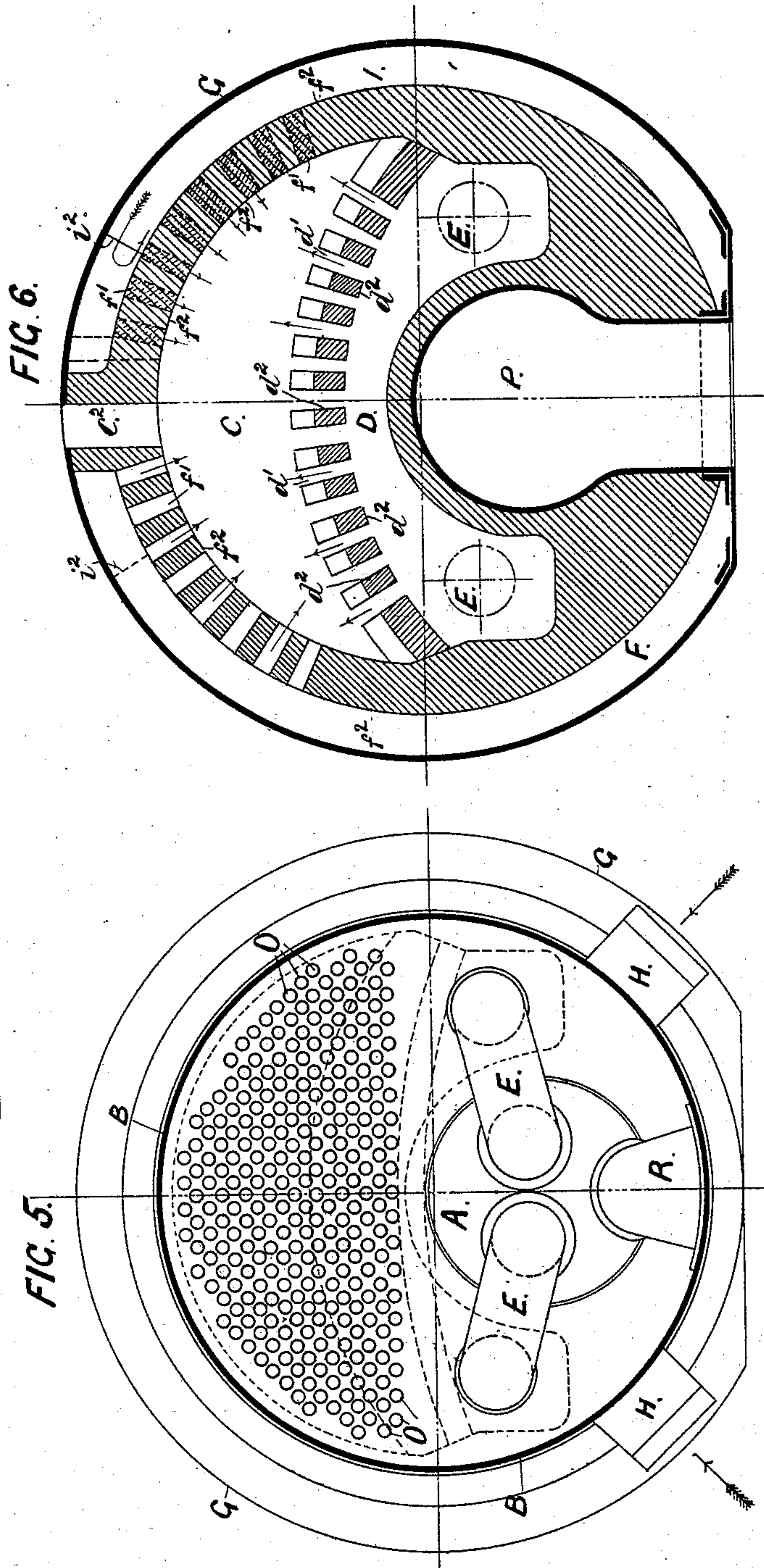
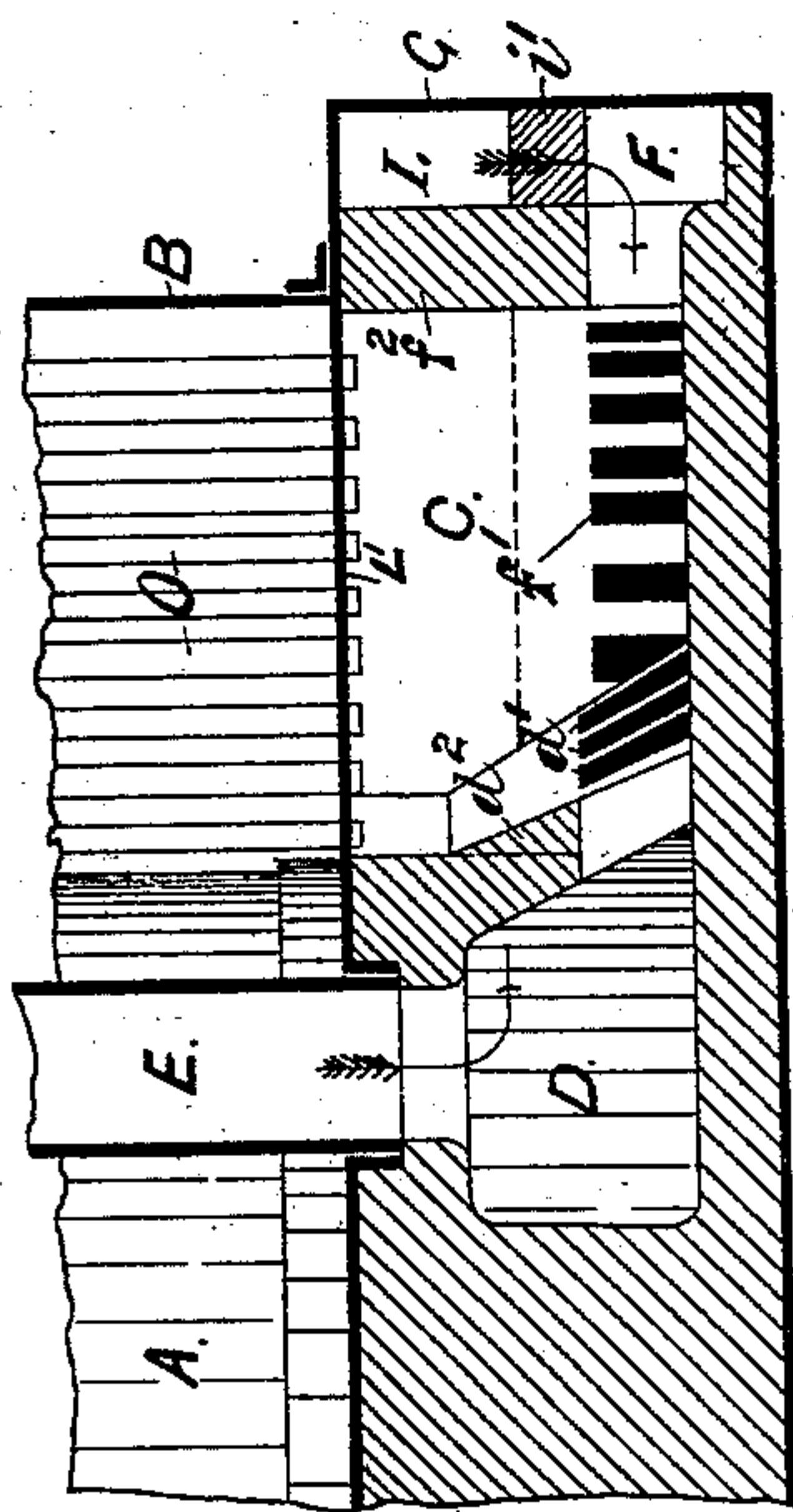
(No Model.)

3 Sheets—Sheet 3.

J. JACKSON.
STEAM GENERATOR.

No. 455,622.

Patented July 7, 1891.



WITNESSES.

Ernest R. Royster
James A. Coulbrough.

INVENTOR.

John Jackson

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. 455,622, dated July 7, 1891.

Application filed March 14, 1891. Serial No. 385,084. (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
10 which it appertains to make and use the same.

This invention relates to steam-generators fired by gas made therein, and consisting as a whole of a combined gas-producer, combustion-chamber, and water and steam containing vessel, forming practically one structure. According to this invention the gas-producer is arranged eccentrically within the shell of the generator and having a nest of tubes at one side of it. The gases may be led by a
20 downtake pipe or pipes from the upper part of the producer to a gas-chamber, and then into a combustion-chamber outside of it and lying about or in the base thereof; or the gases, according to another arrangement, may
25 be led upward and then down to the said chambers.

In the drawings which illustrate examples of gas-fired steam-generators according to the invention I give one in which the gas-producing furnace is eccentrically arranged in the water-containing vessel and wherein the heating-tubes are wholly covered with water.

The same letters of reference are used throughout the views to denote the same or
35 corresponding parts.

Figure 1 is a sectional elevation of the generator through the gas-furnace and combustion-chamber. Fig. 2 also shows the generator in vertical section; but such section is taken at a point at right angles to that at which the view in Fig. 1 is taken. Fig. 3 is a plan taken through the generator, half at the line A A and half at the line B B in Fig. 1; and Fig. 4 is a plan viewed from the top. Figs. 5 and 6 are plans, and Fig. 7 an elevation in section, illustrating a modified arrangement of gas-producer, tubes, and combustion-chamber of the arrangement shown in Figs. 1 to 4. Of these plans, Fig. 5 is taken at a

point above the gas-producer, while Fig. 6 is taken through the ash-pit and combustion-chamber. The sectional elevation shown in Fig. 7 is taken through the combustion-chamber and nest of tubes.

Referring to the drawings, particularly to Figs. 1 to 4, A is the gas-producer, which is arranged in the shell of the generator eccentrically. B is the said generator-shell.

C is the combustion-chamber disposed below the gas-producer and directly underneath the lower tube-plate.

D is the chamber to which the gases produced in the furnace A are conveyed prior to delivery to the combustion-chamber C. E is the downtake pipe or tube by which said gases are conveyed from the gas-furnace A to the chamber D.

F is the chamber or conduit to which the heated air used to support combustion of the gases is conveyed prior to its introduction into the combustion-chamber.

d' and f' are the narrow apertures in the walls d^2 and f^2 , which separate the gas-chamber D and hot-air chamber or conduit F, respectively, from the combustion-chamber, by which apertures the gas and heated air are distributed and flow from said chambers into the combustion-chamber, 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 aforesaid chamber in the lower portion of the structure.

H is the air-inlet, having the governing-valve h' , and H' are pipes through which the air subsequently used to support combustion of the gases generated in the producer within the combustion-chamber enters the casing G.

I are the passages between the wall f^2 and the case G, which convey the air from the pipes H' to the chambers or conduits F, and in which the air is heated by the heat which passes from the combustion-chamber through the wall f^2 , and i' is a horizontal partition by which the passage I and the chamber or conduit F are separated.

The walls f^2 , i' , d^2 , and d^4 are of suitable

fire-brick or fire-resisting material, and the bottoms of the chambers C and D are also lined with the same material.

With regard to the upper parts of the generator, K is the steam dome or vessel.

L is the upper and L' the lower tube-plate.

M is the waste-gas chamber or "smoke-box."

N is the funnel.

O designates the heating-tubes. It will be seen with reference to Figs. 1 to 4 that the tubes O are arranged in two nests, one on each side of the gas-producer A and the gas-tube E, and that the combustion-chamber C and the waste-gas chamber M are disposed, respectively, directly below and directly above these tubes, their shape being made to correspond to the figure circumscribed by the outside row of tubes of the two nests thereof.

This figure or form—*i. e.*, the figure of the combustion and waste-gas chambers—it will be seen, is a crescent. The steam dome or chamber K is also arranged eccentrically to the center of the generator.

The waste-gas chamber M is provided with swinging smoke-doors m' , by which access is had thereto and whereby means are provided for a ready access to the tubes O for the purpose of cleaning them or renewal or other purposes.

A door c' and passage c^2 are provided at the bottom of the base of the generator, by which ready access is had to the combustion-chamber C for the purposes of inspection, repairs, cleaning, and other objects, and a door d^3 is provided in the wall d^4 separating the chamber D from the ash-pit P for gaining access to said chamber D when desired.

It will be seen that the air used to convert the solid fuel in the furnace A to a gaseous form is delivered to the ash-pit P by a suitable conduit Q, which in practice may be a steam-jet blower, and that the ash-pit is inclosed with an ordinary close-fitting door p' , and the fuel is supplied to the furnace A by an ordinary trapped chute R and is supported upon an ordinary bar-grate S.

With reference to the gas-producing furnace A the gas downtake-tube E is attached to the crown at one side. The producer A is arranged eccentrically for the purposes of rendering the stoking, clinkering, and cleaning of the fires and the emptying of the ash-pit easy. With a centrally-arranged furnace all these operations are far more difficult, as they are too far from the outside of the generator; and, besides these purposes, it is also designed in this manner for the purpose of arranging the tubes in the generator so that the convection and circulation shall be efficient; and, again, the respective arrangement of the shell, furnace, and tubes is such that the whole operation of the generator shall be as good as possible and the construction of the parts simple, accessible, and strong.

By the construction of generator shown the tubes O are kept covered with water, the wa-

ter-level (which is designated W L) being maintained at the point shown in the figures, and hence no portions of such tubes are surrounded with water. This is very important for the object of making the durability of the tubes as great as possible. Liability of corrosion and damage is greatest during the process of getting up steam. However, when steam is once "up" damage to the tubes, if not so covered with water, is not likely to occur, especially when using fresh water, and then, if desired, the level of the water may be let down below the upper tube-plate L. If this is done, of course a greater free surface of water is obtained, and consequently a free liberation of steam would be effected. The converse of this arrangement consists in providing an annular steam-dome round the outside of the shell at the same level as that shown in the figures, the smoke-box being within it; or both this and the one shown may be provided.

The air used to support combustion of the gases introduced into the combustion-chamber C is heated in passing through the horizontal passages I by coming in contact with and being subjected to the radiant heat of the hot walls f^2 . It passes from these passages into the chambers or conduits F at i^2 , where the partition i' is stopped. From here (wherein it receives additional heat) it passes into the combustion-chamber by the oblong apertures f' and is broken up into and delivered in a number of comparatively thin streams and meets corresponding streams of gas, which also will be hot, issuing through corresponding apertures d' from the chamber D. These divided streams of heated air and gas thereby simulate and become thoroughly mixed and complete combustion results.

It will be seen that the furnace A is wholly within the shell B (*i. e.*, above the tube-plate L') of the generator, and that the whole of its surface is surrounded with water in the boiler, so that no heat due to radiation is lost thereby, all of the heat radiated from the walls of such furnace passing into the water surrounding it; also, it will be seen that the depth of the structure beneath the shell is small and the length of the tubes O for a given height of generator is great. Therefore by this arrangement and construction a large extent of heating-surface in a generator of given height and size is afforded.

The arrangement shown in Figs. 5, 6, and 7 is one in which the relative disposition of gas-producer, heating-tubes, and gas-conduits and combustion-chamber, set forth with reference to Figs. 1 to 4, is slightly modified—that is to say, on one half or side of the generator I provide a gas-producer eccentrically arranged and two downtake gas-conduits E branching out one on either side and both wholly within the shell of the generator and above the tube-plate and leading and opening out into a common gas-distribution chamber D directly under the tube-plate L', while

in the opposite half of the steam-generator is located a single semicircular nest of tubes O within the shell B, and directly below same a combustion-chamber C.

5 I would state, in conclusion, that this invention is not confined to the particular construction and arrangement of parts shown, as such parts may be modified in different ways to suit varying applications of the invention
10 and requirements without departing from its controlling features.

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

15 1. A steam-generator comprising a shell adapted to contain water, having an upper and a lower tube-plate, a gas-producing furnace the crown and upper part of which stand within the shell and above said lower
20 tube-plate and are surrounded by the water in the generator-shell, a combustion-chamber disposed beneath said lower tube-plate and whereinto the gases produced in said furnace and air are introduced and wherein they
25 burn, a conduit or conduits communicating between the upper part of said gas-producer and said combustion-chamber, and whereby the gases made are passed into the combustion-chamber, passages by which air is intro-
30 duced into said combustion-chamber, and suitable heating-tubes fixed in the tube-plate and extending upward through the water, and through which the gases of combustion pass.

2. In a steam-generator, the combination of
35 a cylindrical shell having an upper and a lower tube-plate in a plane substantially at right angles to the axis of said shell, a gas-producing furnace fixed at its lower end to said tube-plate and lying substantially wholly
40 above said tube-plate and within said shell, a conduit or conduits fixed to the upper part of said furnace and the tube-plate and lying within the shell, and by which the gases made in the furnace are carried off therefrom, a
45 nest of heating-tubes springing from said lower tube-plate, and a combustion-chamber beneath said tube-plate in which air and the gases made in the gas-producers are introduced and burned.

50 3. A steam-generator consisting of an upper portion comprising substantially a vertical shell, upper and lower plates, a gas-producing furnace fixed to the lower tube-plate and disposed substantially wholly within the
55 shell and above said tube-plate, a plurality of heating-tubes fixed at their lower ends to said lower tube-plate and rising through the water in the shell, a tube or tubes connecting the upper part of the producer-furnace and the lower tube-plate, and by which gases
60 are led off from the producer, a lower portion, composed mostly of fire-brick, upon which said upper part rests, and consisting of a combustion-chamber disposed directly
65 under the tubes in the lower tube-plate, and an ash-pit under the gas-producing furnace

in the same plane substantially as the combustion-chamber, substantially as set forth.

4. In a steam-generator, the combination of
70 a cylindrical shell, an upper and a lower tube-plate, a chamber disposed below said tube-plate and wherein the gases made in the generator burn, a gas-producing furnace disposed eccentrically in relation to the main axis of
75 the generator, suitable conduits by which the gases made in the producer are conveyed to the combustion-chamber of the generator, and a nest of tubes lying within said shell and fixed at their lower ends to said lower tube-
80 plate and through which the gases of combustion from said chamber pass, for the purposes set forth.

5. In a steam-generator, the combination of
85 a cylindrical shell, an upper and a lower tube-plate, a chamber disposed below said tube-plate and wherein the gases made in the generator burn, a gas-producing furnace disposed mainly or wholly within the shell above the
90 level of said lower tube-plate and eccentrically to the main axis of said shell of the generator, suitable conduits by which the gases made in the producer are conveyed to the combustion-chamber of the generator, and a
95 nest of tubes lying within said shell and fixed at their lower ends to said lower tube-plate and through which the gases of combustion from said chamber pass, for the purposes set forth.

6. In a steam-generator, the combination of
100 a shell B, having an upper and a lower tube-plate LL' and a suitable steam-chamber at the upper part, a gas-producing furnace A, disposed eccentrically to the main axis of said shell and partly or wholly within said shell above said lower tube-plate, a gas conduit or
105 conduits E, connecting said furnace with said tube-plate, for conveying the gases made in said furnace away therefrom, a combustion-chamber C, disposed under said tube-plate and whereinto the gases from said furnace
110 conveyed by the conduits E pass and are burned, suitable air-inlet conduits for conveying air to said combustion-chamber, and a nest or nests of heating-tubes O, disposed within and between said shell and said furnace
115 A, and through which the gases of combustion from the combustion-chamber pass, substantially as described.

7. A steam-generator consisting of a shell substantially vertically arranged, an upper
120 and a lower tube-plate, tubes fixed therein and springing therefrom and through the water contained in the shell, a gas-producing furnace, a combustion-chamber disposed below
125 said tube-plate and tubes and connected with the upper part of the gas-producing furnace by suitable conduits and having suitable brick-work walls f^2 inclosing it on the out-
130 side, air-heating conduits IF, disposed in the horizontal plane and formed by said combustion-chamber walls, and a casing or wall G outside same, and said combustion-chamber wall having apertures f' therein, whereby

said air passes from said air-heating conduits to said combustion-chamber in jets, the cool air entering said conduits at one part being caused to pass to and fro in horizontal directions and delivered hot into the combustion-chamber, substantially as and for the purposes set forth.

8. The combination, with the shell B, upper and lower tube-plates L L', furnace A, and tubes O, of the combustion-chamber C under said tube-plate and tubes, brick-work wall f^2 outside said combustion-chamber, having air-distributing ports f' , air-heating conduits I F outside said wall f^2 , and gas-chamber D, having gas-distributing ports d' , substantially as set forth.

9. In a steam-generator, the combination of a shell having upper and lower tube-plates and tubes passing therethrough and secured in said tube-plates, a gas-producing furnace, a downtake-pipe from the gas-producing furnace, a gas-chamber communicating with the downtake-pipe, a combustion-chamber arranged under said lower tube-plate and tube ends and having communication with the gas-chamber, and a steam-vessel secured in said upper tube-plate and springing upward therefrom, the level of water in the generator being adapted to be maintained within said vessel, whereby the tubes are wholly submerged

and surrounded with water and said upper tube-plate lying below the level of the water, substantially as and for the purposes described.

10. The herein-described steam-generator, consisting of the combination of the shell B, having the upper and lower tube-plates L L', gas-producing furnace A, disposed within said shell and above said lower tube-plate, gas downtake-conduits E, connected to said furnace and lower tube-plate, ash-pit P below said furnace, heating-tubes O, fixed on said tube-plates L L' and passing through the water in the shell, combustion-chamber C below said lower tube-plate and under the lower ends of said tubes O, gas-chamber D under said gas-conduits E and whereinto the gases made in said furnace are delivered, and having distributing-ports d' in the wall d^2 thereof, and air-inlet conduits by which air is introduced into said combustion-chamber, all substantially as set forth.

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

JOHN JACKSON.

Witnesses:

ERNEST R. ROYSTON,

JAMES ANDREW CONBROUGH,

Both of 15 Water Street, Liverpool.