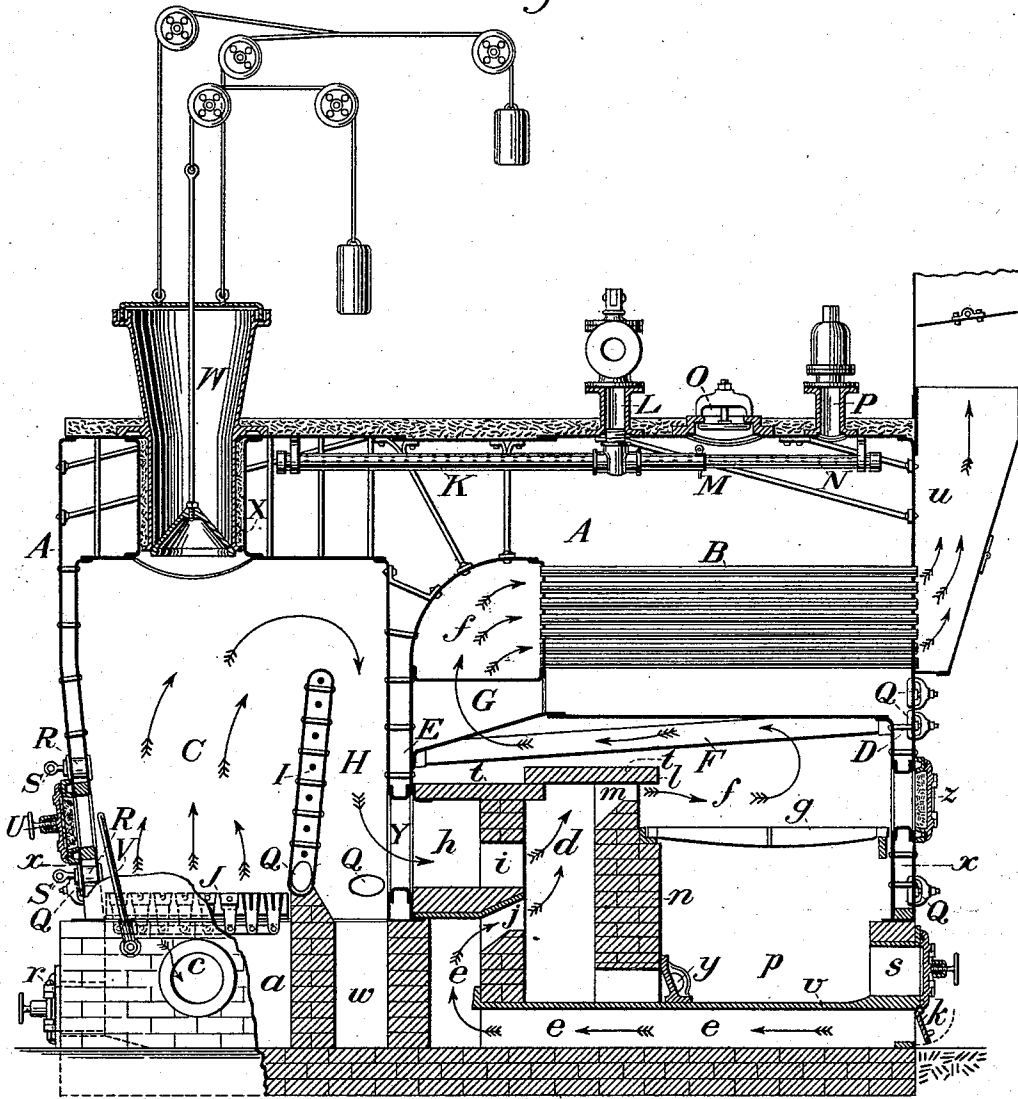


G. E. BELMOR.
STEAM BOILER FURNACE.

No. 524,128.

Patented Aug. 7, 1894.

Fig. 1.



Witnesses:

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Wilson D. Best, Jr.

Inventor:

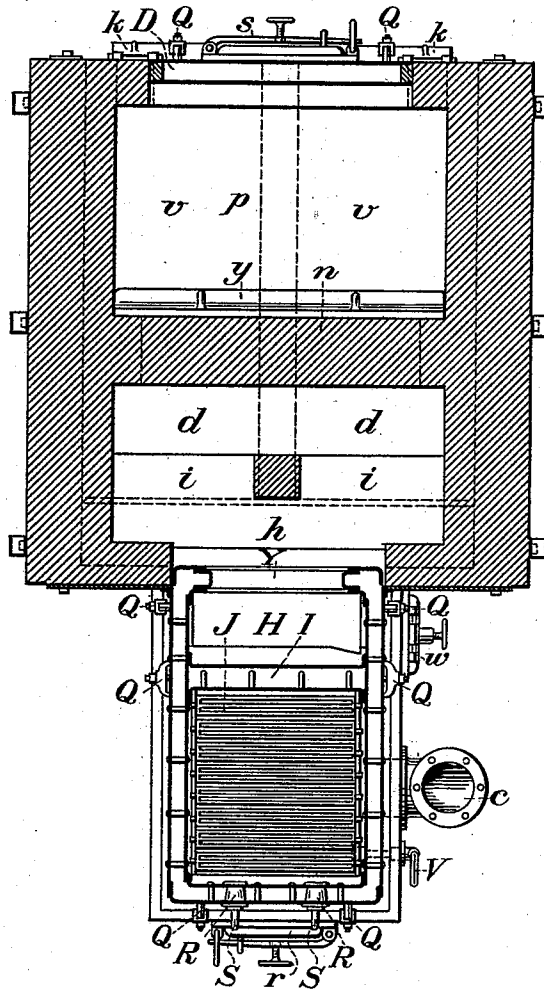
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Fig. 2.



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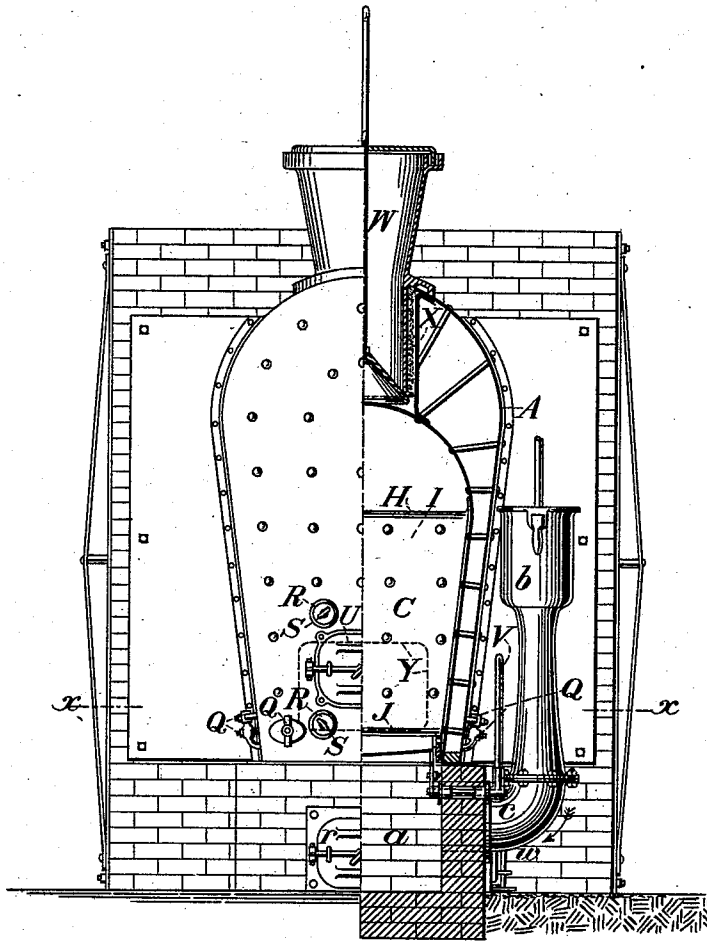
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Fig. 3.



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UNITED STATES PATENT OFFICE.

GEORGE E. BELMOR, OF SAN FRANCISCO, CALIFORNIA.

STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 524,128, dated August 7, 1894.

Application filed April 21, 1893. Serial No. 471,299. (No model.)

To all whom it may concern:

Be it known that I, GEORGE E. BELMOR, a citizen of the United States residing in the city and county of San Francisco and State of California, have invented certain new and useful Improvements in Steam-Boiler Furnaces, of which the following is a specification, reference being had to the drawings accompanying and forming a part of the same.

My invention relates to combined gas producing and steam generating boilers having a gas-producing chamber inclosed in the shell or body, and a fire chamber, or furnace, in which the gases discharged from the producing chamber are burned by contact with additional air, so as to impart heat to the water contained in the said shell. Thereby constituting the gas generating and combining elements an integral part of the steam generator, thus securing a wider adaptation to various purposes, including what are called portable boilers, and those employed for locomotion. The principal features of a steam generator of this class are embodied in my application for Letters Patent filed March 11, 1891, and serially numbered 384,523.

The invention set forth in the present specification comprises various alterations of form, and the addition of certain parts, which I have found by experiment to be advantageous.

The new combinations herein claimed therefore constitute an improvement upon those embraced in the application already referred to.

The main objects of the improvements herein set forth are: to improve the construction of the gas producer so as to make a more compact fire bed, and so as to prevent losses of heat by radiation from the gases in the upper part of the producing chamber and while in transit to the furnace; and to attain more perfect combustion of the gases, by providing a fire-brick combining chamber beneath the boiler, and means of regulating and pre-heating the supply of air to the furnace. The means by which I attain these objects are illustrated by the accompanying drawings.

Figure 1 is a central longitudinal vertical section of a steam generator embodying my recent improvements. Fig. 2 is a horizontal section through the furnace on the line $x-x$

(Fig. 1), and Fig. 3 is a combination of a front elevation and a cross section through the gas-producer.

The same letters indicate the same parts in all the views.

A (Fig. 1) indicates the main shell, or body, of the boiler, which is of cylindrical form, and fitted with horizontal fire tubes B. At the front end is situated the gas-producing chamber C, inclosed in a double shell forming part of the water space of the boiler. At the rear end is a vertical water-leg D, formed by a downward extension of the shell, this water-leg being connected to the water space E, at the rear of the gas-producing chamber, by the inclined circulating tubes F. A large circulating tube G also connects the water space E with the lower part of the main shell A.

The general features of the boiler, in so far as they have now been described, are covered by my application for Letters Patent filed March 11, 1891, and before referred to.

The main features of improvement in the boiler proper, as distinguished from the setting, consists,—first, in reducing the height of the gas-producing chamber, and inclosing it at the top in the water space of the boiler, thus diminishing the loss of heat by radiation; second, in abolishing the external iron flues formerly used to conduct the gases from the producing chamber to the furnace, which were subject to considerable losses of heat by radiation and convection, and substituting for them the interior passage H, traversing the water-shell of the boiler, and separated from the fire-box of the producer by the water bridge I, thus effecting a further saving of heat; third, in gradually drawing in the sides of the fire-box toward the bottom, so as to reduce the area of the grate J, and, by means of the tapering form, to cause the bed of fuel to become more compact as it works downward. This form of fire-box I have found improves the quality of the gas, by preventing the passage of an excessive volume of air through the fuel bed. The gas passage H communicates with the passage h through an opening Y in the water-leg E.

Another improvement in the boiler consists in suppressing the steam dome, illus-

trated in the drawings accompanying my former application, Serial No. 384,523, and substituting the perforated "dry-pipe" K connected to the main steam pipe L. The dry-pipe is made with a telescope joint at M, so that the piece N may be pushed aside to facilitate entrance to the interior of the boiler through the man hole O. I prefer generally to attach to the shell of the boiler an additional steam nozzle P, unconnected with the dry-pipe for the accommodation of a safety valve.

Hand holes, Q are provided at convenient points, so that all parts of the interior of the boiler are accessible for inspection and cleaning; and a number of holes, R, through the water-space forming the front of the producing chamber, allow inspection of the fire, and the introduction of an iron bar for stirring the fuel bed. When not in use, these holes may be closed with stoppers, S.

The door U permits access to the interior of the fire-box, and is used in kindling the fire, and in cleaning the grate. The grate bars J may be of any suitable type, but are preferably arranged as shown so that they may be given a rocking motion by means of a handle V, in order to discharge the ashes and clinkers into the ash-pit, *a*.

The blast for the gas producer is preferably supplied by a steam-jet blower, *b*, (Fig. 3) and enters the ash-pit through the side opening *c*.

The charging hopper, W, which is similar in its operation to those generally applied to gas producers, is preferably surrounded, where it passes through the steam space of the boiler, with a layer of non-conducting material X, such as asbestos, in order to prevent any chilling of the steam when a fresh charge of fuel is introduced.

My improvements in the setting of the boiler consist chiefly in providing devices for regulating and preheating the supply of air to the gas-burning furnace, and a chamber or passage, *d*, with walls of fire-brick or like refractory material, between the gas-producing chamber C and the flame chamber, or passage, *f f*. In this chamber *d*, which I call the combining chamber, the stream of gas entering from the passage *h*, meets and mingles with the air which enters through the passage *e*, and is thoroughly ignited before being cooled by contact with the boiler shell. By this means I am able to secure practically perfect combustion.

The ports *i* and *j* through which the streams of gas and air enter the combining chamber *d*, are preferably, though not necessarily, placed close together, and so arranged that the streams issue from them in the same direction, as shown. The gas, being propelled by the blower *b*, thus tends to assist the chimney draft in inducing a current in the passage *e*. The quantity of air supplied may be regulated by a damper at *k*, or equivalent

means, and where the natural draft is insufficient, a blower may be employed.

In the rear part of the furnace, I generally set an auxiliary grate *g*, with a firing-door Z in the rear water-leg of the boiler, and an ash-pit *p* separated from the combining chamber by the bridge-wall *n*. This grate is not used during the ordinary continuous operation of the boiler, but a fire may be kindled upon it if desired in order to assist in raising steam quickly at starting, or in case it is required to empty the fire chamber of the producer C for inspection and cleaning without stopping the operation of the boiler.

At *m* is a slit, or row of ports, preferably extending across the entire width of the furnace, through which the gas flame issues over the top of the bridge wall into the flame passage *f f*.

The combining chamber *d* and passage *h* are covered with tiles, *t*, the upper layer of which may be made to overhang more or less beyond the face of the bridge wall at *l*, forming a ledge, or shelf, by which the flame is projected farther into the fire chamber.

After entering the passage *f f*, the flame and hot gases return under the main shell of the boiler, pass upward around the water-tube G, and traverse the fire-tubes B to the uptake or smoke-flue *u*. The course of the air and gases is indicated by the arrows in Fig. 1.

I prefer to make the partition *v*, separating the air passage *e* from the ash-pit *p* and combining chamber *d*, of iron, in order that the downward radiated heat from the furnace may be readily taken up by the inflowing air. Such preheating of the air I have found to improve the working of the furnace by causing a more perfect combustion of the gas. If the iron plate tends to become overheated, it may be protected by a covering of tile.

Doors *r*, and *s*, are provided for access to the ash-pits *a* and *p* respectively, a door *w* permits access to the passage H, and a door *y* to the combining chamber *d*, from the ash-pit *p*.

The drawings show what I consider generally the most advantageous arrangement of the passage *e* for introducing air to the combining chamber; but I do not limit myself to the special arrangement of air passages here shown. When it is more convenient, the air may be admitted to the chamber *d* through the side walls, or from the front, by a conduit passing under the ash-pit *a*, or it may be admitted partly or wholly from the ash-pit *a*, by a suitable passage leading from the latter to a port, as *j*, in the wall of the combining chamber *d*.

The combination of devices herein described has been referred to as a steam generator, but it is obvious that it may be applied to the heating of water or other non-corrosive liquids for any purpose, and to temperatures either above or below the boiling point. It is also obvious that while the de-

scriptions here given are for greater simplicity confined to stationary boilers mounted in masonry, the same methods and apparatus can with slight modification be applied to what are called portable boilers or those employed for locomotion on land or water.

Without confining my claims strictly to the details of construction shown and described, what I now desire to claim as my invention, and to secure by Letters Patent, is—

1. In a steam boiler and furnace, a gas producing chamber, formed within and integral with the boiler, three sides of which extend to and join the crown sheet, the fourth side terminating below the crown sheet, leaving a passage for the gases from the top of the gas-producing chamber and providing a down-take flue behind the furnace, all sides of which except the escape passage, are surrounded by water, in the manner substantially as and for the purpose specified.

2. In a steam boiler and furnace, a gas-producing chamber formed within and integral with the boiler, the sides inclined to produce a hopper form, three sides completely surrounded by the water space of the boiler and extending to the crown sheet, the fourth or inner side of the furnace terminating below the crown sheet to leave a passage for gas over the top, having a double wall with a water space to provide a down-take flue behind the gas-producing furnace, in the manner, substantially as described.

3. In a steam boiler and furnace, a gas-producing chamber formed integrally therewith, and except the grates or the bottom thereof and a gas escape passage, inclosed in and surrounded by the water space of the boiler, a grate and air passage beneath and a closed fuel inlet at the top, a gas passage beneath the crown sheet and downtake passage between the gas-producing furnace and the main boiler shell, combined and arranged in the manner substantially as shown and described.

4. In a steam boiler furnace, a gas-producing chamber surrounded by the water shell of the main boiler, a combining and combustion chamber, having walls of refractory material that may become incandescent under the heat of the flame, passages for gas and air leading into this chamber from the gas-producing compartment and the atmosphere respectively, also flame passages by which the flame and hot gas issuing from the combining chamber are conducted to the heating surfaces of the boiler, substantially in the manner and for the purposes described.

5. In a steam boiler furnace an inclosed gas-producing chamber, a combining chamber lined with refractory material, in which the gases formed in the producing chamber are ignited by admixture of air before coming in contact with the heating surface of the boiler, in combination with an interior gas conduit passing through the water shell of the boiler, and connecting the producing and combining

chambers, substantially as herein set forth and described.

6. In a steam boiler furnace, an interior gas-producing chamber surrounded by water spaces, a combining chamber or passage lined with refractory material in which the gas is ignited before traversing the heating surfaces of the flues and main shell of the boiler, an internal gas conduit passing through the water shell of the boiler, for conducting the gas from the gas-producing chamber to the combining chamber, an air passage provided with a damper or other regulating device for admitting air to the combining chamber, substantially as set forth and for the purposes specified.

7. In a steam boiler furnace, the combination of a gas producing chamber surrounded by a double shell, including part of the water space of the boiler, a grate or grate space beneath the boiler at the end opposite to the gas-producing chamber, a combining chamber, composed of or lined with fire brick, tile or other like material between the said grate space and the gas-producing chamber, one or more flame outlets connecting said combining chamber with the space above the grate, a gas conducting passage leading from the upper part of the producing chamber to the combining chamber, and one or more ports or passages for the admission of air to the combining chamber, substantially as set forth.

8. In a steam boiler furnace, the combination of a gas-producing chamber surrounded by the water space of the boiler, an auxiliary furnace situated at the end of the boiler opposite the gas producer, and adapted to contain a grate, a combining chamber of refractory material between said auxiliary furnace and the gas-producer, flame ports or passages connecting said combining chamber with the space above the grate, a gas-conducting passage connecting the producing and combining chambers, and an air-conducting passage, provided with a damper or other controlling device, connecting the combining chamber and the atmosphere, substantially as described.

9. In a steam boiler furnace, the combination of a gas-producing chamber surrounded by water spaces, and a gas burning furnace in which the gases discharged from the producing chamber are burned by contact with additional air, of an air admission passage traversing said furnace and separated therefrom by a partition of iron, whereby the air admitted for combustion of the gas is preheated, substantially as set forth.

In testimony whereof I have hereunto affixed my signature in the presence of two witnesses.

GEORGE E. BELMOR.

Witnesses:

A. J. TREAT,
CH. S. HERMANN.