No. 622,404. Patented Apr. 4, 1899.

J. E. THORNTON & J. P. LEA.

STEAM GENERATOR.

(Application filed June 13, 1898.)

(No Model.) 2 Sheets—Sheet 1.

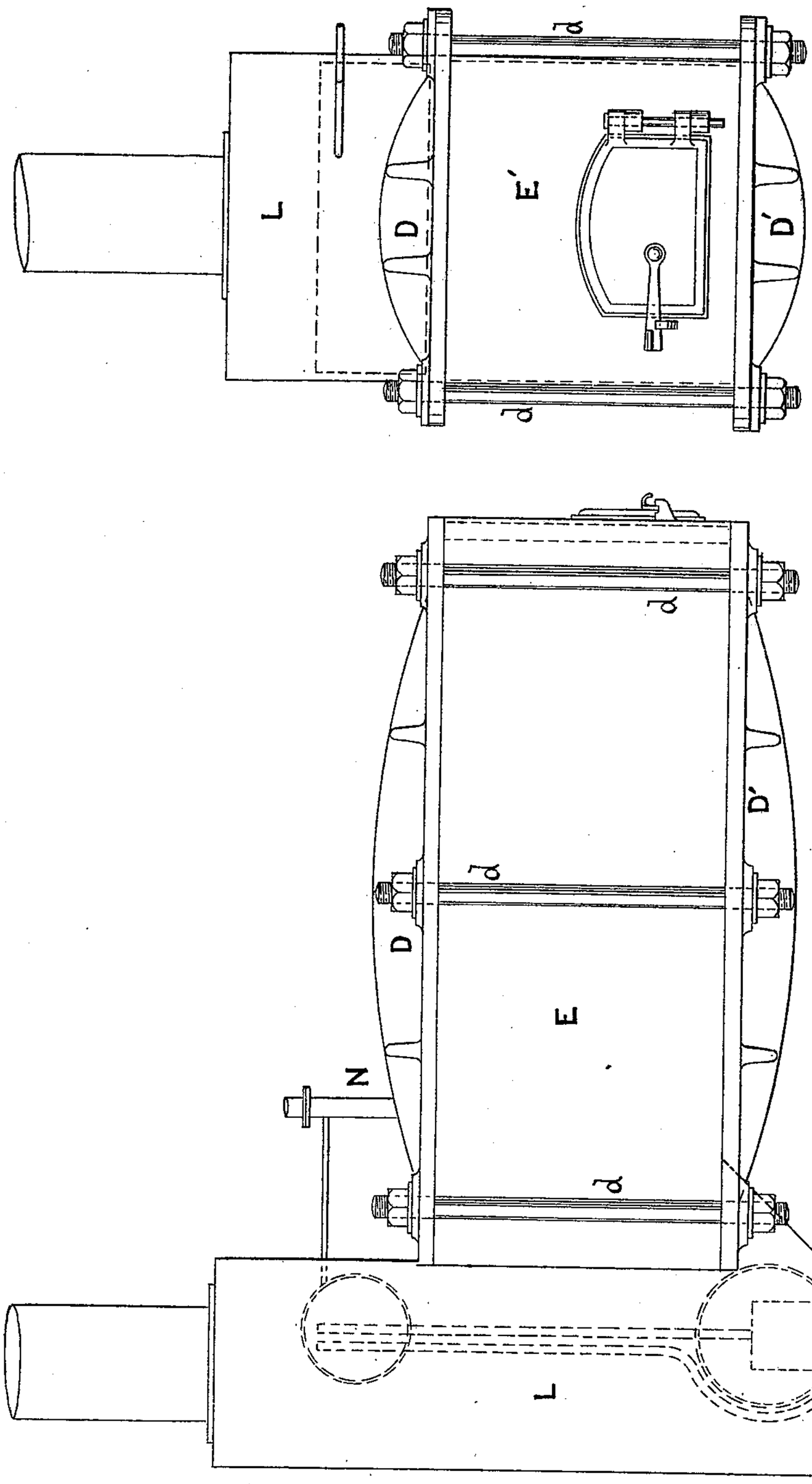

FIG. 1.

FIG. 2.

WITNESSES

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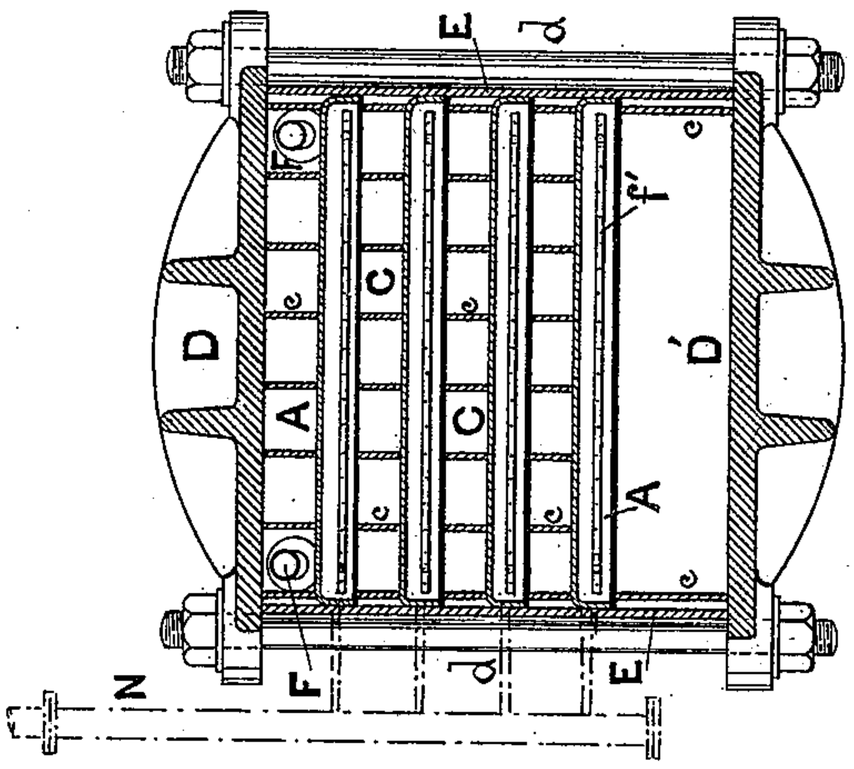

FIG. 4

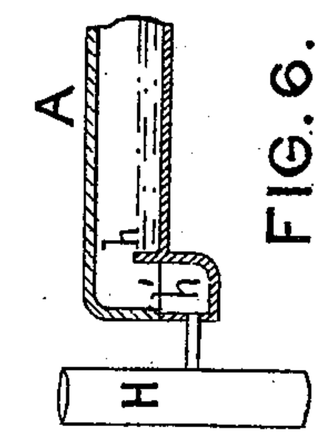

FIG. 6.

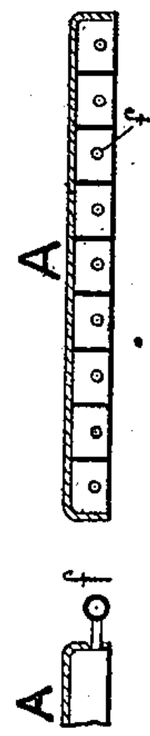

FIG. 7.

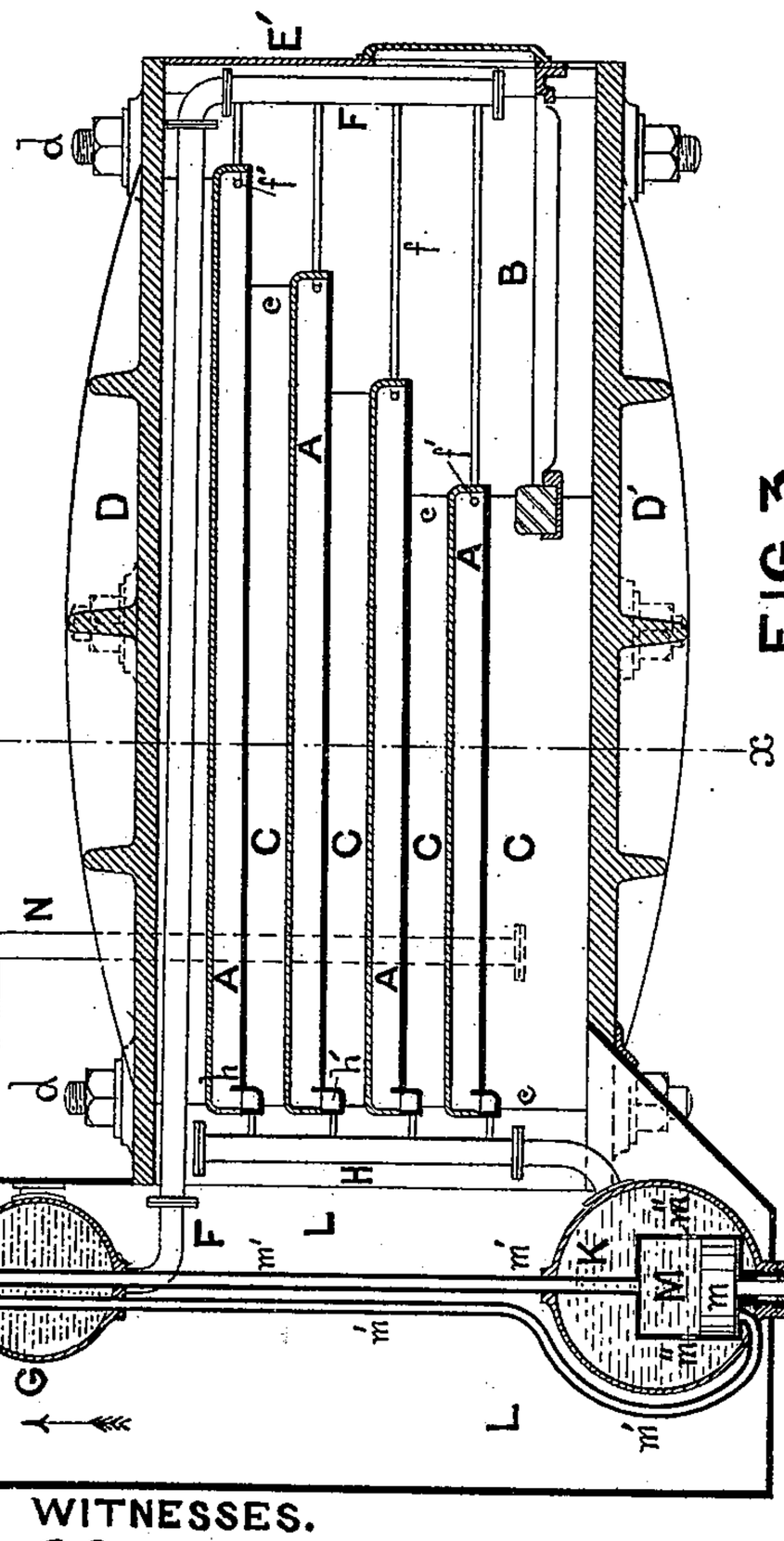

FIG. 3.

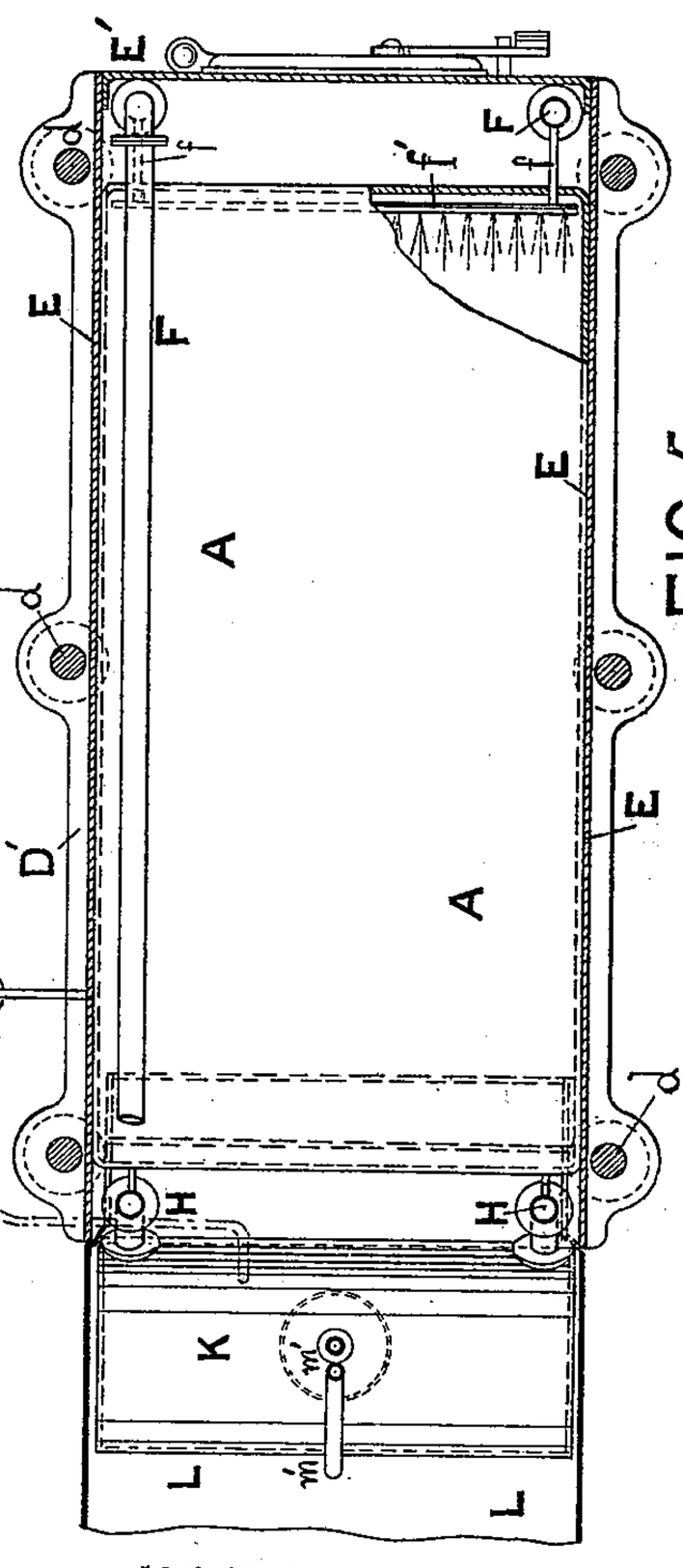

FIG. 5.

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UNITED STATES PATENT OFFICE.

JOHN EDWARD THORNTON, OF ALTRINCHAM, AND JAMES POLLARD LEA, OF MANCHESTER, ENGLAND.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 622,404, dated April 4, 1899.

Application filed June 13, 1898. Serial No. 683,334. (No model.)

To all whom it may concern:

Be it known that we, JOHN EDWARD THORNTON, of Altrincham, in the county of Chester, and JAMES POLLARD LEA, of Hulme, Manchester, in the county of Lancaster, England, have invented certain new and useful Improvements in Steam-Generators, of which the following is a specification.

This invention relates to a steam-generator in which water or other liquid may be quickly vaporized, more particularly adapted for motor-vehicles, steamboats, or other structures where a light generator capable of resisting a high pressure is desirable.

It comprises a number of shallow vessels of considerable horizontal area, superimposed, with a flue-space between each, each vessel being connected at one end to an inlet-pipe and supply-reservoir and at the other end to an outlet or overflow pipe and overflow reservoir or receiver, from which the water is continuously pumped up to the supply-reservoir.

It will be fully described with reference to the accompanying drawings.

Figure 1 is a side elevation. Fig. 2 is a front elevation with the steam-receiver N omitted. Fig. 3 is a longitudinal section. Fig. 4 is a transverse section on line *x x*, Fig. 3. Fig. 5 is a plan, partly in section. Fig. 6 is a detail showing overflow arrangement. Fig. 7 is a modification showing method of retaining bottom plates covered with water should the generator become tilted.

The shallow vessels A are placed in a number of tiers one above another, any desired number being employed, according to the required capacity of the generator. These are preferably arranged as shown, each one slightly shorter than the one above it, to provide a combustion-chamber and grate B, from which the products of combustion and heated gases pass.

A passage or flue C is provided under each vessel A, through which the heated gases pass from the combustion-chamber B, a large heating-surface under each vessel being thus obtained. These may be divided longitudinally by a series of bars or plates *c*, by which one vessel is supported on top of the next one.

The vessels A are secured between strong plates D D′ top and bottom, which are held or clamped together by tension-bolts *d* and prevent any deformation of the vessels which might arise from the internal pressure. Side and end plates E E′ are also provided to form a casing or framing to inclose the vessels A.

Each vessel is constructed, preferably, of two parts, the top of thin sheet metal of dish shape and a flat bottom of thin sheet-copper or of other suitable material, riveted or otherwise secured to the top part.

Each vessel A is at one end supplied with a continuous stream of water from an inlet-pipe F, connected to a supply-reservoir G, forming part of the generator. The supply-reservoir G is directly connected by the inlet-pipes F and auxiliary pipes *f* with all the vessels A, each one of which acts independently of the other. The feed-water advantageously enters each vessel A through a number of small openings or perforations in the internal pipes *f′*, connected to the auxiliary pipes *f*. The water may be caused to enter at a considerable velocity or under considerable pressure, which induces a flow of the water at a definite rate across the surface of the bottom of the vessel toward the overflow. As a result of this movement the vessels A may in the course of operation all be permitted to move considerably out of the horizontal in the direction of the flow without any part of the heated bottom plates becoming uncovered with water. Thin strips may be attached to the bottom plate longitudinally, as shown in Fig. 7, in order to limit the movement of the water in the event of the generator tipping in the other direction, and thus prevent the heated plate being uncovered with water.

The steam is generated in each vessel in the space between the top and the water-level, and the heat of the top plates serves to superheat the steam.

At the end of each vessel A, opposite to the inlet-pipe F, is placed an overflow arrangement, consisting of a lip *h*, running transversely across the vessel A, and a pocket *h′*, into which the overflow-water falls, and thence passes through pipes H of ample capacity into the reservoir K, which is placed at a lower level than the bottom vessel A.

The overflow-reservoir K is preferably

placed in the end flue or smoke-box L in order to avoid loss of heat by radiation. Although the quantity of water in the vessels A is very small and steam is quickly generated therefrom the reservoirs G and K contain sufficient reserve of water for a considerable period.

The water is continuously pumped up from the overflow-reservoir K to the supply-reservoir G, so that as long as there is any water contained in these two reservoirs the generator can continue at work without fresh supply.

After the generator has been at work some time the whole of the water contained in the generator and vessels K and G assumes the temperature of the steam at its working pressure, and thus the water serves to store a very considerable quantity of heat, which is immediately available to form steam whenever the working pressure in the generator tends to fall.

The steam from each of the vessels A collects in the receiver N, from whence it passes by a pipe to the top of the supply-reservoir G and is led away to be used.

The pump for raising the water from the overflow-reservoir K to the supply-reservoir G comprises a cylinder M, closed at both ends and fitted with a piston *m*, the rod attached to which passes through a suitable stuffing-box in one of the cylinder-covers and is connected to and worked to and fro by a motor or other reciprocating mechanism. Each end of the cylinder M has a pipe *m'* connected with it, which passes to the supply-reservoir G above. The capacity of such pipe is small compared with the working capacity of the cylinder. At the center of the cylinder are openings *m''*, and toward the completion of each stroke the piston uncovers them, and as they are in free communication with the lower reservoir and below the level of the water in it the water flows freely into the cylinder. On its return stroke the piston covers these openings and afterward forces the water through the pipe into the vessel above. On the next stroke the water in the pipe *m'* reenters the cylinder M, and then steam follows until the openings in cylinder-walls are uncovered, when water fills the cylinder, expelling the steam through the delivery-pipe. Then the action is as before described. The delivery-pipes *m'* enter the supply-reservoir G above the level of the water therein.

In generators of considerable size a rotary pump may be employed instead of the piston-pump before described to raise and circulate the water, and such rotary pump may be driven by an electric motor or other suitable means.

What we claim as our invention, and desire to protect by Letters Patent, is—

1. A steam-generator comprising in its construction a number of superimposed horizontal shallow vessels feed-inlet pipes at one end and overflow-pipes at the opposite end each vessel provided at its outlet end with a lip running transversely across it to maintain a layer of water of constant depth on the surface of the vessel in combination with an overflow-reservoir and circulating apparatus substantially as described.

2. In a steam-generator the combination with a number of superimposed shallow vessels each provided with an overflow-lip, and strongly-constructed top and bottom holding-plates bolted together to transmit the strain to the holding-plates, of the water-inlet pipes at one end and outlet-pipes at the opposite end a water-receiver and circulating-pump at a lower level than the horizontal vessels substantially as described.

3. A steam-generator comprising a number of superimposed shallow vessels each provided with a feed-inlet pipe at one end and an overflow-pipe at the opposite end, a supply-reservoir above the level of the generating vessels, an overflow-reservoir below them and a pump for raising the water in a continuous flow from the one to the other substantially as described.

4. In a steam-generator the combination with a number of shallow superimposed generating vessels A, of a supply-reservoir G, an overflow-reservoir K, inlet-pipes F, overflow pipes H connecting the respective reservoirs with the generating vessels A and a pump for raising water from the lower reservoir to the higher one, substantially as described.

5. In a steam-generator the combination with the superimposed shallow generating vessels A provided with flues C between them and the grate B of the supply-reservoir G, the inlet-pipes F connected thereto, the overflow-pipes H, the overflow-reservoir K and the pump M for raising the water from one reservoir to the other substantially as described.

In witness whereof we have hereunto signed our names in the presence of two subscribing witnesses.

JOHN EDWARD THORNTON.
JAMES POLLARD LEA.

Witnesses:
H. P. SHOOBRIDGE,
F. P. EVANS.