

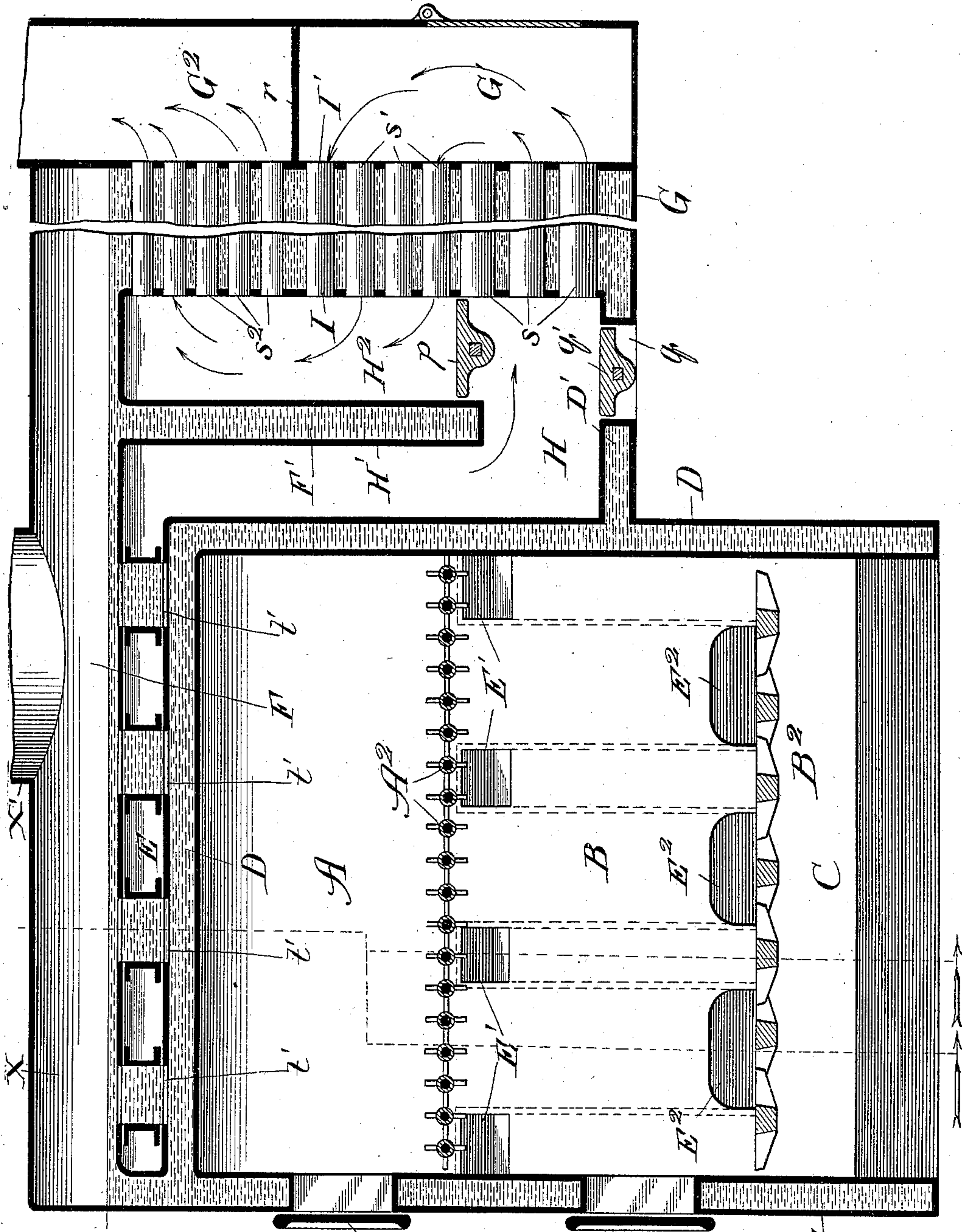
(No Model.)

2 Sheets—Sheet 1.

R. H. LAIRD.
BOILER FURNACE.

No. 540,393.

Patented June 4, 1895.



Witnesses:
E. S. Hayward,
Lute J. Allen

Fig. 1.

Inventor.
Robert H. Laird
By Dyrnforth & Dyrnforth,
Attys.

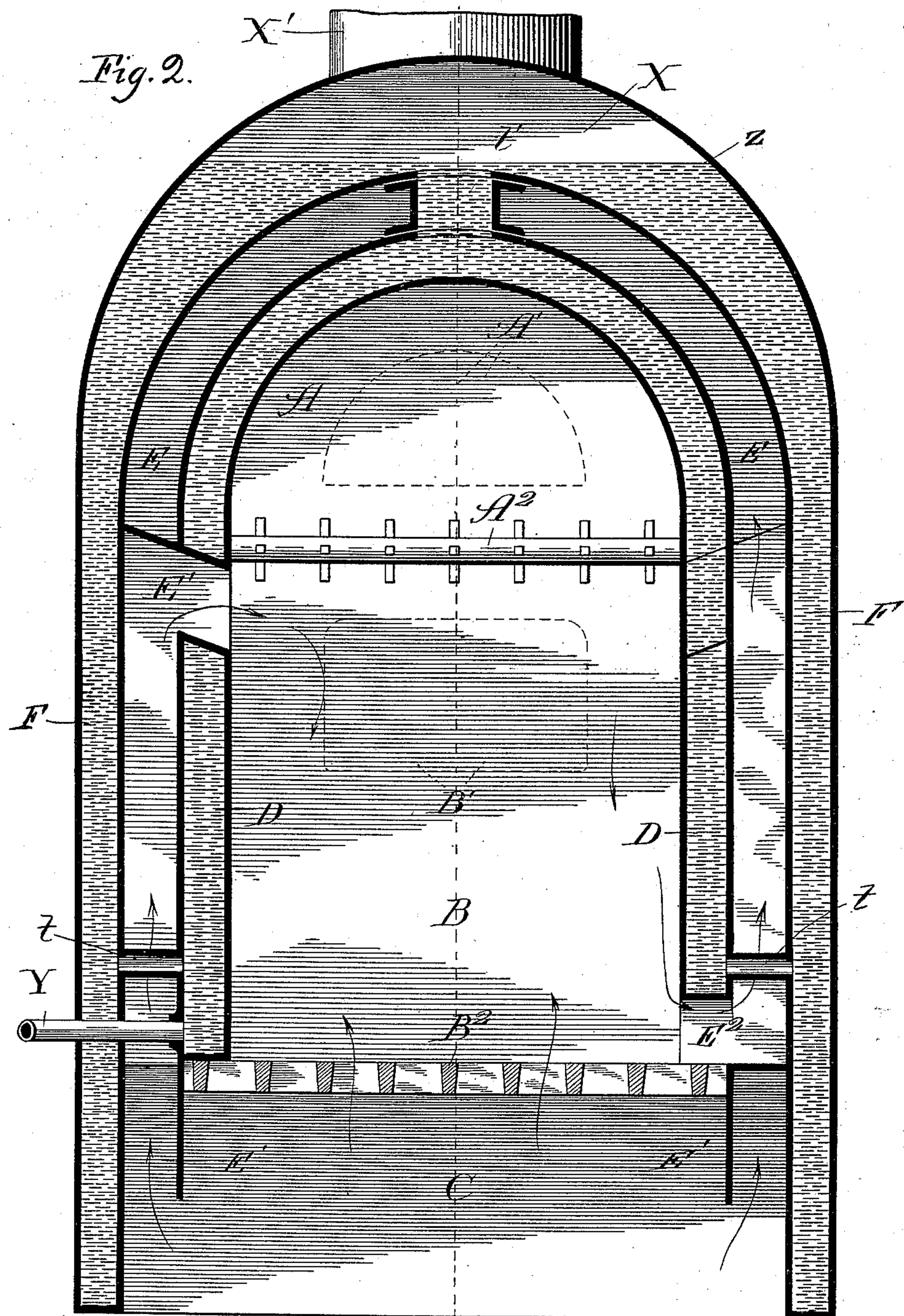
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2 Sheets—Sheet 2.

R. H. LAIRD.
BOILER FURNACE.

No. 540,393.

Patented June 4, 1895.



Witnesses:
Wm. E. Gaylord,
Lucas J. Allen.

Inventor:
Robert H. Laird.
By *Dyrenfuch & Dyrenfuch,*
Attys.

UNITED STATES PATENT OFFICE.

ROBERT H. LAIRD, OF CHICAGO, ILLINOIS.

BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 540,393, dated June 4, 1895.

Application filed July 3, 1894. Serial No. 516,476. (No model.)

To all whom it may concern:

Be it known that I, ROBERT H. LAIRD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Boiler-Furnaces, of which the following is a specification.

My invention relates to improvements in water heaters generally, though more particularly to improvements in boiler furnaces of the class designed more especially for generating steam in large quantities and at high pressure; and my object in the latter connection is to improve the construction of such boiler furnaces to the end of giving to the boiler comparatively great capacity for steam generation, and so utilizing the heat from the furnace that particular economy will result in the amount of fuel necessary for the generation of a given quantity of steam.

In the drawings, which illustrate a locomotive furnace and boiler constructed in accordance with my improvements, Figure 1 is a broken vertical and longitudinal section on line 1 of Fig. 2, and Fig. 2 a broken section on lines 2 2 of Fig. 1.

A is an upper retort or coking chamber provided with a feed door A' and a dumping grate A². B is a lower combustion chamber provided with a door B' and a grate B²; and C an ash pit. Extending over the top, sides and back of the combustion and coking chambers is a chamber or water jacket D. Extending over the top and sides of the water jacket D is a chamber or flue E; and over the front, sides and top of the chamber or flue E is a chamber F more highly arched than the other chambers to afford a steam space X, and surmounted by a steam-dome X'. In the chamber E are flues E' extending from the ash pit C to the level of the top of the lower combustion chamber B, whence they pass through the water jacket D to the chamber B just below the upper grate bars A². Just above the lower grate bars B² are flues E² which extend between the combustion chamber B and chamber E through the water jacket. Extending between the water jacket or chamber D and chamber F, a little above the plane of the lower grate bars B² are circulating flues t t; and circulating flues t' extend between

the chambers D and F, through the chamber E, at the top. The outer water jacket or chamber F is open to the boiler G.

H is a flue chamber with which the chamber or flue E communicates throughout its entire end area above the tops of the flues E', and extending downward in the chamber H is a hollow diaphragm H' containing a water chamber F' which communicates at its upper side with the chamber F.

I is the rear tube-sheet of the boiler, and I' the front tube-sheet, between which extend three series of flues s, s' and s², respectively. The tubes of the lower series s are comparatively large, say four inches in diameter. The tubes of the central series s' are preferably somewhat smaller, say three inches in diameter; and the tubes of the top series s² may be still smaller, say two and one-half inches in diameter.

In front of the tube-sheet I' is a lower smoke-box or chamber G' to which extend the flues s s', and above the chamber G', and divided from the latter by a diaphragm r, is an upper smoke-box or chamber G² to which extend the flues s² only. At the base of the chamber H is an opening q provided with a damper q'. Around the sides and lower part of the chamber H is a water jacket D', which at one end, opens into the water jacket D, and at its opposite end into the boiler. The opening q extends through the water jacket. Between the diaphragm H' and tube-sheet I is a damper p, at about the plane of the lower end of the diaphragm, and the plane of division between the series, s and s', of tubes. The smoke-box G² communicates with the smoke-stack. Not shown.

Extending across the chambers F E to the chamber or water jacket D is a feed pipe Y. The pipe Y may be the feed pipe for the boiler and extends from the water-tank, on the locomotive tender; a suitable injector being interposed in the pipe. The water jackets D and F and the boiler are filled and maintained filled with water up to the water-line z, which is above the tops of the chamber E and boiler tubes s². Initially, the fire is built upon the grate bars B², and when the combustion chambers become heated to a high degree all further feeding of fuel is done through the upper

door A', the fuel being spread upon the upper grates A² and coked before it is dumped upon the lower grate.

The upper chamber is not only a preparatory chamber for heating the fuel before it is introduced into the lower combustion chamber, but it is a retort chamber into which no air is admitted to support combustion, so that the heat from the lower chamber distills gas from the coal on the upper grate, the gas of distillation passing through the upper grate bars to the chamber B. The fuel therefore that is dumped upon the lower grate is more or less coked.

In practice air to supply combustion enters through the grate bars B² and through the flues E'. The air passing through the flues E' mingles with the gases from the chamber A which pass down through the fuel on the grate A² to the chamber B. The gases as they descend into the chamber B and are carried down by the air current from the flues E' are subjected to the heat in the latter chamber, whereby substantially complete combustion of the gases is effected. From the chamber B the products of combustion pass through the flues E² to the chamber E and pass thence to the combustion chamber H. The diaphragm H' deflects the products of combustion downward and cause them to pass below the damper p, and through the lower series s of tubes to the smoke-box G', whence they pass through the return tubes s' to the part H² of the chamber H, and thence through the tubes s² to the smoke-box G² and out at the smoke-stack. The heat of the combustion chambers exerts itself directly upon the water in the chamber D, and the heat of the hot products of combustion passing through the chamber E is exerted against the chambers D and F. In passing to the chamber H the products of combustion exert their heat upon the outer surface of the water jacket D; upon the water in the diaphragm chamber F' and in the water jacket D'; and, in passing through the tubes s, returning through the tubes s', and passing again through the tubes s², approximately all the heat of the products of combustion is absorbed and utilized in heating the surrounding water. As the water in the chamber D is heated it rises through the flues t', water from the chamber F entering the chamber D through the flues t, whereby continued circulation is kept up.

The products of combustion in passing from the chamber H through the lower tubes s lose a certain proportion of their heat and become contracted in volume, and they are still further contracted in passing through the second series of tubes s'. Therefore by providing tubes s' of proportionately smaller diameter than the tubes s and tubes s² of still smaller diameter, an even draft is maintained through the flues. Live cinders which are light enough to be carried through the tubes by the draft will, owing to the distance of their travel be

entirely consumed, or lose their incandescence before reaching the chimney.

In my improved construction substantially all the available heating space is utilized in making steam, and as all the walls with which the products of combustion come into contact are surrounded by water, the danger of injury to the metal, forming the walls, from the heat is reduced to the minimum. By feeding the furnace at the upper chamber the cooling influence of fresh fuel upon the main fire bed B² is avoided; and in the down draft of the more volatile gases substantially perfect combustion of the fuel is attained.

At suitable places, as at the base of the chamber F on opposite sides, and at the base of the chamber F', draw-off cocks may be provided for draining out sediment when desired. The draw-off cocks may be of any suitable form usually provided for this purpose on other boilers.

Though my invention, as illustrated, is intended for use in connection with boiler-furnaces adapted to generate steam at high pressure, it may be employed in connection with steam-heating systems, where steam is generated at low pressure, or in connection with hot-water heating systems. In either case the structure is adapted to economize in fuel by utilizing the heat therefrom to an extent beyond the capacity of furnaces hitherto constructed for the same purpose.

While I prefer to construct my improvements as shown and described, they may be modified in the matter of details without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a boiler furnace, the combination of a combustion chamber B provided at its lower side with a grate B², an inner, water-jacket D extending over the top and sides of the chamber B, a flue chamber E extending over the top and sides of the inner water-jacket, outlet flues E² extending between the lower parts of the chambers B and E, air inlet flues in the chamber E extending from below the grate B² and opening into the chamber B toward the top thereof, an outer water-jacket F, extending over the sides and top of the chamber E, and circulating flues t t' extending between the said outer and inner water-jackets toward the lower and upper parts of the latter, all constructed and arranged to operate substantially as described.

2. In a boiler-furnace, the combination with the combustion-chamber of a chamber H, a flue extending from the combustion chamber to the chamber H, a chamber H², a separating wall between the chambers H and H², chambers G' and G², a dividing-wall between the chambers G' and G², a boiler extending between the chambers H H² and the chambers G' G², provided with a lower series of tubes s extending between the chambers H and G', an

intermediate series of return-tubes s' , of smaller diameter than the tubes s , extending between the chambers G' and H^2 , and an upper series of tubes s^2 of smaller diameter than the tubes s' , extending between the chambers H^2 and G^2 , substantially as described.

3. In a heater or boiler-furnace, the combination of a combustion chamber, an inner water-jacket D extending over said chamber, a flue E extending from said chamber around the inner water-jacket, a chamber H with which the flue E communicates, a boiler G , having tubes extending between the chamber H and a chamber G' , between the chamber G' and a chamber H^2 and between the chamber H^2 and a chamber G^2 , an outer water-jacket extending over the flue E and chambers H H^2 and communicating with the boiler G , and circulating conduits between the inner and outer water-jackets, substantially as described.

4. In a heater or boiler-furnace, the combination of an upper coking chamber A having

a feed door, a lower combustion chamber B , a dumping-grate between said chambers, an inner water-jacket D extending over said chambers, a flue E extending from the said lower chamber around the inner water-jacket, a chamber H to which the flue E extends, a boiler, G , having tubes s , extending from the chamber H to a chamber G' , tubes s' extending from the chamber G' to a chamber H^2 , and tubes s^2 extending from the chamber H^2 to a chamber G^2 , an outer water-jacket extending over the flue E and chambers H H^2 and communicating with the boiler G , a hollow diaphragm H' , having a water chamber F' , between the chambers H and H^2 , and circulating conduits between the inner and outer water-jackets, substantially as described.

ROBERT H. LAIRD.

In presence of—

M. J. FROST,
J. N. HANSON.