

(No Model.)

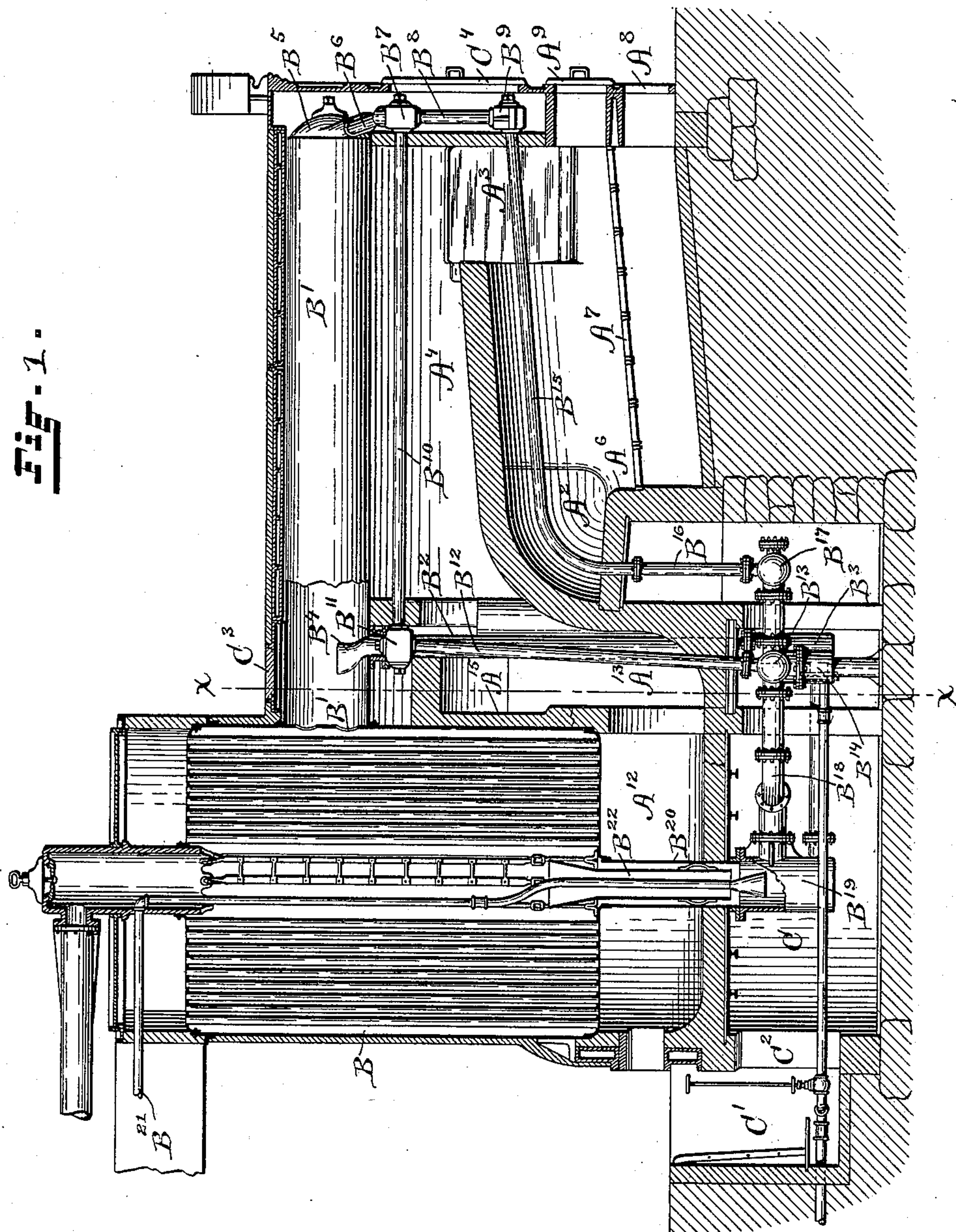
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D. M. THOMPSON.
STEAM GENERATOR.

No. 601,487.

Patented Mar. 29, 1898.

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WITNESSES:

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E. M. Simme

INVENTOR:

David M. Thompson
by Joseph A. Miller & Co. Attys

(No Model.)

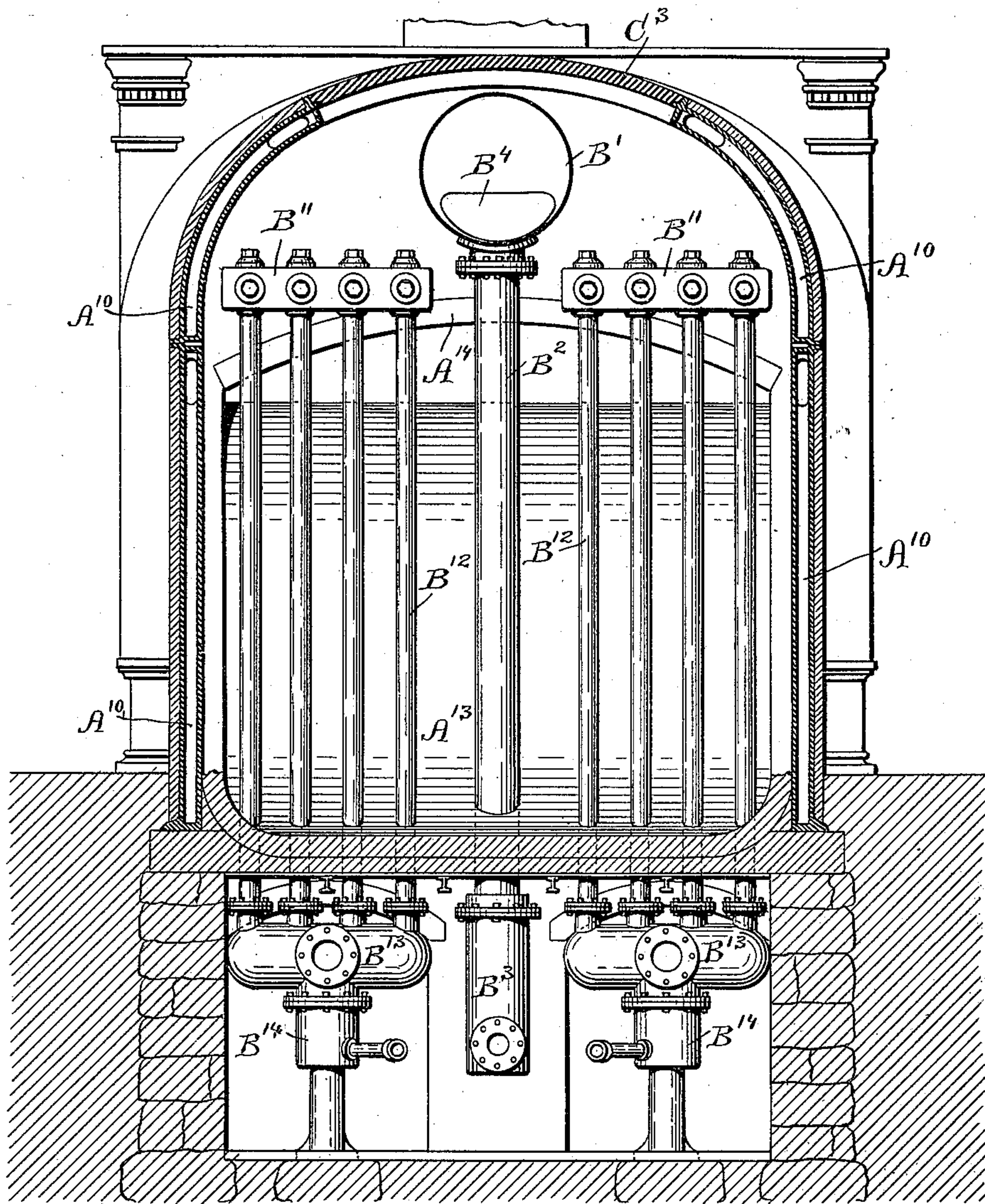
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Fig. 2.



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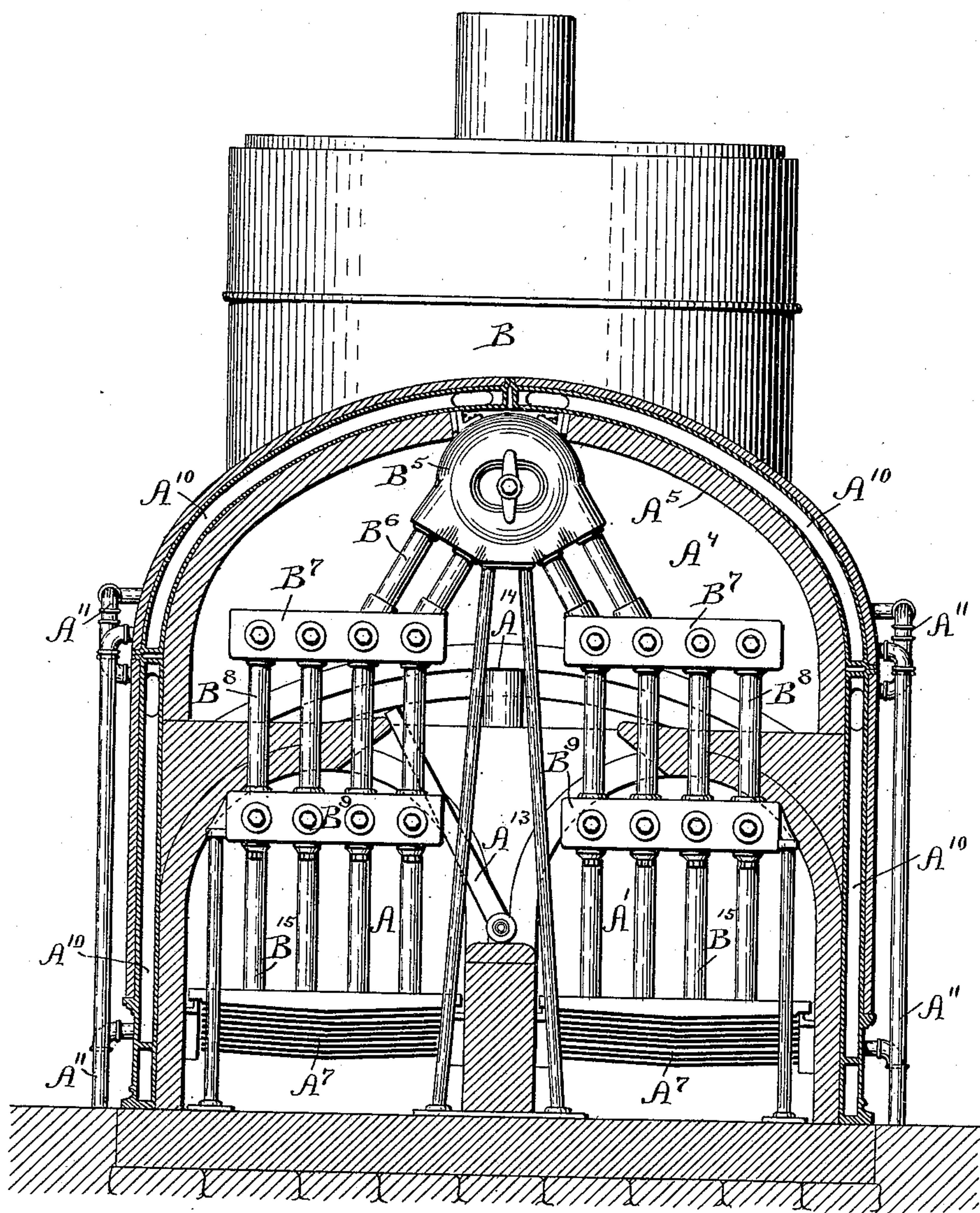
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Fig. 3.



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UNITED STATES PATENT OFFICE.

DAVID M. THOMPSON, OF PROVIDENCE, RHODE ISLAND.

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 601,487, dated March 29, 1898.

Application filed July 23, 1897. Serial No. 645,711. (No model.)

To all whom it may concern:

Be it known that I, DAVID M. THOMPSON, of Providence, in the county of Providence and State of Rhode Island, have invented a new and useful Improvement in Steam-Generators; and I hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

The invention has reference to an improvement in steam-boilers and furnaces therefor.

The invention consists in the peculiar and novel construction of the steam-boiler, the water-tube circulating attachment, and the furnace, whereby the more perfect combustion of the fuel in the furnace is secured, the circulation of the water increased, the separation of the steam facilitated, and better economic results secured, as will be more fully set forth hereinafter.

One object of the invention is to secure the more perfect combustion of the fuel and prevent the discharge of black smoke.

Another object of the invention is to separate impurities contained in the water and collect the same below the parts exposed to the action of the fire.

Another object of the invention is to secure the rapid circulation of the water and facilitate the separation of the steam from the water.

Another object of the invention is to facilitate the separation of soot and ashes from the products of combustion to prevent the clogging of the vertical tubes; and a further object of the invention is to reduce the height of the vertical tubular boiler without impairing its efficiency.

In steam-generators as heretofore constructed, and particularly in the type known in the arts as "vertical tubular boilers," the furnace was placed below the vertical tubular boiler and the products of combustion impinged on the boiler and passed from the fire upward through the vertical tubes, the volatile gases, with the unconsumed carbon, soot, ashes, and vapor, coming in contact with the surface of the boiler, and the tubes were chilled by the comparative low temperature of the boiler and adhered to the interior sur-

face of the tubes, thereby clogging the tubes, reducing the draft and the steam-generating efficiency of the tubes. To avoid this clogging of the tubes and secure the more perfect combustion of the volatile carbon in the fuel, I place two furnaces side by side in front of the vertical tubular boiler and practically on a level with the lower tube-sheet of the vertical tubular boiler. I inclose these furnaces with fire-brick or other similar material and connect the rear of these furnaces so that the products of combustion from one furnace will pass over the fire of the other furnace and then into a large combustion-chamber, from which they pass down under the vertical tubular boiler and upward through the tubes of the same to the uptake, or they may surround the lower part of the vertical tubular boiler and, descending, enter the tubes, to be carried to the uptake and chimney. To utilize the radiated heat in these furnaces, I extend a series of water-tubes through the same.

Figure 1 is a vertical section showing the relations of the furnaces, the water-tubes, and the vertical steam-boiler to each other. Fig. 2 is a vertical transverse section on the line X X of Fig. 1, looking toward the front of the steam-generator. Fig. 3 is a vertical transverse sectional view showing the two furnaces, the combustion-chamber, and the water-tubes.

Similar marks of reference indicate corresponding parts in all the figures.

In the drawings, A indicates the furnace on the left-hand side of the steam-generator, which, as shown in the drawings, is the furnace to which the fuel has been last supplied; A', the furnace on the right-hand side, in which the fire has given up its volatile gases, so that a bright fire burns on the grate; A², an arched opening connecting the rear ends of the furnaces; A³, a swing-gate controlling the front connections between the furnaces A and A' with the combustion-chamber A⁴, the arch A⁵ of which extends over the width of the two furnaces; A⁶, the bridge-wall at the end of the grate A⁷. Each furnace is provided with an ash-pit door A⁸ and a firing-door A⁹.

The furnaces and the combustion-chamber may be inclosed, and in the preferred form

are inclosed, by the cellular casing A¹⁰, consisting of a series of hollow sections divided by vertical partitions pierced with openings to connect the adjoining cells. The several
 5 sections are connected by the pipes A¹¹ A¹¹, and water is supplied to the cellular casing, to be heated and conducted from the casing to a tank or pump, to be delivered to the boiler. The vertical tubular boiler B has its
 10 lower tube-sheet at or nearly at a level with the grate-surface of the furnaces, and the combustion-chamber A⁴ connects with the flame-chamber A¹², under the tubular boiler, by the drop-flue A¹³. The transverse wall, supported
 15 on the arch A¹⁴ and the wall A¹⁵, prevents direct access to the shell of the vertical tubular boiler in the form shown in the drawings; but this construction may be modified so as to leave an open space around the lower part
 20 of the vertical boiler B, closed in at a point below the water-level in the boiler, a method well known and generally practiced in steam-boiler construction.

The vertical tubular boiler B is provided
 25 with the horizontal cylinder B', extending through the combustion-chamber A⁴ to the front. The pipe B² extends from the cylinder B' downward through the drop-flue A¹³ to the mud-drum B³, and within the pipe B²
 30 is placed a pipe surmounted with the scum-collector B⁴. The front end of the cylinder B' is provided with the head-fitting B⁵ and is connected by the pipe B, extending diagonally on each side, with the manifolds B⁷ B⁷,
 35 and these manifolds are connected by the pipes B⁸ B⁸ with the manifolds B⁹ B⁹. The water-tubes B¹⁰ B¹⁰ extend from the manifolds B⁷ B⁷ to the manifolds B¹¹ B¹¹, and from these the water-tubes B¹² B¹² extend downward to
 40 the manifolds B¹³ B¹³, each connected with a mud-trap B¹⁴.

From the manifolds B⁹ B⁹ extend the water-tubes B¹⁵ B¹⁵ through the length of the furnaces A and A'. The portions of these water-tubes beyond the bridge-wall are bent and
 45 connect, by means of the tubes B¹⁶ B¹⁶, with the manifolds B¹⁷ B¹⁷, connected each by means of a suitable connecting-pipe with the manifolds B¹⁸ B¹⁸, and these manifolds B¹⁸ B¹⁸ are
 50 connected by the pipes B¹⁸ with the mud-drum B¹⁹, secured to the lower end of the cylinder B²⁰, extending downward from the central portion of the lower tube-sheet of the vertical tubular boiler B. The feed-water is supplied
 55 to the steam-generator through the pipe B²¹, which extends through the central portion of the vertical tubular boiler B and through the circulating-tube B²² in the cylindrical projection B²⁰ and ends in a conical nozzle or
 60 other suitable distributor within the mud-drum B¹⁹.

To secure convenient access to the mud-drums and connections, the souterrain C is built below the floor-level of the boiler-house.
 65 The well C' and door C² connect with the souterrain C, which is of such height and dimen-

sions as will enable a person to enter and make any required inspection or repairs. The manifolds B¹¹ B¹¹ may be conveniently reached
 70 by removing the section C³, which is disconnected from the cellular casing A¹⁰. The manifolds B⁷ and B⁹ are reached by opening the door C⁴ over the fire-doors A⁹ A⁹ in the front of the generator. The manifolds are provided with the usual hand-hole covers op-
 75 posite each of the water-tubes.

To enable others skilled in the art to use my invention, I will describe the operation of the same more fully.

Before lighting the fire in the improved
 80 steam-generator the boiler is to be filled with water until the horizontal cylinder B' is at least half full, and the water-line is maintained above the horizontal center of the cylinder B'. The fire is first lighted in one of
 85 the two furnaces A or A', and the products of combustion are passed through the other furnace into the combustion-chamber and from this through the drop-flue and the tubes of the vertical boiler to the chimney. As soon
 90 as the fire burns brightly the firing and ash-pit doors of this furnace are closed, the other furnace is lighted, and the smoke and gases of this furnace are made to pass by the adjustment of the gate A³ through the open-
 95 ing A² and over the fire of the first furnace. This alternate firing of one furnace after the other and the passing of the products of combustion of one furnace over the incandescent fire in the other furnace is continued. When
 100 the brickwork has been thoroughly heated, the arches over the furnace that is being supplied with fuel greatly facilitate the combustion of the fuel and the combustion of the volatile gases disengaged by the combustion
 105 of the fuel. These gases pass from the furnace in which they are generated through the arched opening A² into the other furnace, in which a bright incandescent fire is burning and the arch of which is highly heated. The
 110 gases are by this passage from one furnace to the other thoroughly mixed, while they are maintained at the high temperature required for combustion. In this condition the gases pass upward into the combustion-chamber
 115 A⁴, the cross-sectional area of which is about three times the cross-sectional area of the furnace. The gases expand and, being surrounded by the heated brickwork, are thoroughly consumed. The heated products of
 120 combustion descend to the flame-chamber A¹² and pass upward through the tubes of the vertical tubular boiler to the uptake and chimney. Neither soot nor smoke enters the tubes of the boiler, and the fine ashes usually
 125 carried into the tubes are precipitated in the combustion-chamber and flame-chamber, owing to their great cross-sectional area and slower movement of the gases.

The water heated in the cellular casing under atmospheric pressure by the heat carried
 130 through the brickwork into the casing is

forced by a pump through the feed-pipe into the mud-drum B¹⁹, from which it flows into the two manifolds B¹³ B¹³, and from these into the manifolds B¹⁷ B¹⁷, and, ascending through the water-tubes B¹⁵ B¹⁵, extending through the two furnaces A and A', is delivered highly heated through the manifolds B⁹ B⁹ B⁷ B⁷ and the connecting-pipes into the front end of the horizontal cylinder B', where the liberation of the steam is facilitated by the extended water-surface, the level of which is maintained by the connection of the horizontal cylinder with the vertical steam-boiler B and the pipe B², through which the surplus water is conveyed to the mud-drum B³, the lower end of which is connected by a large pipe with the mud-drum B¹⁹ under the vertical steam-boiler B, thereby securing the rapid circulation of the water through the water-tubes, the liberation of the steam, and the maintenance of a reliable water-level. The impurities are gathered by the scum-collector B⁴ and carried to the mud-drum B³. A portion of the water ascends from the manifolds B¹³ B¹³ through the vertical water-tubes B¹² B¹² to the manifolds B¹¹ and thence through the water-tubes B¹⁰ to the manifolds B⁷ and enters the front end of the horizontal cylinder B', where the steam is separated from the water, the water-level maintained, and the rapid circulation of the water secured in the manner above described with reference to the water-tubes B¹⁵. Circulation of the water is maintained in the vertical tubular steam-boiler B by means of the circulating-tube B²⁵, the annular space forming ascending currents, while the descending currents pass down the tube B²⁵ to the mud-drum. The horizontal cylinder B' has large steam and water connections with the boiler B. The steam generated passes freely to the boiler and the large body of water in the boiler maintains the normal water-level in the horizontal cylinder, although the same is exposed to the first action of the heat.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a steam-generator, the combination with the vertical tubular steam-boiler, of two furnaces placed side by side, said furnaces extending above the lower end of the tubular boiler, brickwork inclosing the furnaces, a combustion-chamber above the furnaces, and a drop-flue connecting the combustion-chamber with the space under the vertical tubular boiler; whereby the fuel is consumed in brick-inclosed furnaces and the products of combustion pass through the combustion-chamber and downward under the tubular boiler, as described.

2. In a steam-generator, the combination with the vertical tubular steam-boiler, of two brick-inclosed furnaces located above the lower end of the tubular boiler and connected so as to be alternately fired, a combustion-

chamber above the furnaces, a cylinder connected with the tubular boiler at the water-line and extending through the combustion-chamber, and a flue connecting the combustion-chamber with the space under the tubular boiler; whereby the fuel is consumed in brick-inclosed furnaces, soot and ashes are retained and the heat is made to enter the tubes of the vertical boiler, as described.

3. In a steam-generator, the combination with the vertical tubular steam-boiler, the horizontal cylindrical extension and the furnaces, of the series of water-tubes B¹⁰, B¹² and B¹⁵ connected with the boiler below the furnaces and with the horizontal cylinder, whereby the circulation of the water in the boiler, the water-tubes and the horizontal cylinder and the separation of the steam are facilitated.

4. In a steam-generator, the combination with two furnaces placed side by side and connected, as described, so that they may be alternately fired, a combustion-chamber above the furnaces, said furnaces and combustion-chamber inclosed in brickwork, a vertical tubular boiler located in the rear of the furnaces, the tube-sheet of which is below the normal level of the fuel in the furnaces, a flame-chamber below the vertical tubular boiler, a drop-flue connecting the combustion-chamber with the flame-chamber, and a cellular casing, inclosing the furnace portion of the steam-generator, provided with water-supply and connecting pipes, whereby the part of the heat held back in the combustion-chamber and transmitted through the brickwork is utilized to heat the feed-water, as described.

5. In a steam-generator, the combination with the vertical tubular boiler B, the vertical cylindrical extension B²⁰, the circulating-tube B²² and the mud-drum B¹⁹, of the horizontal cylinder B' connected with the vertical boiler at the normal water-line, the tube B², the mud-drum B³, connections between the mud-drums B³ and B¹⁹, furnaces located on one side of the vertical boiler having the grate practically on a level with the lower end of the vertical boiler, and flues for conveying the products of combustion downward under the vertical tubular boiler, whereby the circulation of the water and the liberation of the steam are facilitated, as described.

6. In a steam-generator, the combination with the vertical tubular boiler B, the horizontal extension B', the vertical cylindrical extension B²⁰, the circulating-tube B²², the mud-drum B¹⁹, the vertical tube B², the mud-drum B³ and connection between the mud-drums B³ and B¹⁹, of the manifolds B¹³ and B¹⁷ connected with the mud-drum B¹⁹, the manifolds B⁷, B⁹ and B¹¹, the water-tubes B¹⁵ connecting the manifolds B⁹ through the pipes B¹⁶ with the manifolds B¹⁷, the water-tubes B¹⁰ and B¹² connecting the manifolds B⁷, B¹¹ and B¹³, connections between the manifolds

B⁷ and the fitting B⁵ at the front end of the cylinder B', the furnaces A and A', the combustion-chamber A⁴, the drop-flue A¹³ connecting the combustion-chamber with the
5 flame-chamber A¹², and the souterrain C, whereby access is had to the connections below the floor-level, as described.

In witness whereof I have hereunto set my hand.

D. M. THOMPSON.

Witnesses:

JOSEPH A. MILLER,
JOSEPH A. MILLER, Jr.