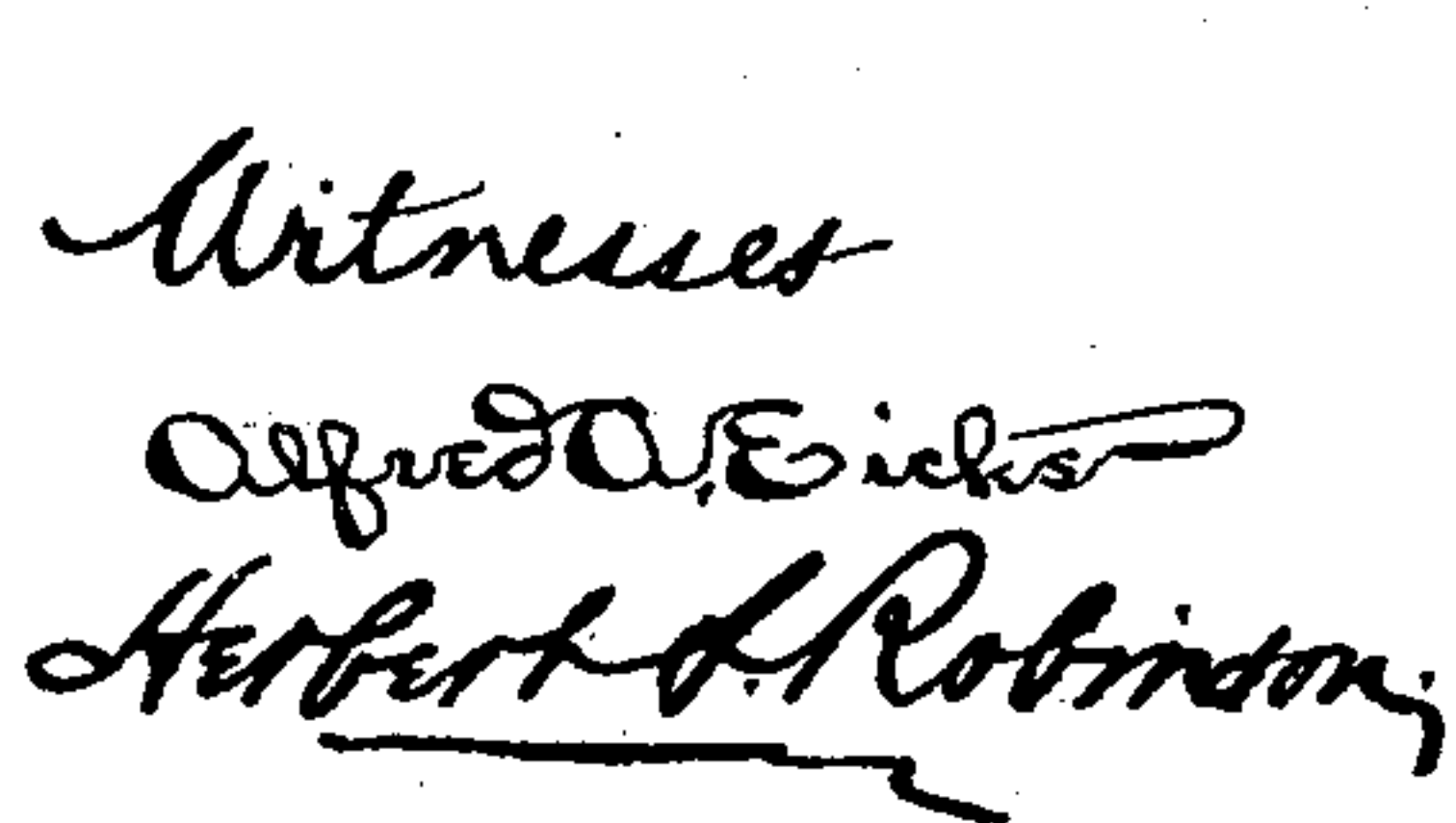


3 Sheets—Sheet 1.

No. 518,160.

Patented Apr. 10, 1894.



Inventor,
William S. Plummer,
By Higdon Higdon Longau, *Attys*

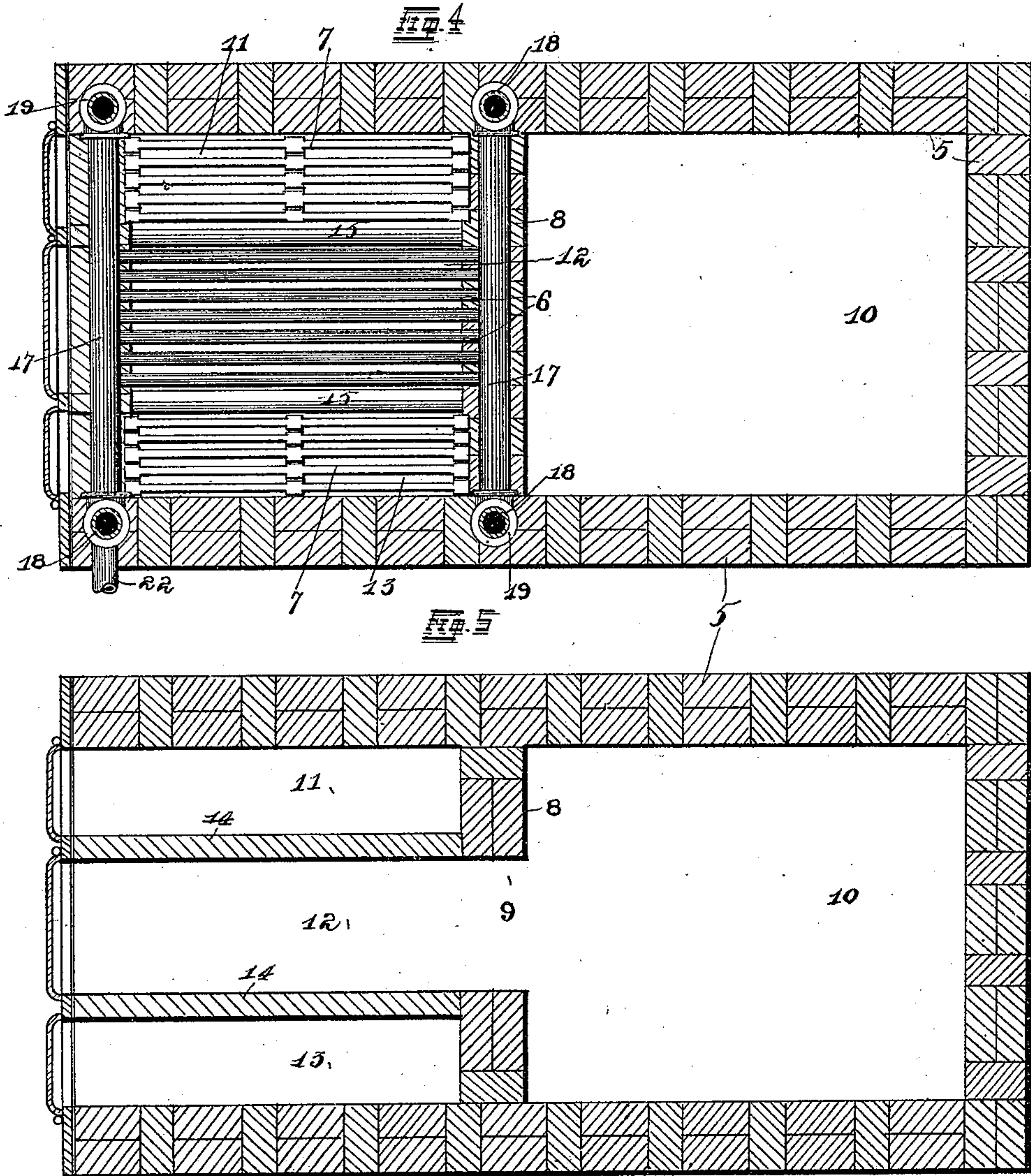
(No Model.)

3 Sheets—Sheet 2.

W. S. PLUMMER.
SMOKELESS BOILER FURNACE.

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Witnesses

Alfred A. Eicher

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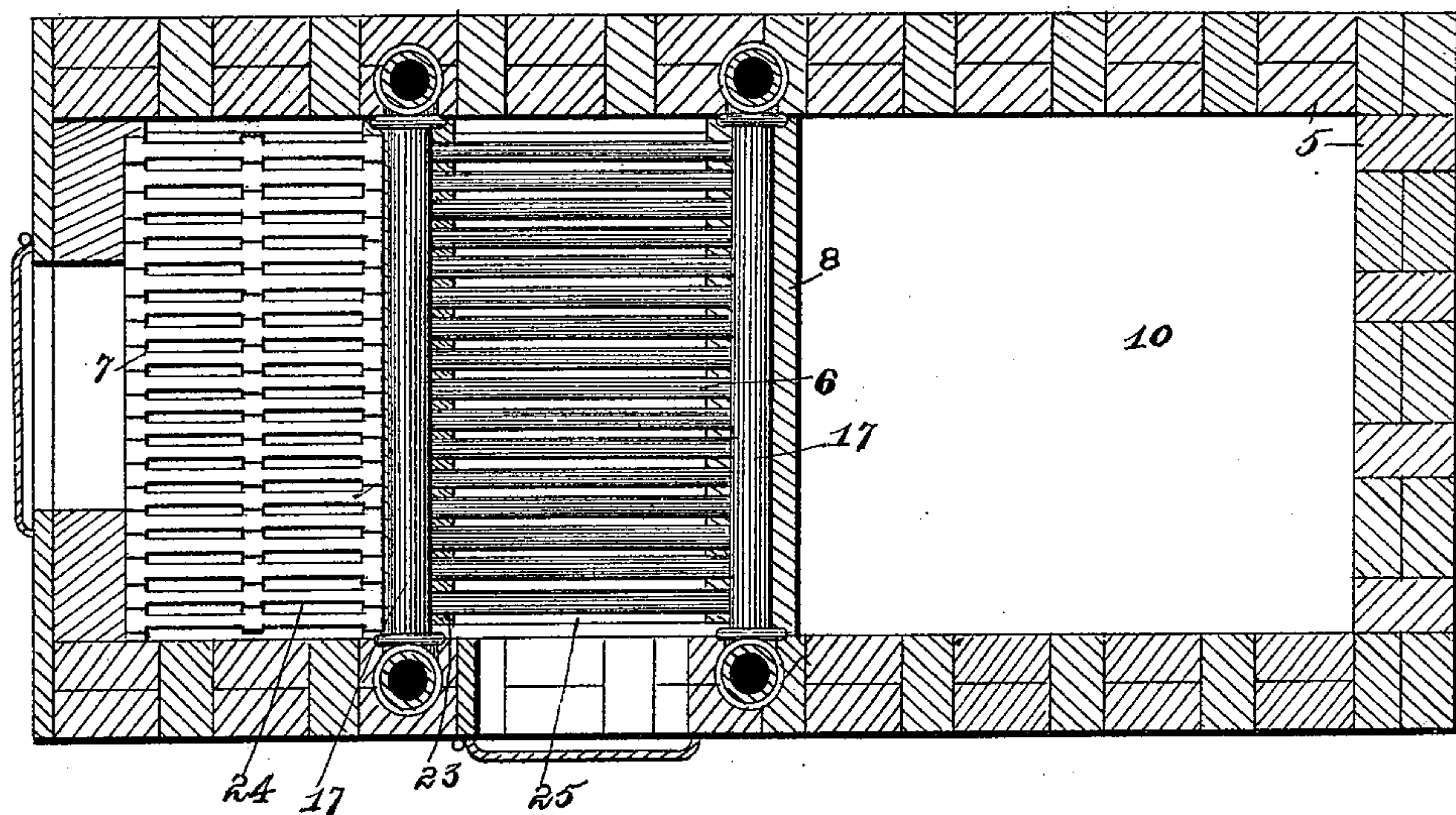
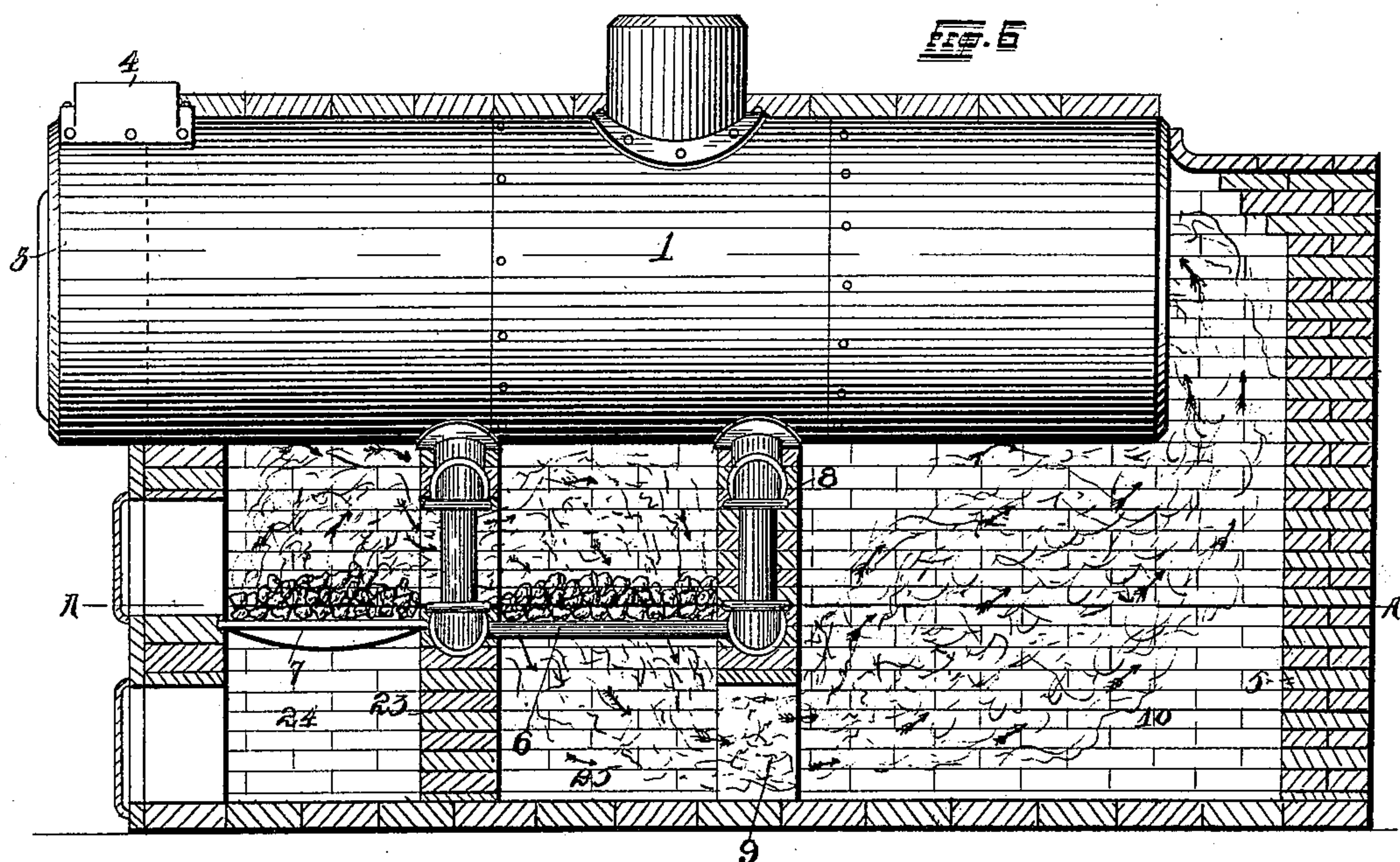
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UNITED STATES PATENT OFFICE.

WILLIAM S. PLUMMER, OF ST. LOUIS, MISSOURI, ASSIGNOR OF ONE-THIRD
TO ARTHUR M. MORSE, OF SAME PLACE.

SMOKELESS BOILER-FURNACE.

SPECIFICATION forming part of Letters Patent No. 518,160, dated April 10, 1894.

Application filed February 6, 1893. Serial No. 461,090. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM S. PLUMMER, of the city of St. Louis and State of Missouri, have invented certain new and useful Improvements in Smokeless Boiler-Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention relates to smokeless-furnaces of the class known as down-draft furnaces, and it may be said to consist in a novel and peculiar combination and arrangement of both the down-draft water-grate and the up-draft fire-grate, particularly adapted for use under steam-boilers.

My invention consists, further, in certain details of construction, as will be hereinafter fully set forth and pointed out in the claims.

In the drawings, Figure 1 is a sectional side-elevation of a boiler-furnace embodying my invention. Fig. 2 is a sectional front elevation, with both parts broken away. Fig. 3 is a sectional transverse elevation of same, the section being taken on line $x-x$ of Fig. 1. Fig. 4 is a sectional plan-view of same, the section being taken on line $y-y$ of Fig. 1. Fig. 5 is a similar view, with the section taken on line $z-z$ of Fig. 1. Fig. 6 is a sectional side-elevation of a boiler-furnace fitted with a modified form of the combination-grates. Fig. 7 is a sectional plan-view of same, with the section taken on line $a-a$ of Fig. 6.

Referring again to the drawings, 1 indicates the boiler, or other object to be heated. The boiler has the usual horizontal-flues 2 and smoke-cap or breeching 3 communicating with chimney or smoke-stack connection 4.

5 indicates the furnace-walls, which, in the case of a horizontal steam-boiler, are the same as usual, with the exception of the bridge-wall and the grate-setting and the parts near by the grates.

I may state again that my invention contemplates a novel combination of a down-draft water grate 6 and one or more up-draft fire-grates 7. (See Fig. 2.) These different grates may be relatively located with a separate fire-grate on each side of the water-grate, as illustrated in the first five figures of the drawings: or they may be disposed in such a relative position that the fire-grate will

be situated in the forward portion of the furnace, and the water-grate in rear, or to one side thereof, as shown in Figs. 6 and 7, and the operation and result will be substantially the same in each case. There is a single bridge-wall 8 for all the grates, and this is distinguished from the usual bridge-wall, in that it is fitted closely to the under side of the boiler or other object to be heated, so as to prevent any passage of products of combustion between it and said object, or in other words, it has an imperforate surface above the grates, but it is arched or otherwise supported across the space beneath the object to be heated, so as to form what I term a fire-passage 9 centrally beneath the imperforate portion of said bridge-wall, in a plane below the plane of said grates.

10 indicates an open space beneath the object to be heated, and in rear of the grates, which may be of any desired area and shape, to be determined by the arrangement of the walls 5 and the floor of the furnace, the only essential construction being that the said space or chamber 10 be open at the top, so as to expose the boiler or thing to be heated to the direct action of the flames and heat issuing from the said fire-passage 9, as is hereinafter stated. The space beneath the grates, which would ordinarily correspond to the ash-pit of an ordinary boiler-furnace, is divided longitudinally into three separate chambers 11, 12 and 13 respectively, which I denominate the two side ash-pits and the central combustion-chamber, 12 indicating said combustion-chamber.

14 indicates the short longitudinal walls, or partitions, which thus divide the space below the grates. They are preferably built of fire-brick, and extend vertically a short distance above the upper surface of the grates, so as to form low bridge-walls 15, in the combustion-chamber 16 above said grates. The object of these two low bridge-walls is to separate the grate-surface into three distinct portions, each extending longitudinally of the furnace. Thus permitting each portion to be fired and cleaned separately, without disturbing the fire on either of the other portions. These low longitudinal bridge-walls 15 may be dispensed with in some cases, if

desired, as their function is mainly to direct the flame upward toward the thing to be heated, prior to its entrance into the central combustion-chamber.

5 Located above each of the side ash-pits (11 and 13) are the series of ordinary grate-bars 7, having any preferred construction and setting: and located above the central combustion-chamber (12) are a series of down-draft
10 grate-bars, preferably in the form of tubular-bars 6, forming a fire-supporting surface at one side of each of said series of ordinary grate-bars. These grates are preferably constructed as herein shown and described, but,
15 of course, variations in them not amounting to invention may be made during the course of their erection, without departing from the spirit and scope of my invention. The central fire-supporting surface is here shown as
20 consisting of a series of tubes having each end threaded or otherwise arranged and properly connected to a larger transverse tube 17 extending across the furnace and connected with the water or steam space of the boiler
25 1. I here show two large transverse-tubes 17, one at the forward ends of the water-tubes 6 and one at their rear-ends, and both connected to the water space of the boiler by means of shorter vertical tubes 18, elbows 19, upper
30 horizontal transverse-tubes 20 and a three-way cast-iron fitting 21, the said three-way fitting having its upper surface of such a contour as to make a tight joint with the under side of the boiler, and all of which may be
35 constructed by a skilled mechanic without further description.

The short vertical tubes 18 and the transverse-tubes 17 and their fittings or connections, are preferably incased or surrounded
40 by the material of which the front and bridge walls are composed, for protection from the intense heat of the fire, to which they would otherwise be exposed. (See Fig. 1.)

It will be observed that the transverse
45 tubes 17 extend completely across the furnace, and are supported partially by the side-walls thereof.

From the above it will be seen that the water-tube grate-bars have connection with
50 the water-space of the boiler at each of their ends, so that circulation of water therein may take place in either direction.

I may state that I have found it to be advantageous to inject the feed-water through
55 the forward one of the transverse tubes 17, and for this purpose I have shown a suitable connection 22. (See Figs. 1 and 2.)

In Figs. 6 and 7 I have shown a modified arrangement of the parts, which I will describe as follows: The result of this modified
60 arrangement is substantially the same as that above described, the differences being in the fact that the two grates extend entirely across the furnace, and are made shorter, with the
65 ordinary grate-bars at the forward-portion of the furnace and the water-grates or down-draft fire-surface, in the rear of said ordinary

bars. Further, in this modified arrangement, there is an additional transverse support or
70 wall 23, which extends across the furnace beneath the object to be heated, and forms a support for the rear ends of the ordinary grate-bars and for the forward-ends of the
75 water-grates or for the forward portion of the down-draft fire-surface. This wall 23 also divides the space beneath the grates into a forward ash-pit 24 and a rear combustion-
80 chamber 25. The water-grates are connected to the boiler in the manner previously described. The rear combustion-chamber is in communication with the open space 10 in rear
85 thereof, and this in turn is in communication with the tubes of the boiler, and with the chimney or smokestack connection 4.

The front of the furnace is fitted with a
85 feed-door, or with a number of such doors, and with ash-pit doors. In the arrangement shown in Figs. 1 to 5 inclusive, there should be a fuel-feeding door for each series of grate-
90 bars, so that each may be supplied with fuel at separate intervals, and independently of the others.

The method or mode of treating and feeding the fuel in the furnace, for the purpose
95 of consuming the smoke before it leaves the combustion-chambers of the furnace, and the full operation is as follows: A fire is built in the three fire-chambers (referring now to
100 the construction shown in Fig. 1) and permitted to burn till glowing-coals are produced: then the side fire-chambers and the central
105 fire-chamber are supplied with fuel alternately, the direction of the draft through the bars of said side chambers being upward while that of the central-chamber is downward. It
110 will thus be observed that the central fire-chamber and its down-draft grate acts not only to consume the smoke generated by itself, but it acts as a smoke-consumer for the
115 products of combustion discharged by each of the fire-chambers located adjacent to it, so that the result is that all smoke produced by all the fire-chambers, is consumed prior to its
120 discharge into the smoke stack or chimney of the furnace.

The construction is low in first cost, reliable
125 in operation, and very economical in the consumption of fuel.

I do not herein claim broadly an updraft
130 fire grate located in the forward portion of the furnace, and a downdraft grate located adjacent said updraft grate but in the rear of same, as I am aware that such is not new. Nor do I claim herein the invention and details of construction shown in Figs. 1, 2, 3, 4,
135 and 5 of this application, as I have claimed the same in a separate application filed August 9, 1893, Serial No. 482,779.

What I claim is—

1. In a smoke consuming furnace, the combination with a boiler of a lower pair of horizontal tubes 17 having a length equal to the
140 width of a furnace grate and arranged one tube of the pair forward of the other tube of

the pair, a fire supporting furnace 6 composed of hollow bars or tubes arranged parallel, with their forward ends communicating with the forward one of the pair of tubes 17 and with their rear ends communicating with the rear one of the tubes 17, a series of solid updraft grate-bars 7 arranged in the furnace forward of and adjacent the forward one of the horizontal tubes 17, an upper pair of horizontal transverse tubes 20, arranged parallel, with one of said pair directly above the forward one of the pair of tubes 17, and with the other one of said pair directly above the rear one of the pair of tubes 17 and in a plane closely adjacent the under surface of said boiler, short vertical tubes 18 and elbows 19 located in the side walls of the furnace and connecting the outer ends of said lower pair of tubes 17 with the outer ends of said upper pair of tubes 20, and a three-way cast iron fitting 21 having its upper surface in contact with the adjacent under surface of said boiler and making a tight joint therewith and applied one centrally of the length of each one of the pair of tubes 20 and connecting the interior thereof with the interior of the boiler, one at a point directly above the forward one of the pair of tubes 20, and one at a point in rear thereof and separated a distance therefrom, substantially as herein specified.

2. In a smoke consuming furnace, the combination with a boiler, of a lower pair of horizontal tubes 17 having a length equal to the width of the furnace grate and arranged one tube of the pair forward of the other tube of said pair, a fire supporting surface 6 composed of hollow bars or tubes arranged parallel, with their forward ends communicating with the forward one of the pair of tubes 17, and with their rear ends communicating with the rear one of the tubes 17, a series of solid updraft grate bars 7 arranged in the furnace forward of and closely adjacent the forward

one of the horizontal tubes 17, an upper pair of horizontal transverse tubes 20 arranged parallel, with one of said pair directly above the forward one of the pair of tubes 17, and with the other one of said upper pair directly above the rear one of said pair of tubes 17 and in a plane closely adjacent the under surface of said boiler, said fire surface 6 arranged for a downdraft, and composed solely of tubes having each of their ends threaded, a bridge-wall 8 fitted closely to the under side of said boiler to prevent passage of products of combustion between it and the boiler and arched or supported across the space beneath said boiler so as to form a fire-passage 9 beneath itself, an additional transverse wall 23 extending across the furnace beneath the boiler, the adjacent ends of said solid grate bars and said water tubes being supported by said wall 23 and said wall dividing the space beneath the grates into a forward ash pit 24 and a rear combustion chamber 25, short vertical tubes 18 and elbows 19 connecting the outer ends of said lower pair of tubes 17 with the outer ends of said upper pair of tubes 20, said tubes 17, 18 and 20 being located in and protected by said walls 8 and 23, and a three-way cast iron fitting 21 having its upper surface in contact with the adjacent under surface of said boiler and tightly fitted thereto and applied one centrally of the length of each one of the upper pair of tubes 20 and connecting the interior thereof with the interior of the boiler at a point directly above each tube of said upper pair of tubes 20, substantially as herein specified.

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

WILLIAM S. PLUMMER.

Witnesses:

HERBERT S. ROBINSON,
ALFRED A. EICKS.