No. 849,103. PATENTED APR. 2, 1907.

I. H. BOYER.

STEAM BOILER FURNACE.

APPLICATION FILED JAN. 6, 1906.

3 SHEETS—SHEET 1.

Fig. 1.

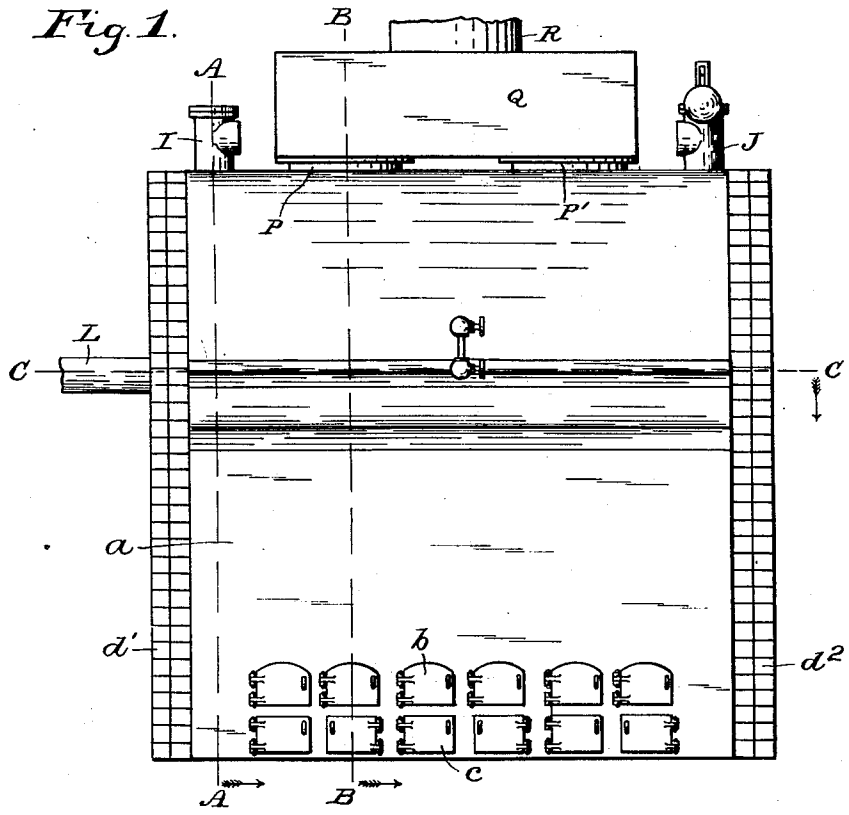
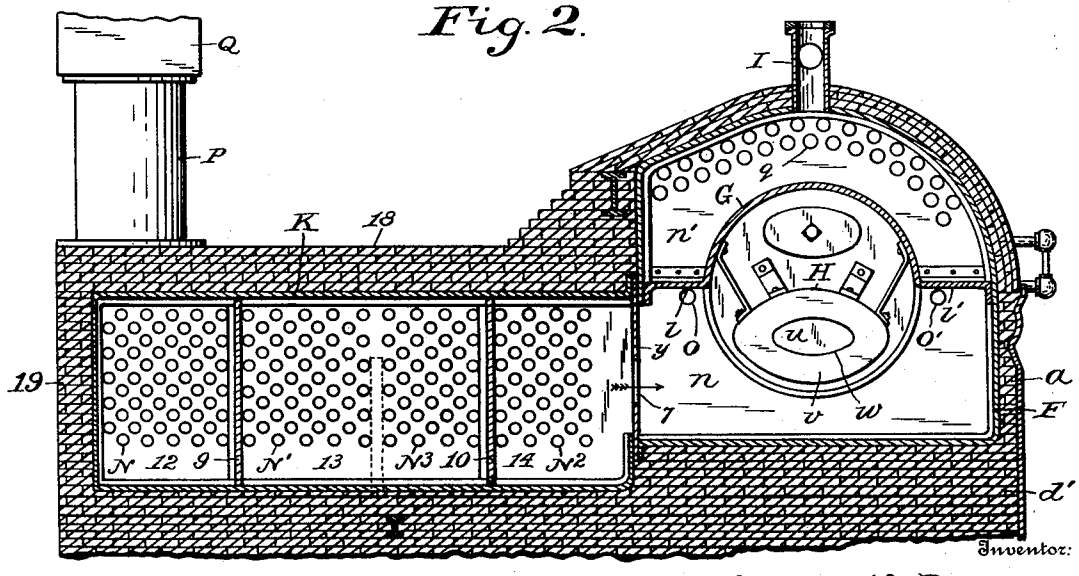


Fig. 2.



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3 SHEETS—SHEET 2.

Fig. 3.

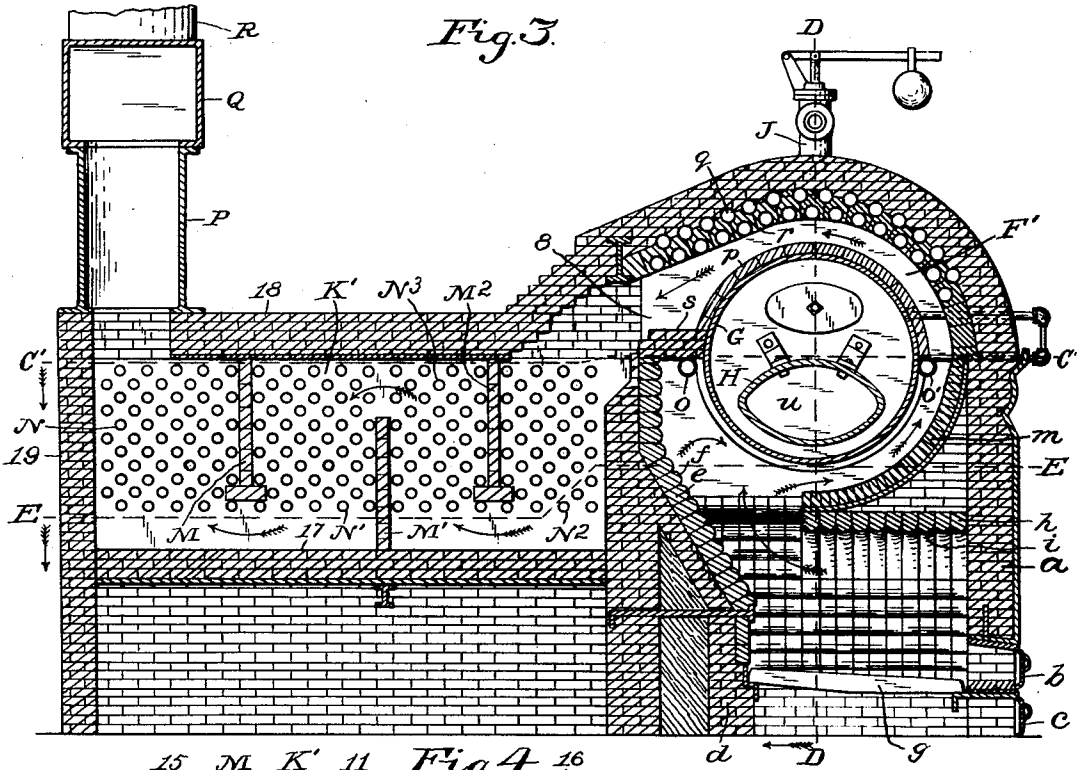
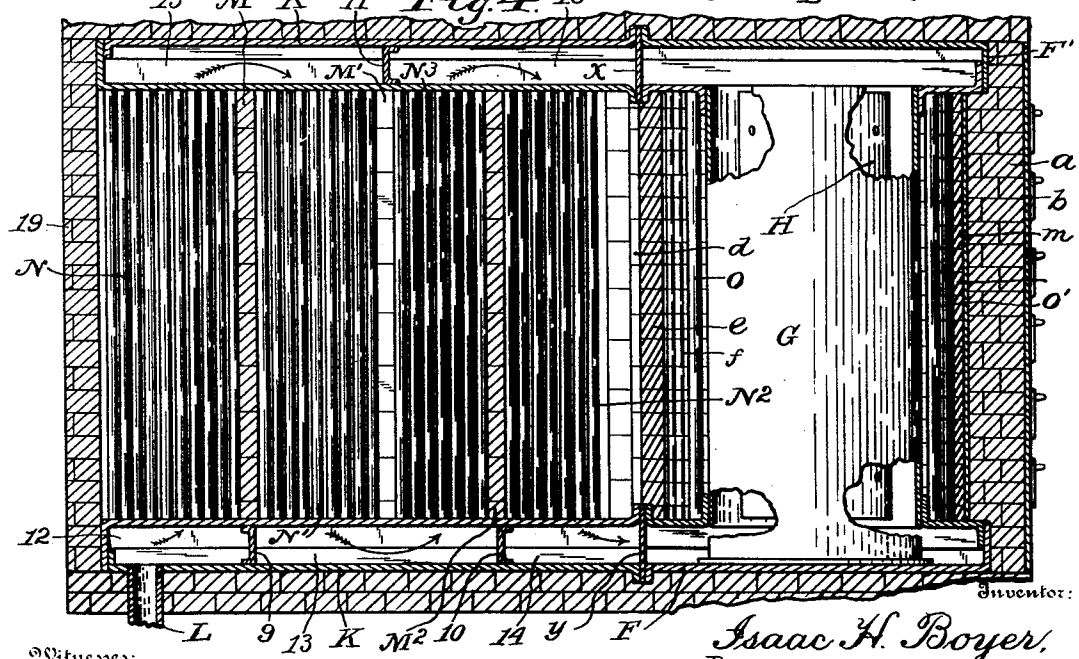


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

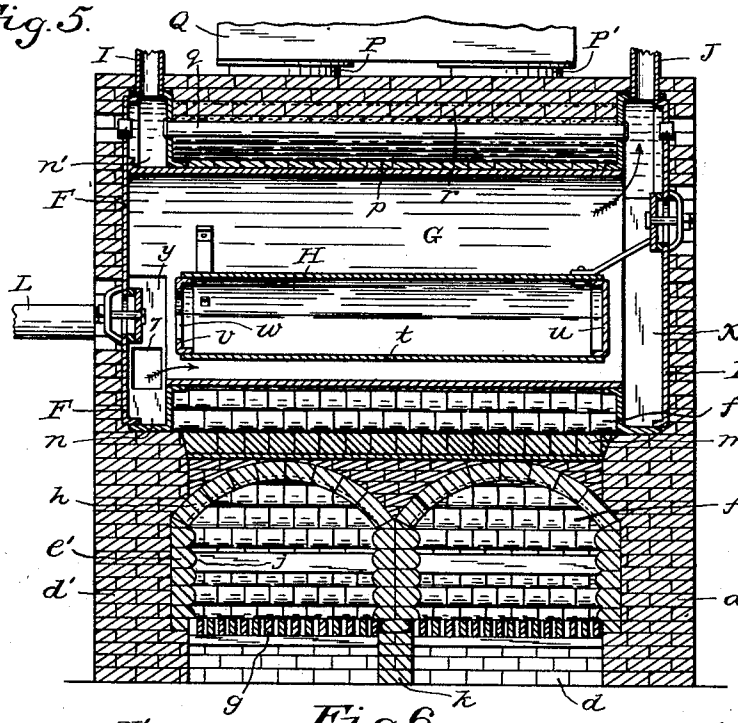
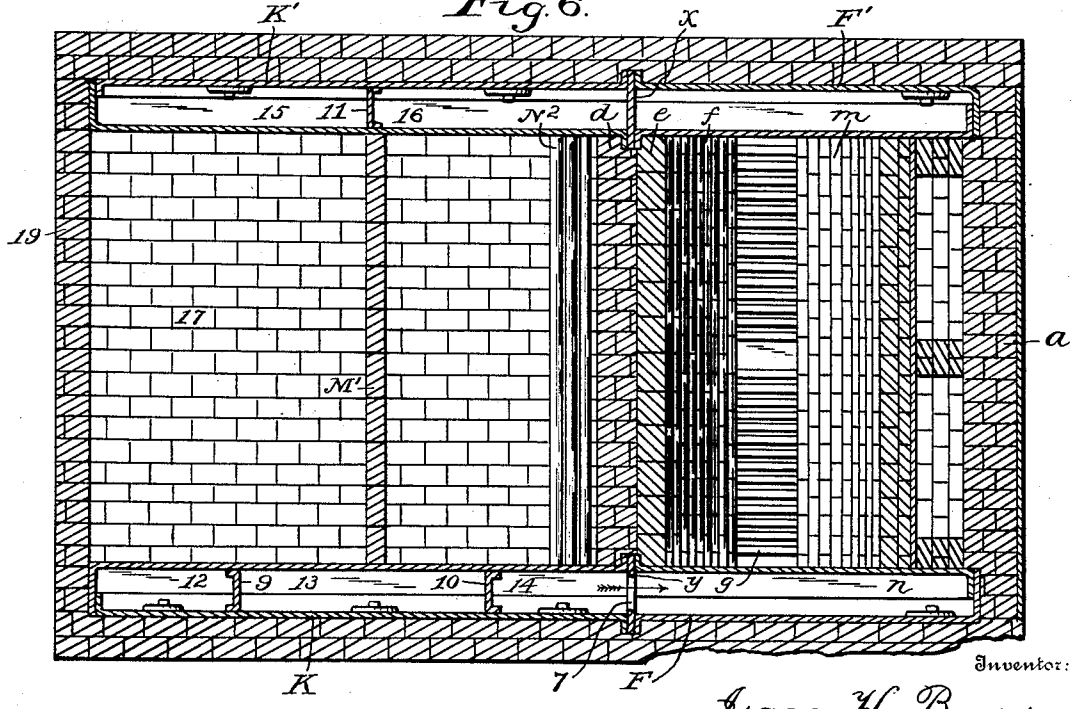


Fig. 6.



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UNITED STATES PATENT OFFICE.

ISAAC H. BOYER, OF MUNCIE, INDIANA.

STEAM-BOILER FURNACE.

No. 849,103. Specification of Letters Patent. Patented April 2, 1907.

Application filed January 8, 1906. Serial No. 295,029.

To all whom it may concern:

Be it known that I, ISAAC H. BOYER, a citizen of the United States, residing at Muncie, in the county of Delaware and State of Indiana, have invented new and useful Improvements in Steam-Boiler Furnaces; and I do declare the following to be a full, clear, and exact description of the invention, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to apparatus for producing steam from water for industrial purposes, the invention having reference particularly to producers that include furnaces in which heat is generated from fuel and the arrangement of evaporating vessels or boilers in which the water may be converted into steam.

Objects of the invention are to provide a steam-boiler-furnace construction whereby steam may be produced economically with respect to the consumption of fuel and whereby the heat from the fuel may be utilized to the greatest advantage to rapidly produce the steam.

A further object is to provide a steam-boiler furnace in the operation of which by the consumption of coal or similar fuel the highest degree of perfection may be attained in the combustion of fuel, so as to avoid losses due to unburned gases which commonly prove wasteful in the form of smoke emission.

With the above-mentioned and minor objects in view the invention consists in an improved steam-producer comprising, broadly stated, a novel form of furnace, a novel arrangement of boiler or evaporation vessel with respect to the furnace, improved forms and arrangements of heat-passages for conducting the furnace heat transversely to the longitudinal axis of the boiler, and in a novel arrangement of feed-water heater transversely to the direction of the heat-current toward the chimney; and the invention consists, further, in the novel parts and the combinations and arrangements of parts, as hereinafter particularly described and claimed.

Referring to the drawings, Figure 1 is a front elevation of a steam-producer constructed substantially in accordance with the invention; Fig. 2, a fragmentary vertical sectional view on the line A A in Fig. 1; Fig. 3, a vertical sectional view approximately on the line B B in Fig. 1; Fig. 4, a horizontal sectional view approximately on the line C C in Fig. 1, corresponding approximately to the line C′ C′ in Fig. 3; Fig. 5, a vertical sectional view on the line D D in Fig. 3; and Fig. 6, a horizontal sectional view approximately on the line E E in Fig. 3.

Similar reference characters in the different figures of the drawings designate corresponding elements or features.

In a practical embodiment of the invention a front furnace-wall *a*, having suitable fire-doors *b* and ash-pit doors *c*, is provided, there being suitable openings in the wall that are closed by the doors. A rear furnace-wall *d* is erected opposite to the front wall, and side walls *d′* and d^2 connect the front and rear walls. The rear wall *d* has a vertical lower portion and vertical upper portion, the middle portion being inclined, as indicated particularly in Fig. 3, the wall having a lining of fire-brick *e*, the face of which has a multiplicity of projections *f*. Suitable grates *g* are arranged in the furnace thus provided by the walls, and above the grates are fire-brick arches *h*, of suitable number, extending over the forward portion of the grate area at a suitable height therefrom, the under side of the arches having projections *i*. The arches are of suitable width, so as to extend from the front wall *a* toward the rear wall *d* as far as may be desired, leaving an opening for the flames to pass upwardly from the grates along the face of the rear wall. One or more arches may be provided, according to the dimensions of the furnace, there being a suitable number of partitional walls *k* erected in the furnace when required to support adjacent ends of the arches when two or more arches may be desired. The sides of the furnace and the partitions are also lined with the bricks having the projections on their faces.

Two counterpart hollow water-heads F and F′ comprise parts of the furnace-walls and are mounted on the side walls *d′* and d^2, one on either wall, oppositely arranged. The inner wall of each water-head has a relatively large opening, and an evaporator G, preferably of tubular form, extends from one to the other opening and is attached at one end thereof to the inner wall of the water-head F′, the opposite end of the evaporator having the lower portion thereof attached to the inner wall and the upper portion thereof extending to and attached to the outer wall of the water-head F, there being lateral wings *l* and

l' extending from said upper portion of the evaporator to the ends of the water-head F and attached thereto and also to the inner and outer walls, so as to divide the water-head F into a lower water-chamber n, communicating with the interior of the evaporator, and an upper chamber n', that affords a steam-chamber. The bottom of the evaporator G is relatively close to the inner end of the arch or arches h, and a curved wall m extends under a portion of the evaporator from the front wall a to the top of the arch or arches, providing a narrow heat-passage from the rear of the furance around the forward side of the evaporator, the passage being continued over the top of the evaporator as a result of building a roof over the evaporator that extends upwardly from the front wall a between the water-heads, as will further appear. The evaporator G may be made in various shapes, but for obvious reasons may be constructed more cheaply and strongly in circular form. The evaporator includes, besides the shell or body portion thereof, a water-divider H, that is supported in the shell suitably near the bottom thereof. Said water-divider has a suitable number of small drain-holes t in the bottom thereof, there being a head u closing one end and a head v, having a manhole w at the opposite end of the shell of the water-divider.

At opposite sides of the shell of the evaporator G are suitable supports, preferably water-tubes o and o', connected to the inner walls of the water-heads F and F', and a fire-brick cover p extends over the top of the shell to protect it above the water-line against the direct action of the heat, the cover resting upon the supports. A suitable number of superheating-tubes q are arranged in parallel order above the cover p and are connected to the inner wall of the water-head F' and also to the inner wall of the water-head F, so as to communicate with the steam-chamber n' thereof. Fire-bricks r are placed between and over the tubes p and extending collectively down to the curved wall m, so that an arch is formed over the evaporator-shell with a heat-passage formed thereby, there being a suitable cover extending from the front wall a over the arch and the superheating-tubes. A horizontal furnace-top s extends from the top of the rear wall d of the furnace to the rear side of the shell of the evaporator G, there being a combustiom-chamber formed under the top s between the evaporator and the rear furnace-wall communicating with the heat-passage that extends over the evaporator to the upper side of the top s, from whence the gases of combustion may escape from the furnace structure. Any suitable provision may be made for forcing feed-water into the lower chamber n of the water-head F. A steam-pipe connection I is attached to the water-head F for the delivery of the steam from the steam-chamber n', and a safety-valve J is mounted on the water-head F'.

The feed-water heater is arranged behind the furnace structure as a continuation thereof and includes a draft-duc extending from the heat-passage of the furnace to the chimney, which may be located in any desired convenient place, and the draft-duct may be of any desired length and may extend in generally horizontal, inclined, or vertical direction to the chimney, as may be desired.

In the preferred form of construction and arrangement a pair of water-heads K and K' are provided as walls for the draft-duct and mounted on suitable foundations and are joined to the water-heads F and F' or may be constructed as parts thereof with partitions x and y between them, the partition y having an opening 7 therein for the passage of feed-water into the chamber n, and the draft-duct is arranged between the two water-heads K and K, with a passage 8 thereto formed above the rear wall d, communicating with the heat-passage that is above the shell of the evaporator G. The water-heads K and K' may be of any suitable height, and, as shown specifically, the water-head K has two vertical transverse partitions 9 and 10, thus forming three chambers 12, 13, and 14, the water-head K' having one similar partition 11 arranged in a plane between the partitions 9 and 10, forming two chambers 15 and 16.

A floor 17 and a roof 18, extending between the water-heads K and K', form the bottom and the top, respectively, of the draft-duct, the end structure of which is formed by a wall 19.

A feed-pipe L is connected with the chamber 12 (preferably at the top thereof) of the water-head K.

A baffle-wall M' extends from the floor 17 upwardly a suitable distance across the draft-duct opposite to the partition 11, and two similar walls M and M^2 extend downwardly suitable distances from the roof 18 across the draft-duct opposite to the partitions 9 and 10, so that the draft-current is caused to deviate from a direct course, passing under and over alternate walls.

A multiplicity of water-tubes are arranged to form several series of circulating-ducts between the water-heads K and K', being connected thereto and extending across within the draft-duct, there being a series of ducts N connecting with the chamber 12 and the chamber 15, a series N' connecting with the chamber 15 and the chamber 13, a series N^3 connecting with the chamber 13 and the chamber 16, and another series N^2 connecting with the chamber 16 and the chamber 14, the several series of ducts being separated partially by the baffle-walls. There may be additional series of circulating-tubes arranged above the series N' or N^3, if desired.

A pair of flues P and P′ have connection with the draft-duct and discharge into a smoke-box Q, to which is attached a chimney connection R.

Such inclosing walls are employed as are suitable to the purpose of the invention.

Various modifications may be made fairly within the scope of the invention with respect to the grate-surface and other details of construction. Also any suitable number and size of evaporators may be provided, the single one serving to illustrate the invention, and the rear furnace-wall may have a part thereof inclined at various degrees of angularity to suit various dimensions of furnaces and capacities of evaporators.

In practical use, having supplied the feed-water heater and the evaporator with a suitable quantity of water, which may be indicated by suitable gages, a fire may be started in the furnace, and the smoke and heat will pass from the fire through the heat-passage under and about the evaporator G and thence through the draft-duct among the series of circulating-tubes to the chimney, as indicated by arrows in Fig. 3, the shallow body of water that may be on the bottom of the evaporator-shell beneath the water-divider H being rapidly heated to the boiling-point and converted into steam, which will rise at the sides of the water-divider into the upper portions of the evaporator-shell and the water-head F′, and thence pass through the superheating-tubes *q* into the steam-chamber *n′* to be utilized for such purpose as may be desired. When the fire begins to generate heat, the projections *f* and *i* on the faces of the furnace-walls and arches will become heated in advance of the bodies of the bricks and will therefore early begin to radiate the heat and at all times will afford augmented radiating-surface. The projections *i* under the arches will cause the hot gases and smoke to roll and mix in their passage to the combustion-chamber and heat-passage, thereby aiding combustion, and this result will be contributed to by the projections *f* on the rear wall *d* of the furnace. The curved inclined wall *m* will become heated and reflect the heat toward the under side of the evaporator, while causing the flames to pass close to the evaporator. After the heat-current produces the steam it passes at high temperature under the superheating-tubes with beneficial results and gradually imparts its heat to the feed-water, which circulates to and fro across the path of the heat-current, so that the resultant heat from the fuel may be utilized to the fullest extent.

The course of the water circulation from the supply-pipe L to the evaporator G is indicated by arrows in Figs. 2, 4, 5, and 6, and it will be apparent that the feed-water may be but slightly heated on its entrance to the primary heater, but will increase in temperature rapidly in its circulation through the hotter gases nearer to the evaporator, so that the water may be heated to the boiling-point as rapidly as it enters the evaporator, thus requiring the minimum degree of initial heat in producing the steam, with consequent economy in fuel.

Having thus described the invention, what is claimed as new is—

1. A steam-producer including a furnace comprising a front wall, a rear wall, a pair of opposing side walls, an arch extending from the front wall nearly but not entirely to the rear wall, an upwardly-inclined wall extending from the inner end of the arch toward the front wall, and an evaporator extending longitudinally near the rear wall and the curved wall and spaced therefrom to form a combustion-chamber and also a passage-way for the products of combustion.

2. A steam-producer including a furnace comprising a front wall, a rear wall having an inclined part, an arch extending from the front wall toward but not to the inclined part of the rear wall, opposing side walls, an inclined curved wall extending from the inner end of the arch upwardly toward the front wall, and an evaporator arranged adjacent to the curved wall partially above the inclined part of the rear wall and spaced therefrom to form a passage-way for the products of combustion.

3. A steam-producer including a furnace comprising a front wall, opposing side walls, a rear wall having an inclined part provided with a lining composed of bricks having each a body portion projecting beyond side portions thereof, an arch extending from the front wall toward the inclined part of the rear wall, an inclined curved wall extending from the inner end of the arch upwardly toward the front wall, and an evaporator arranged opposite to the curved wall and spaced therefrom to form a passage-way for the products of combustion.

4. A steam-producer including a furnace comprising a front wall, a rear wall, side walls a plurality of arches extending from the front wall toward but not to the rear wall, supports for the arches, an inclined wall having a concave upper surface and extending from the inner ends of the arches upwardly toward the front wall, an evaporator arranged opposite to and spaced from the concave surface of the inclined wall to form a passage-way for the products of combustion, a furnace-top extending from the rear wall to the evaporator and therewith forming a combustion-chamber, and a roof-wall extending from the inclined wall above and over the evaporator and spaced from the evaporator to form a passage-way for the products of combustion.

5. A steam-producer including a furnace comprising a front wall, a rear wall, side walls, a plurality of arches extending from

the front wall toward but not to the rear wall, a support inclosed by the walls collectively supporting an end of each one of the arches, an inclined wall extending from the inner end portions of the arches upwardly toward the front wall, and an evaporator arranged opposite to the inclined wall and spaced therefrom to form a passage-way for the products of combustion.

6. A steam-producer including a furnace comprising a front wall, a rear wall, side walls having linings composed of bricks having each a projecting body portion extending beyond side portions thereof, an arch extending from the front wall nearly but not entirely to the rear wall, an evaporator extending longitudinally opposite to the rear wall and the end of the arch and spaced therefrom to form a combustion-chamber, a wall extending from the end portion of the arch and curved concavely on its top toward the front wall and spaced from the evaporator to form a passage-way from the combustion-chamber for the products of combustion, and a roof-wall extending from the rear wall to the evaporator forming with the evaporator the top of the combustion-chamber.

7. A steam-producer including a furnace comprising a front wall, side walls, a plurality of arches extending from the front wall toward but not to the rear wall and having projections on the under side thereof, certain of said arches being partially supported by the side walls, a partition-wall partially supporting said arches, an inclined wall extending from the inner end portions of said arches upwardly toward the front wall, and an evaporator arranged opposite to and spaced from the inclined wall to form a passage-way for the products of combustion.

8. A steam-producer including a furnace comprising a front wall, side walls, a rear wall having a lining composed of bricks having each a projecting body portion extending beyond side portions thereof, an arch extending from the front wall toward but not to the lining of the rear wall, an evaporator extending longitudinally opposite to the rear wall and the end of the arch and spaced therefrom to form a combustion-chamber, and an inclined wall extending from the end portion of the arch opposite to the evaporator toward the front wall and spaced from the evaporator to form a passage-way for the products of combustion.

9. A steam-producer including a furnace comprising a front wall, a rear wall, side walls, an arch extending from the front wall toward but not to the rear wall and composed of bricks having projecting body portions extending beyond side portions thereof, an evaporator extending longitudinally opposite to the rear wall and spaced therefrom to form a combustion-chamber, and an inclined wall extending from the inner end portion of the arch upwardly toward the front wall and spaced from the evaporator to form a passage-way for the products of combustion.

10. A steam-producer including a furnace comprising a front wall, a rear wall, side walls, a plurality of arches extending from the front wall toward but not to the rear wall, certain of the arches being partially supported by the side walls, a partition-wall partially supporting said arches and having projections on the faces thereof, an inclined wall extending from the inner end portions of said arches upwardly toward the front wall, and an evaporator arranged opposite to and spaced from the inclined wall to form a passage-way for the products of combustion.

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

ISAAC H. BOYER.

Witnesses:
HARRY D. PIERSON,
E. T. SILVIUS.