

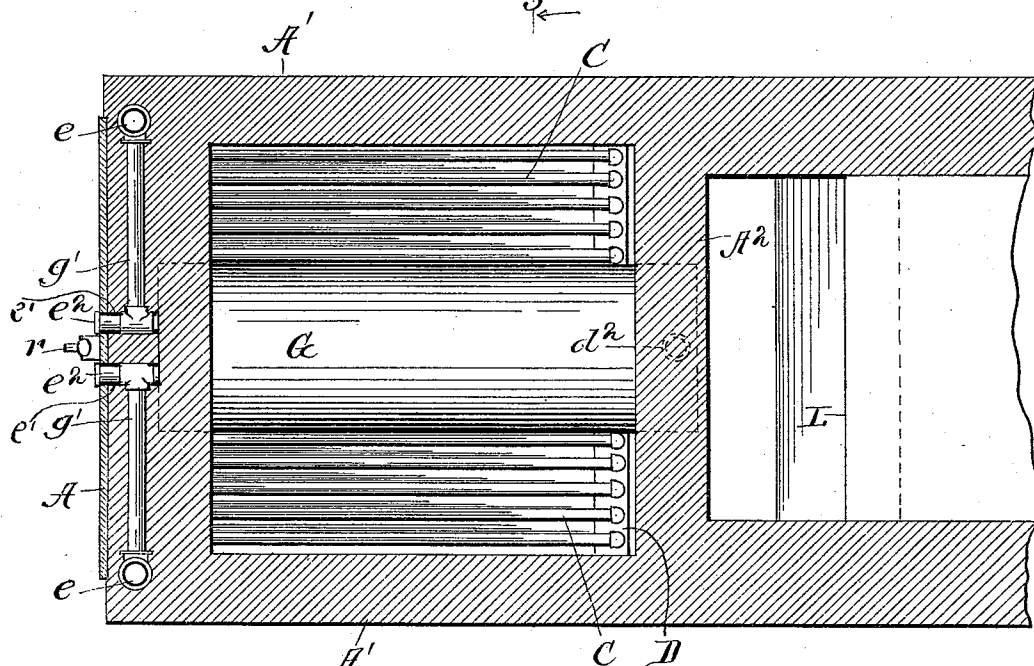
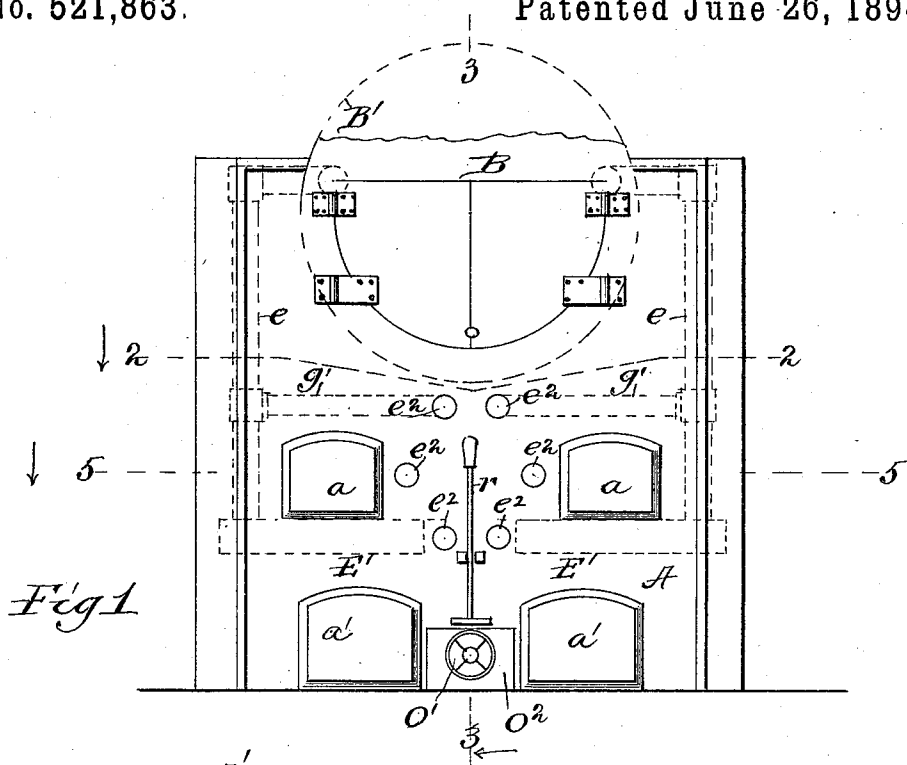
(No Model.)

5 Sheets—Sheet 1.

O. D. ORVIS.  
STEAM BOILER FURNACE.

No. 521,863.

Patented June 26, 1894.



Witnesses  
W. C. Corlies  
Jno. A. Christianson.

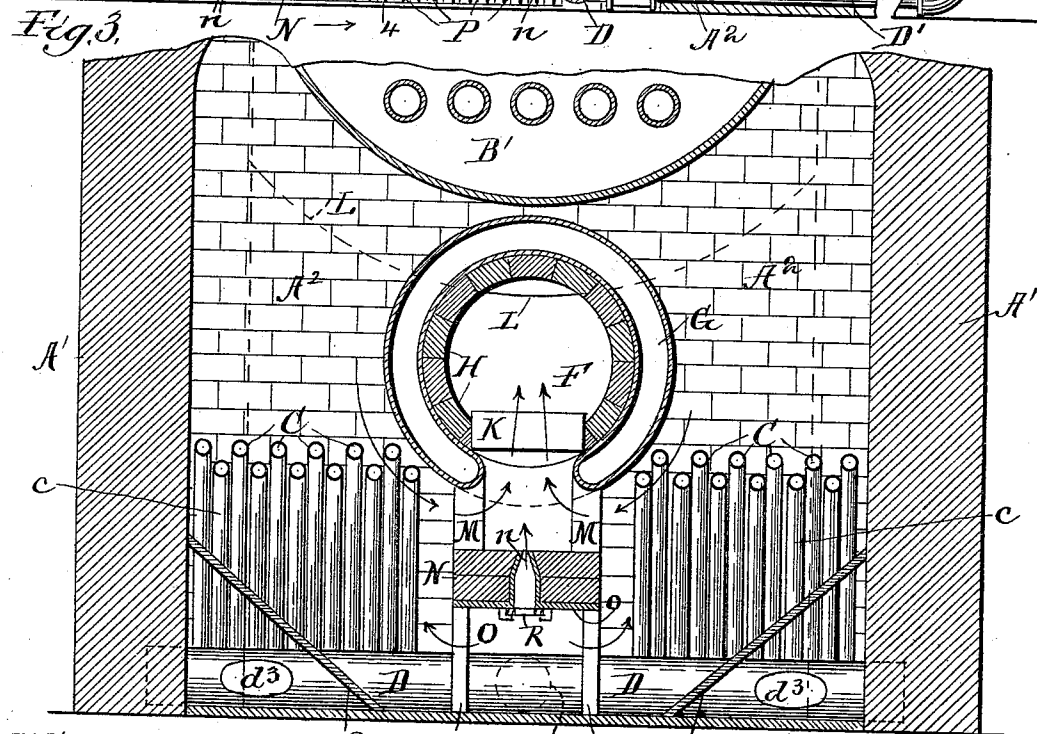
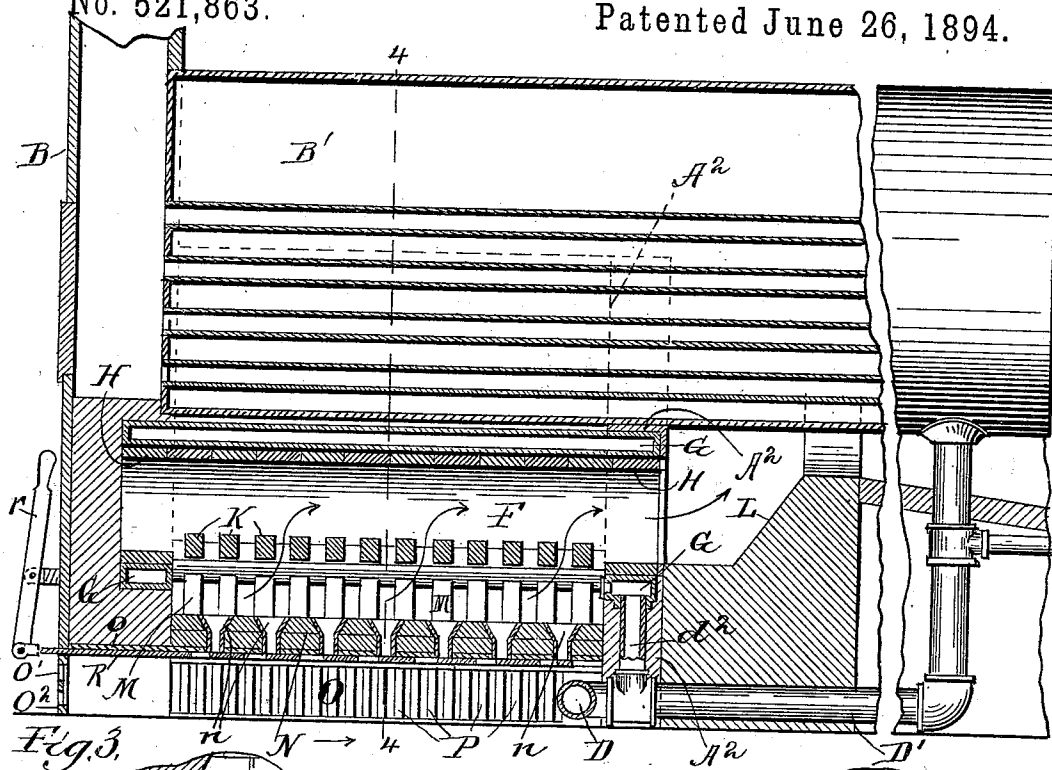
Fig 2

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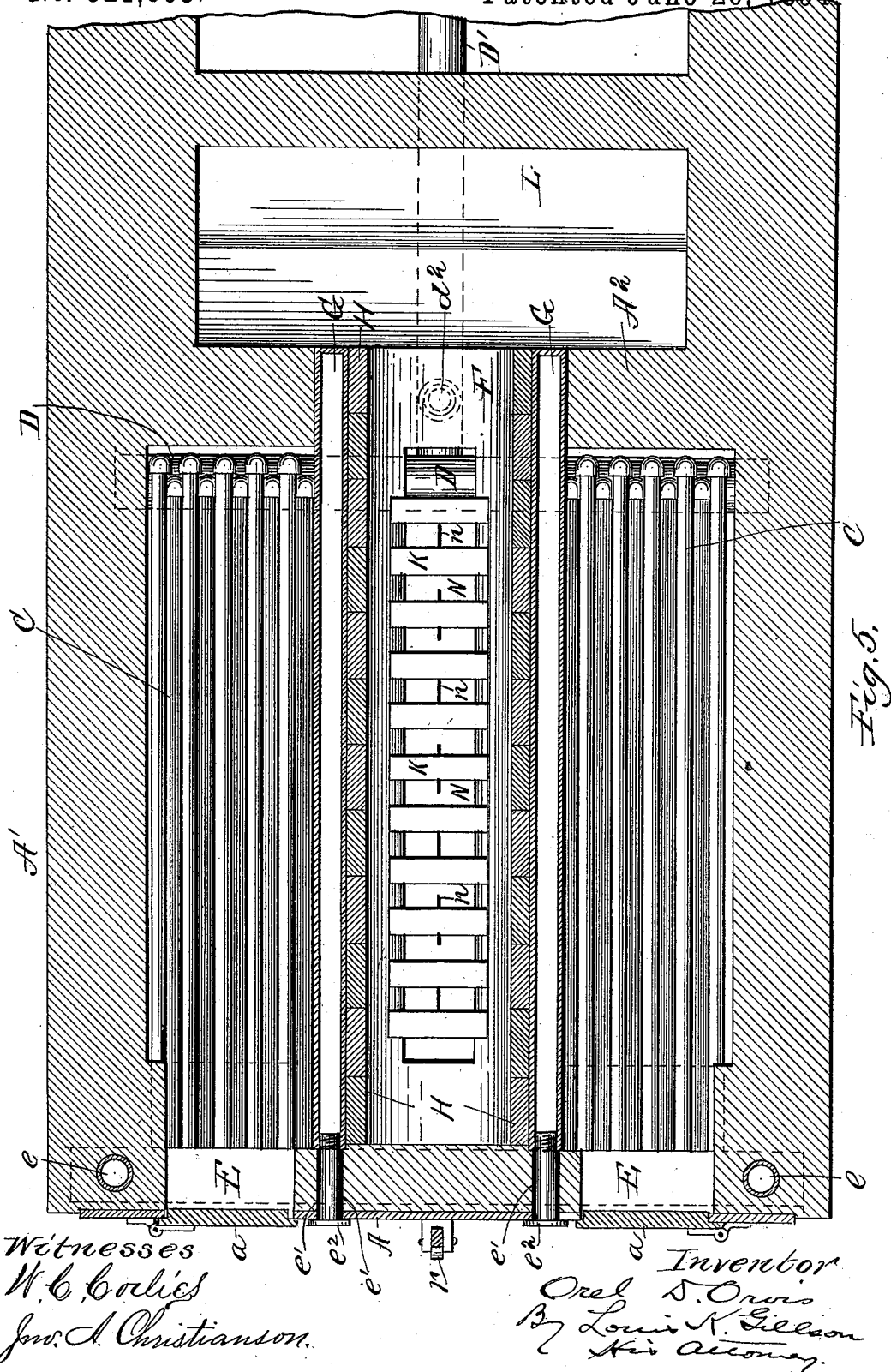
Fig 4

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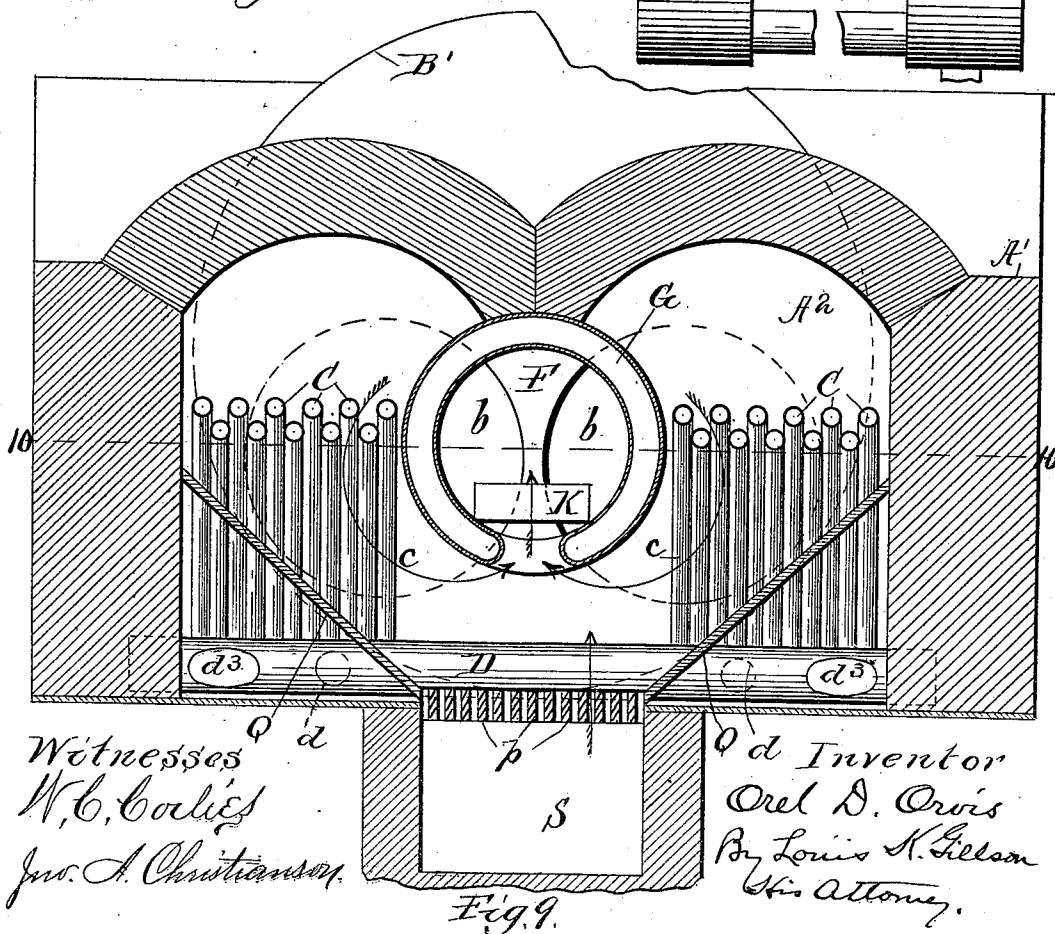
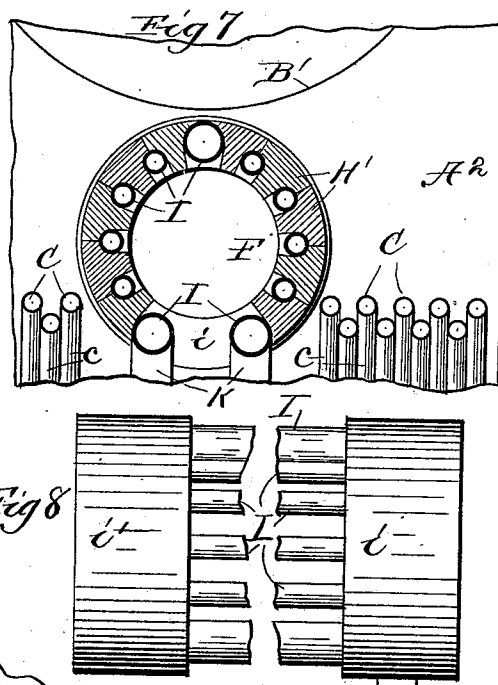
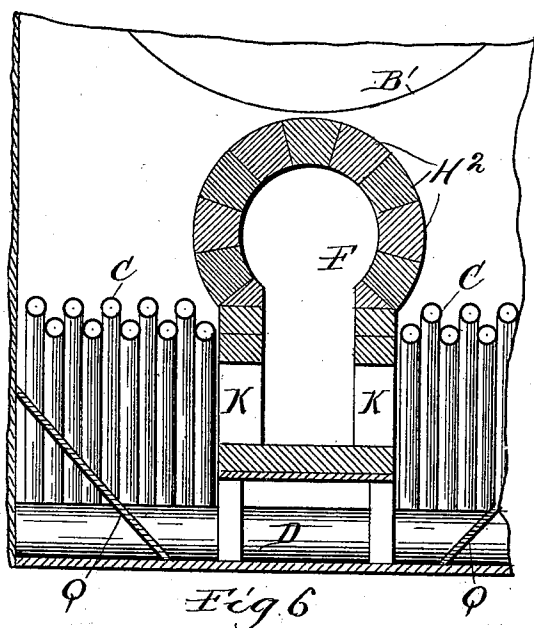
(No Model.)

5 Sheets—Sheet 4.

O. D. ORVIS.  
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No. 521,863.

Patented June 26, 1894.



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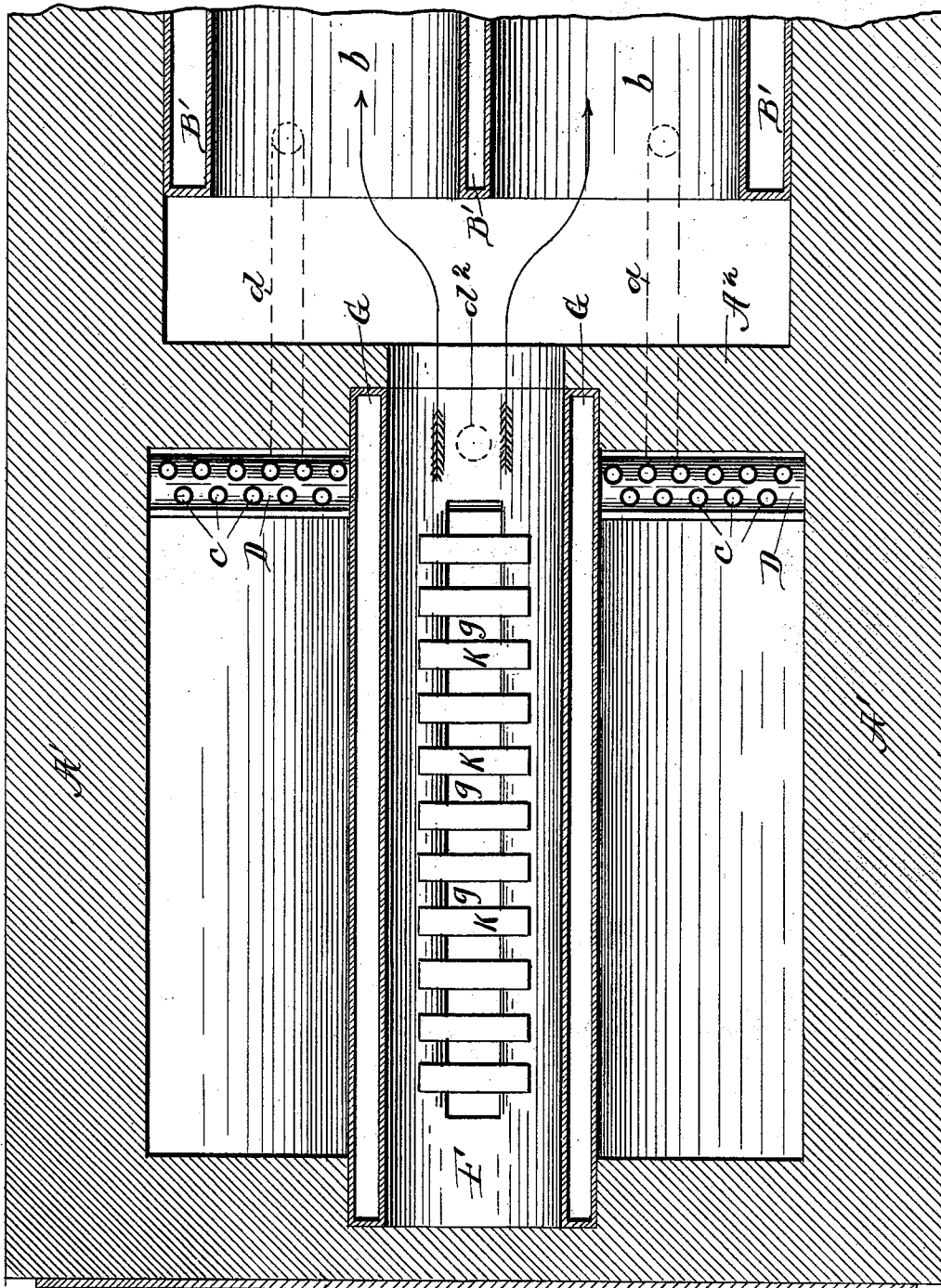
(No Model.)

5 Sheets—Sheet 5.

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STEAM BOILER FURNACE.

No. 521,863.

Patented June 26, 1894.



Witnesses  
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Fig 10

A a Inventor  
 Orel S. Davis  
 By Louis K. Ellison  
 His Attorney.

# UNITED STATES PATENT OFFICE.

OREL D. ORVIS, OF CHICAGO, ILLINOIS.

## STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 521,863, dated June 26, 1894.

Application filed March 12, 1894. Serial No. 503,300. (No model.)

*To all whom it may concern:*

Be it known that I, OREL D. ORVIS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have  
5 invented certain 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, such as will enable others skilled in the art to which it ap-  
10 pertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to down draft furnaces.  
15 Its object is to secure a construction whereby more perfect combustion of the fuel may be obtained than is practicable in furnaces of this class now in use; in which the furnace may be fed below the down draft grate bars  
20 if desired; in which provision is made for complete combustion of the smoke, and in which the highest possible efficiency in steam production is secured.

The invention consists in the use of two  
25 fire-boxes whose grate bars are water pipes communicating with the boiler; a cylindrical retort lying between the two fire-boxes and leading to the combustion chamber, such retort being open along its underside to receive  
30 the products of combustion; and such other parts and arrangement of parts as are hereinafter described.

In the accompanying drawings, Figure 1, represents the front plate of a steam boiler  
35 furnace. Fig. 2, is a plan section on the line 2—2 of Fig. 1. Fig. 3, is a vertical longitudinal section on the line 3—3 of Fig. 1. Fig. 4, is a transverse vertical section on the line 4—4 of Fig. 3. Fig. 5, is a plan section on the  
40 line 5—5 of Fig. 1. Figs. 6 and 7, are transverse sections showing modified forms of a retort. Fig. 8, is a side elevation of the pipe system of the section of the retort shown in Fig. 7. Fig. 9, is a transverse vertical section  
45 through the grate bars showing the application of my invention to the Lancashire form of steam boiler furnaces, and Fig. 10, is a plan section on the line 10—10 of Fig. 9.

The passage of the distilled vapors through  
50 the upper grate bars involves the loss at that point of much of their temperature, the bars

being filled with water drawn from the boiler at its coolest point, and as a result it is difficult to maintain the combustion for the purpose of burning the carbon. By the use of a  
55 long retort through which these vapors are passed after leaving the fire-box their temperature is again raised to the combustion point. The efficiency of this retort is increased by the free use of fire-brick which  
60 speedily become heated to a high degree.

In the drawings I show at, A, the face plate of a steam boiler furnace, the front end of the boiler extension being shown at, B.

Firing doors are represented at, a, a, and  
65 the ash pit doors at, a', a'.

The side walls of the furnace are shown at, A', A', and a transverse wall, A<sup>2</sup>, cuts off the back end of the fire-boxes and extends to the crown sheet of the boiler.  
70

The grate bars, C, are water pipes and are set "staggered," that is, alternate bars are at different elevations. These grate bars are longitudinal with the fire-box and their rearward ends, c, extend downwardly and com-  
75 municate with the cross head, D, which is fed by a pipe, D', leading from the bottom of the boiler, B' at its rearward end. The pipes, C, communicate at their forward ends with the cross-head, E, and pipes, e, e, lead from  
80 this cross-head to the boiler entering it at a greater elevation than does the pipe, D', so that free circulation is insured through the pipes, C, and their steam generating capacity thereby augmented. Two sets of these grate  
85 bars are used and between them extending from the front wall backwardly through the wall, A<sup>2</sup>, is a cylindrical retort whose chamber is shown at, F, and which has an opening  
90 through its lower side. Fuel is thrown upon the grate bars, C, through the doors, a, and these doors remain open to supply the air feed. The plane of the grates described is above the longitudinal opening in the retort and hence the draft is downwardly and into  
95 the retort.

A central flue, O, extends backwardly below the retort from the front wall of the furnace and is provided with a damper controlled opening leading thereto, O'. The flue, O, is  
100 formed by the use of a pair of sets of vertical grate bars, P, P, and a roof plate, o. A

deflecting plate, Q, is set obliquely below and longitudinal with the grate bars, C, extending from the floor of the furnace near the grate bars, P, P, to the side walls, A. Fuel falling through the upper sets of grate bars, C, strikes upon the deflecting plates, Q, and is thrown against the grate bars, P. Air entering through the opening, O', and the flue, O, keeps up the combustion of this fuel and consumes it. The ashes are readily worked through between the grate bars, P, and thence drawn out by the use of a hoe, the front end of the flue, O, being closed by a door, O<sup>2</sup>.

The plate, o, is provided with a longitudinal row of apertures into which are set short pipes, n, open at both ends. A slide bar, R, having corresponding apertures is carried by suitable ways upon the under surface of the plate, o, and has a longitudinal movement, so that its apertures may be caused to register with the lower ends of the pipes, n, or the pipes may be closed by shifting the slide bar, R. This slide bar extends through the front plate A, of the furnace and is pivotally connected to a lever, r, carried by a suitable hanger attached to the front wall of the furnace, whereby it may be operated. I prefer to flatten the upper end of the pipes, n, so that their openings are in the form of slots, thereby guarding against the accidental entry of any cinders which might be too large to find their way through to the flue, O.

The pipes, n, are protected from the intense heat to which they would otherwise be exposed by being inclosed by fire-brick, as shown at, N. These fire-brick also serve as supports for two rows of brick as shown at, M, reaching to the under side of the retort and interposed between the grate-bars and the retort opening. These fire-brick, M, are spaced apart so as to permit the passage between them of the burning gases. I prefer to place a third row of fire-brick transversely across the retort opening as shown at, K, these brick being similarly spaced apart.

The retort may be variously constructed, though preferably being cylindrical in form, and having a longitudinal opening, g, at its under side and substantially through its entire length. This construction provides for the free entry of the burning gases, and an ample flue, F, for their passage backwardly to the combustion chamber, but the precise form of the retort or the means of ingress to it are immaterial.

In Figs. 2, 3, 4, 5, 9, and 10, the retort consists of a hollow shell, G, made of boiler steel, and supported at its forward end by the front wall of the furnace, and at its rearward end by the transverse wall, A<sup>2</sup>. A water leg, d<sup>2</sup>, leads from the cross-head, D, to the rearward end of the shell, G, entering it at its lower side. Discharge pipes g', lead from the forward end of the shell, G, to the pipes e, which communicate with the upper part of the boiler, the pipes, g', communicating with the interior of the shell near its upper side. By

this arrangement of piping provision is made for the free circulation of water through the shell and for the rapid generation of steam. The shell, G, may be lined with fire-brick, as shown at, H, for maintaining the high temperature of the burning gases, or, the shell, G, may be dispensed with entirely and the walls of the retort be composed of fire-brick as indicated at, H', H<sup>2</sup>. In this construction the two rows of fire-brick, K, serve the additional purpose of supports for the retort.

In Figs. 7 and 8, I have shown pipes, I, embedded in the walls of the retort and extending throughout its entire length, annular headers, i', i', being located at the rear and front of the retort, respectively, for feeding and discharging these pipes.

Small pipes, e', lead from the front end of the shell G, or from the front header, i', through the face plate of the furnace, and are closed by the caps, e<sup>2</sup>. These pipes afford convenient access to the interior of the shell, or header, for cleaning. At d<sup>3</sup>, d<sup>3</sup>, are shown hand openings to the cross-head, D, for the same purpose.

Lancashire boiler furnaces are provided with a longitudinal ash pit, S. In this form of furnace I therefore dispense with the flue, O, and consequently with the form of grate-bars, P, and the air supply used in connection with it as already described, and place a set of grate-bars, q, horizontally over this ash pit. The deflecting plates Q, reach to the sides of this set of grate-bars and the fuel falling from the down draft grates, is, consequently, deposited upon them and burns directly below the opening of the retort. In this construction, as well as in that previously described, new fuel may be fed directly to the lower grates, a very decided advantage in case of a sudden demand for increased steam pressure, and the resultant vapors will be consumed as effectively as when the firing is limited to the upper grates.

I show in Fig. 10, the flues, b, b, forming a feature of the Lancashire boiler. The rearward end of the retort is directly in front of these flues so that the flame is divided and enters both of them.

In the style of furnace shown in Fig. 3, a bridge wall, L, is located immediately back of the retort for the purpose of carrying the burning gases up to the boiler, its general form being shown in dotted lines in Fig. 4.

More or less fire-brick will be used in conjunction with the retort according to the kind of fuel intended to be used. A fuel rich in carbon will necessitate the using of a liberal quantity of fire-brick in order that the temperature may be maintained and in this case the open brick work as shown at, M, K, will be especially serviceable.

I claim—

1. In a down draft furnace the combination with a pair of fire-boxes, of a chamber below the grates a tubular flue located between the fire-boxes and opening substantially through

its entire length, to the chamber below the  
grates, and a wall closing the rearward end  
of such chamber, substantially as described  
and for the purpose specified.

5 2. In a down draft furnace the combination  
with a pair of fire-boxes, and with a wall closing  
the rear end thereof, of a chamber below  
the grates a tubular flue located between said  
fire-boxes and leading from this chamber  
10 through said wall, substantially as described  
and for the purpose specified.

3. In a steam boiler furnace the combina-  
tion with upper and lower fire-boxes, and with  
a wall for closing the rearward end thereof,  
15 of a tubular flue leading from the chamber  
between the two sets of grates through said  
wall, substantially as described and for the  
purpose specified.

4. The combination with a pair of down  
20 draft fire-boxes, an up draft fire-box below  
them, and with the wall, A<sup>2</sup>, for closing the  
rearward end of said boxes, of a retort flue  
located between the down draft boxes and  
leading from the chamber below them through  
25 the wall, A<sup>2</sup>, substantially as described and  
for the purpose specified.

5. The combination with a steam boiler; of  
a down draft furnace having its fire-box  
closed by a back wall, A<sup>2</sup>, a tubular water  
30 shell, or jacket, forming a flue leading from  
the chamber below the grates through the  
wall, A<sup>2</sup>, and service and return pipes con-  
necting such water shell with the boiler, sub-  
stantially as described and for the purpose  
35 specified.

6. The combination with a steam boiler, of  
a furnace having two down draft fire-boxes,  
a back wall, A<sup>2</sup>, for closing such fire-boxes, a  
tubular water shell, or jacket, located be-  
40 tween the fire-boxes and having its central  
chamber opened to the chamber below the  
grates and to the combustion chamber back  
of the wall, A<sup>2</sup>, and service and return pipes  
connecting the water jacket with the boiler,  
45 substantially as described and for the pur-  
pose specified.

7. The combination with a steam boiler, of  
a furnace having two down draft fire-boxes,  
a back wall, A<sup>2</sup>, for closing such fire-boxes, a  
50 tubular water shell, or jacket, located between  
the fire-boxes and projecting through the wall,  
A<sup>2</sup>, and having the rearward end of the cen-  
tral chamber open and a longitudinal aper-  
ture for communication between its central  
55 chamber and the chamber below the grates,  
fire-bricks placed across the longitudinal ap-  
erture and spaced apart, and service and re-  
turn water pipes connecting the water shell  
with the boiler, substantially as described and  
60 for the purpose specified.

8. The combination, in a down draft furnace,  
with the fire-box, a wall, A<sup>2</sup>, for closing the  
rear end of such fire-box, and with a retort  
flue leading from the chamber below the  
grates, through the wall, A<sup>2</sup>, of an apertured  
65 wall of fire-brick, M, located across the line of  
draft from the grates to the retort flue, sub-  
stantially as described and for the purpose  
specified.

9. The combination in a down draft furnace, 70  
with the fire-box, a wall, A<sup>2</sup>, closing the rear  
end thereof, and with a retort flue leading  
from the chamber below the grates through  
the wall, A<sup>2</sup>, of air ducts leading from with-  
out and opening to the intake aperture of the 75  
retort flue, substantially as described and for  
the purpose specified.

10. In a steam boiler furnace the combina-  
tion with down draft grates, of inclined de-  
flecting plates, Q, located below such grates 80  
and up draft grates at the foot of such plates;  
substantially as described and for the pur-  
pose specified.

11. In a steam boiler furnace the combina-  
tion with down draft grates, a solid wall, A<sup>2</sup>, 85  
at the rear of such grates, a retort flue at the  
side of such grates and leading from the cham-  
ber below them through the wall, A<sup>2</sup>, of up  
draft grates below and at the side of the down  
draft grates, and deflecting plates, Q, below 90  
the down draft grates and adapted to throw  
the fuel falling therefrom in the direction of  
the up draft grates, substantially as described  
and for the purpose specified.

12. In a steam boiler furnace the combina- 95  
tion of a pair of down draft, and a pair of up  
draft, fire-boxes, a wall, A<sup>2</sup>, closing the rear  
end of such boxes, a retort flue located be-  
tween the down draft fire-boxes and opening  
to the fire-box chamber along its under side 100  
and extending through the wall, A<sup>2</sup>, a central  
air flue, O, between the up draft fire-boxes,  
vertical grates forming the side walls of the  
air flue, deflecting plates, Q, below the down  
draft grates and adapted to convey the fuel 105  
falling therefrom to the vertical grates, air  
openings leading upwardly from the air flue,  
O, a damper for closing the air openings, se-  
ries of fire-brick spaced apart and interposed  
between the grates and the intake aperture 110  
of the retort flue, and a series of fire-brick  
spaced apart and located across such intake  
aperture, substantially as described and for  
the purpose specified.

In testimony whereof I affix my signature in 115  
presence of two witnesses.

OREL D. ORVIS.

Witnesses:

LOUIS K. GILLSON,  
M. H. L. WING.