No. 611,975. Patented Oct. 4, 1898.

# O. D. ORVIS.

## STEAM BOILER FURNACE.

(Application filed Apr. 17, 1897. Renewed Mar. 9, 1898.)

(No Model.) 3 Sheets—Sheet 1.

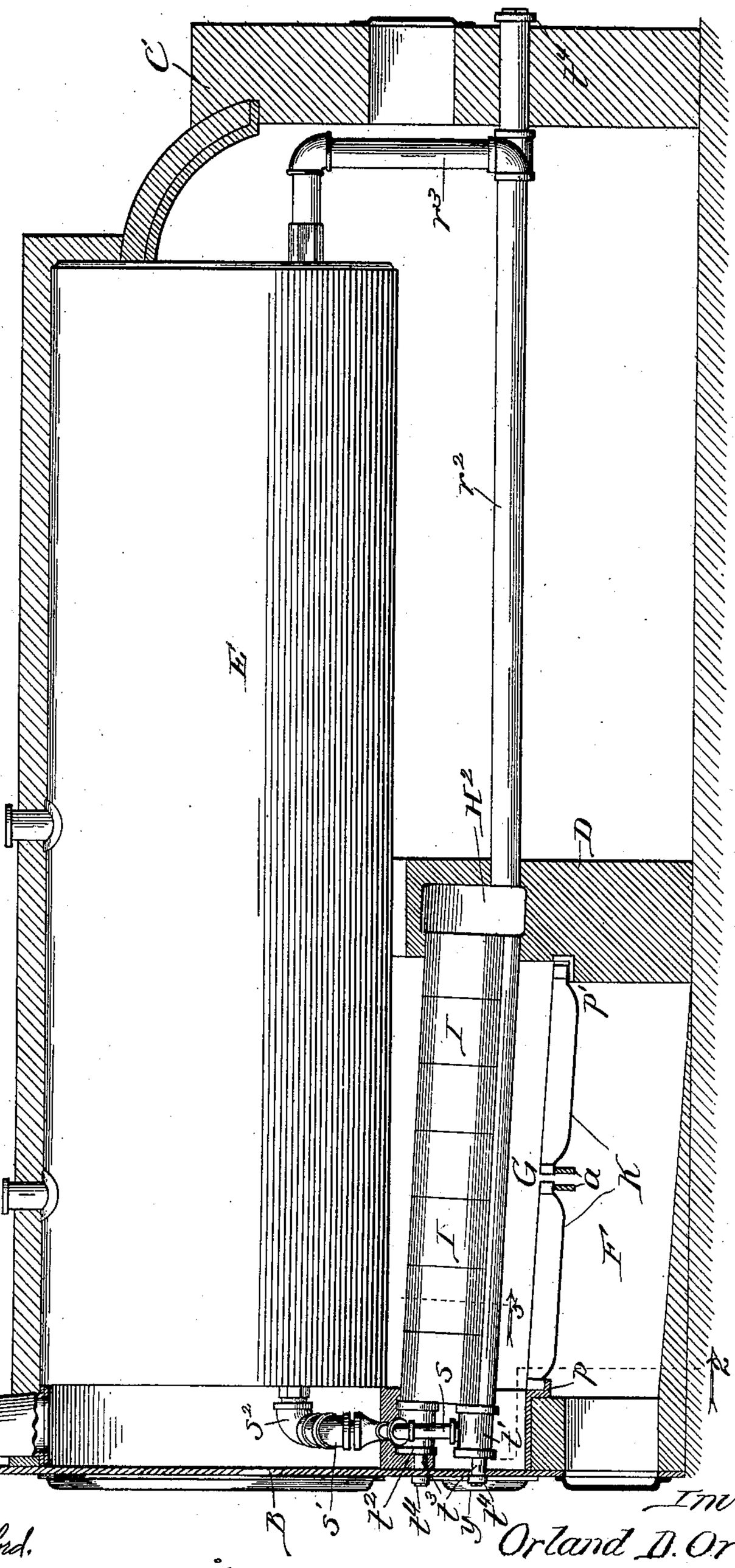


Fig. 1.

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(No Model.) 3 Sheets—Sheet 2.

Fig. 2.

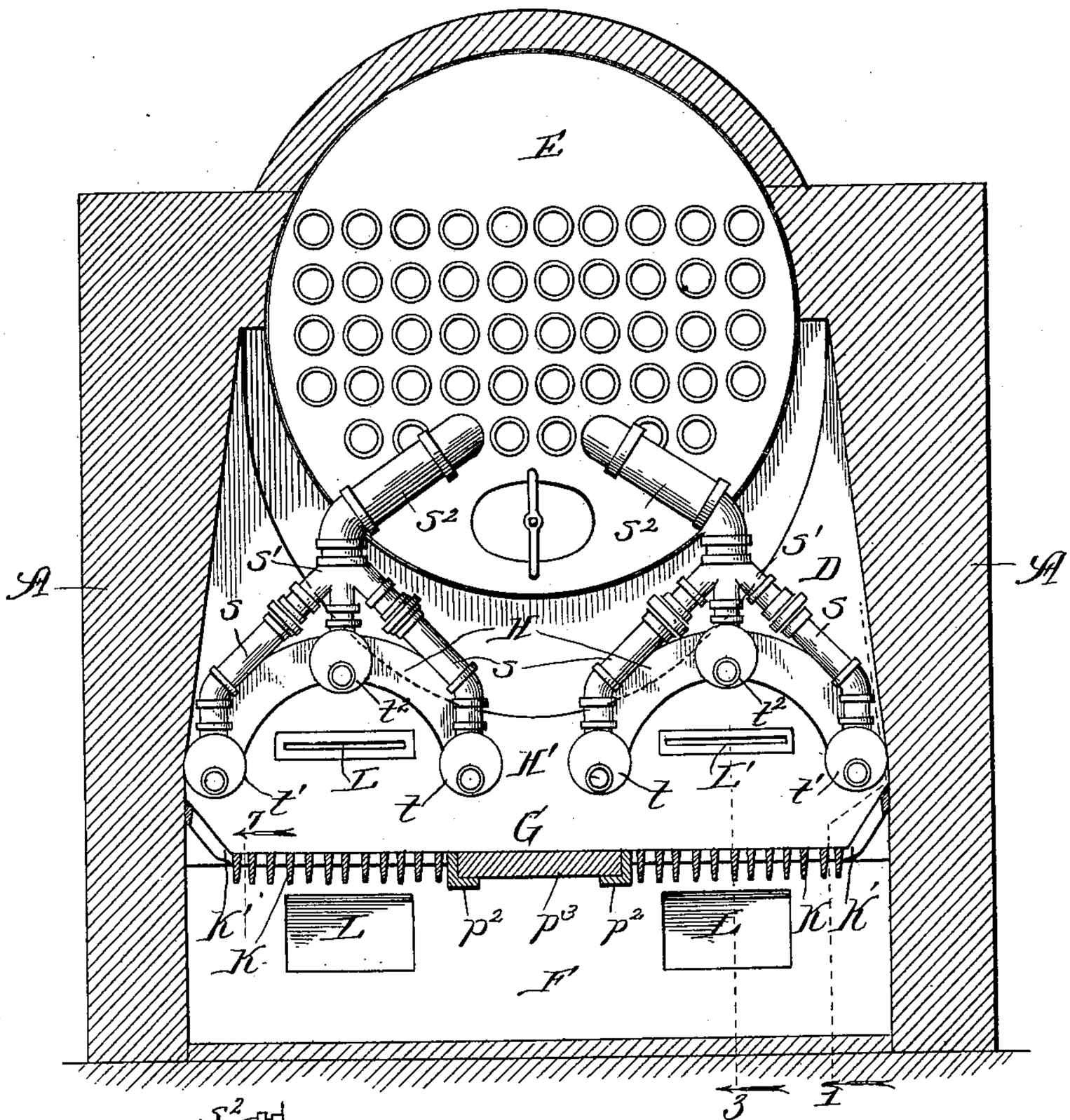
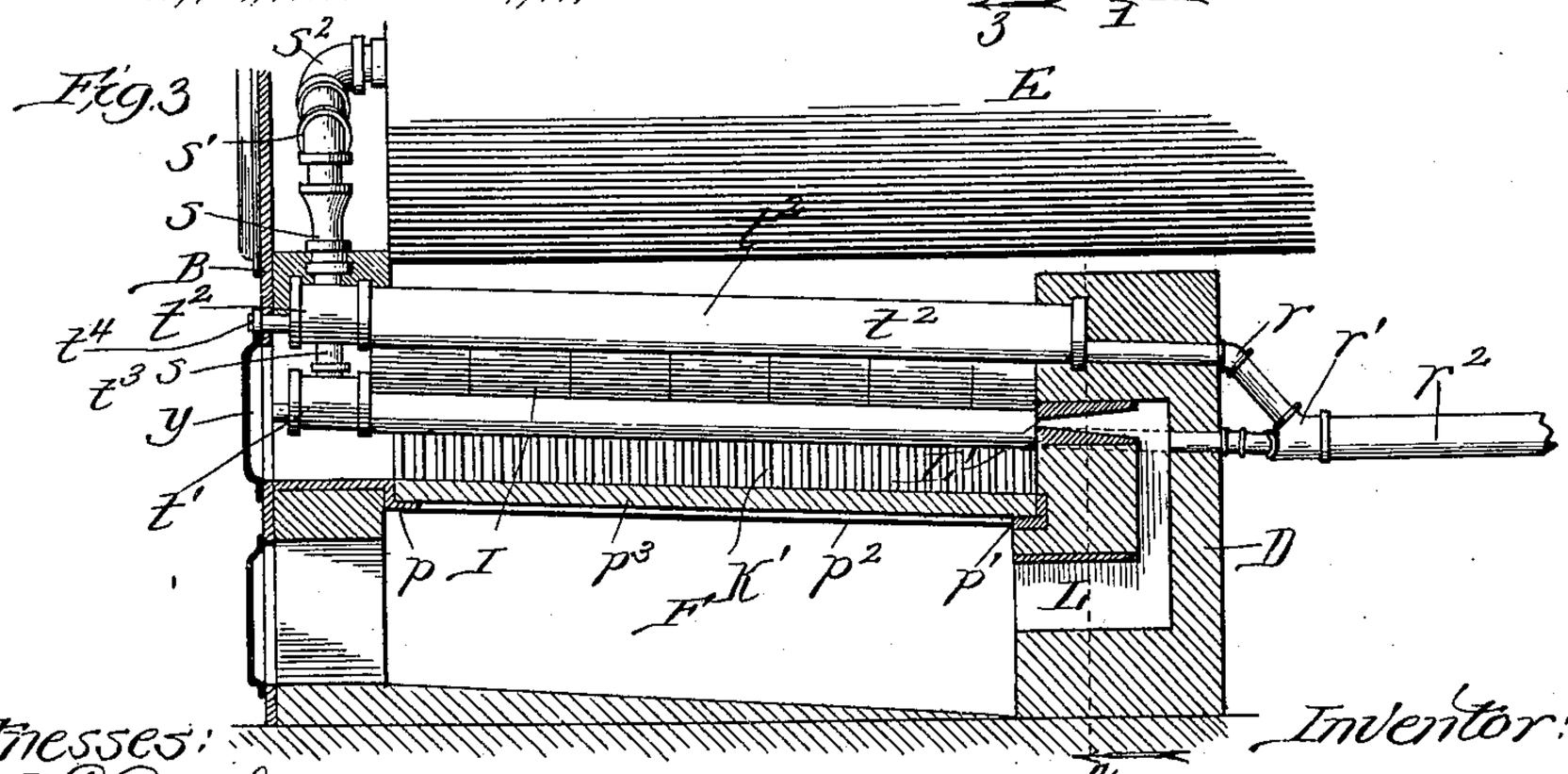



Fig. 3

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(No Model.) 3 Sheets—Sheet 3.

Fig. 4

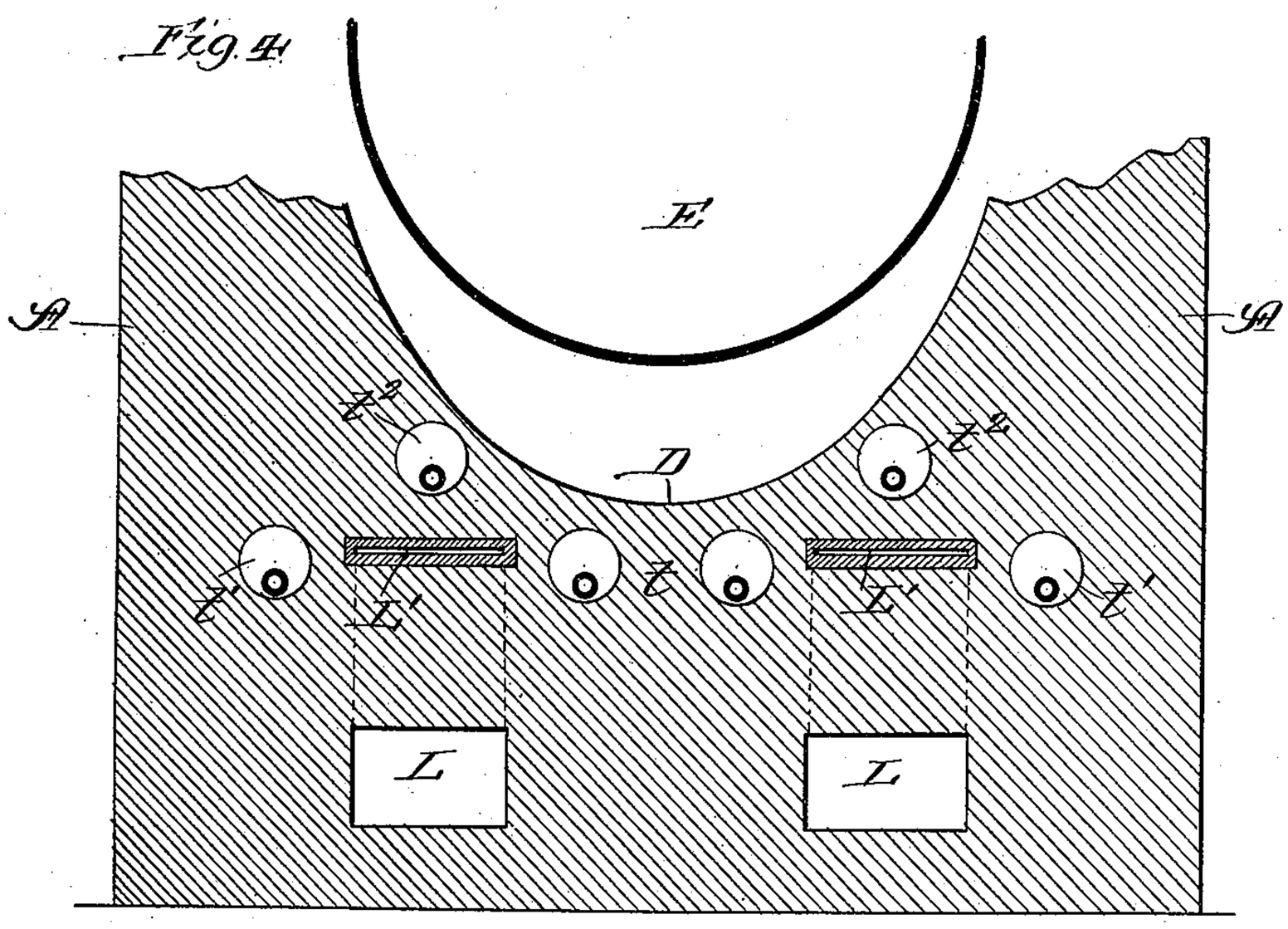



Fig. 7.

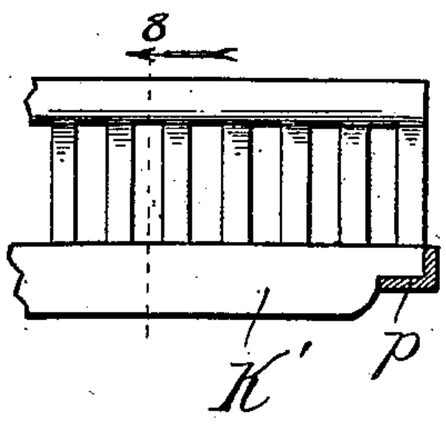



Fig. 5.

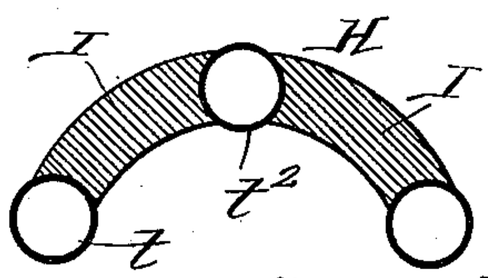



Fig. 6.

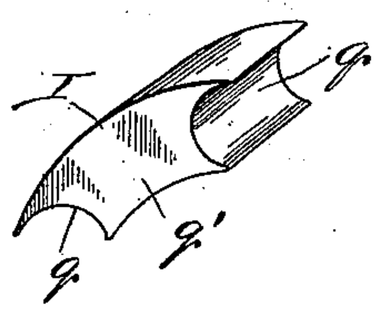
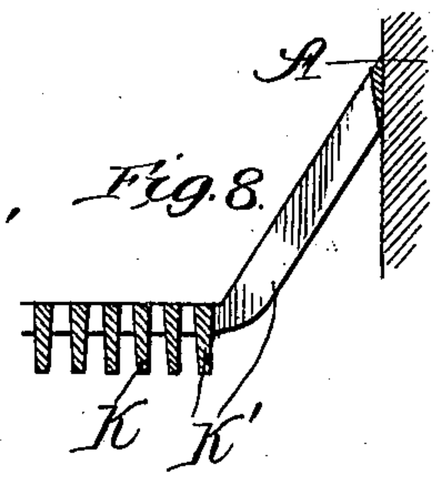



Fig. 8.

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# UNITED STATES PATENT OFFICE.

ORLAND D. ORVIS, OF CHICAGO, ILLINOIS.

## STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 611,975, dated October 4, 1898.

Application filed April 17, 1897. Renewed March 9, 1898. Serial No. 673,276. (No model.)

*To all whom it may concern:*

Be it known that I, ORLAND D. ORVIS, 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 Steam-Boiler Furnaces, of which the following is a specification.

My invention relates to an improvement in furnaces for use more especially in connection with steam-boilers, without, however, limiting it to that particular connection, and is in the nature of an improvement upon the construction of steam-boiler furnaces shown and described in Letters Patent of the United States, No. 524,029, granted to me August 7, 1894.

My present object is to provide certain changes in and additions to the said patented construction which, without departing from the general characteristics thereof, render the furnace still more effective in the directions of perfect combustion of the fuel and maximum utilization of the heat for steam production, as well as more economical to construct and easier, quicker, and less expensive to repair.

In the drawings, Figure 1 is a longitudinal section taken on irregular line 1 of Fig. 2, viewed in the direction of the arrow and showing a steam-boiler furnace constructed with my present improvements with one form of construction at the bridge-wall; Fig. 2, an enlarged cross-section taken on irregular line 2 of Fig. 1 and viewed as indicated by the arrow and showing another form of construction at the bridge-wall; Fig. 3, a broken section on the same scale as Fig. 1, the section being taken on line 3 of Fig. 2, the construction at the bridge-wall being the same as in Fig. 2; Fig. 4, an enlarged broken section taken on line 4 of Fig. 3 and viewed in the direction of the arrow; Fig. 5, an enlarged section of an arch, taken on line 5 of Fig. 1; Fig. 6, a perspective view of one of the blocks or slabs employed in the arch construction; Fig. 7, a broken section showing one of the side grates I employ, and Fig. 8 a section on line 8 of Fig. 7.

A A are the side walls of the furnace; B, the front wall or face; C, the rear wall, and D the bridge-wall.

E is a boiler which may be of any desired construction.

F is the ash-pit, and G the fire-chamber. In the fire-chamber G are preferably two arches H H, extending from the front of the fire-chamber to the bridge-wall. These arches are of the same form in cross-section and are separated by an updraft-passage H′. Each arch is formed with two lower tubes or cylinders $t\,t'$ and an upper tube or cylinder $t^2$, supported at their rear ends in the bridge-wall and at their forward ends in the front wall. From the said forward ends, toward the lower sides, extend tubes $t^3$, which project beyond the face of the furnace and are closed with screw caps or plugs $t^4$. Adjacent to their forward ends the tubes or cylinders $t$, $t'$, and $t^2$ are provided with upwardly-extending pipes $s$, which connect with a three-way union $s'$, from which extends a pipe $s^2$ to the front end of the boiler.

In the construction shown in Fig. 1 the tubes $t\,t'\,t^2$ extend at their rear ends to a water head or chamber $H^2$, mounted in the bridge-wall. Extending from the rear ends of the cylinders or tubes $t$, $t'$, and $t^2$, in the construction shown in Figs. 2, 3, and 4, are pipes $r$, which connect with a three-way union $r'$, from which extends a pipe $r^2$, passing through the rear wall C and closed at the end with a removable cap or plug $t^4$. A pipe $r^3$ extends from the pipe $r^2$ into the rear end of the boiler E. In the construction shown in Fig. 1 the pipe $r^2$ communicates directly with the waterhead $H^2$. The tubes or cylinders $t\,t'$ form the lower side supports of the respective arch to which they belong, the tube $t^2$ forming the ridge. The body of the arch is in sections, comprising blocks or slabs I, of fire-clay or other highly-refractory heat-storing material. They are preferably of the form shown most clearly in Figs. 5 and 6, having concave side edges $q$ to fit closely over the tubes or cylinders, against which they rest, and smooth end faces $q'$. The blocks I may be changed in form, as desired; but when placed in position, as shown, they should fit closely against

the front and rear walls and against each other to form an arch sufficiently tight to prevent the passage of any products of combustion except beneath the tubes or cylinders $t$ to the updraft-passage H'.

Resting upon a sill or shelf $p$ at the front wall and upon a sill or shelf $p'$ at the bridge-wall are parallel angle-iron supporting-beams $p^2$, the outer edges of which should in practice be in direct vertical line with the inner edges of the tubes or cylinders $t$, as shown in Fig. 2. Resting in the supports $p^2$ is a plate $p^3$, which extends approximately the full length of the supports and is formed in one piece or of closely-fitting sections.

K K are grates extending longitudinally of the supports $p^2$ and preferably in two sections, as shown in Fig. 1, resting at adjacent ends on cross-bars $a$. At the outer edge portions of the grates K are upward-inclined grate-sections, forming side grates K', as shown in Fig. 2. The grates K extend in the plane of the plate $p^3$ and are of a width equal to or nearly equal to the distance between the adjacent sides of the cylinders $t\,t'$, the inclined grates K' extending from the edges of the grates K to the side walls of the furnace.

In operation the fuel is fed through the door Y and spread over the surfaces of the grates in a usual manner, the hot products of combustion therefrom rising under the arches H and escaping beneath the tubes or cylinders $t$ to the updraft-passage H', whence they spread under the surface of the boiler, pass backward over the bridge-wall, and thence forward through the boiler-flues to the chimney-flue X. The draft from the ash-pit to support combustion carries the products of combustion from the burning bed of fuel in the upward direction to fill the spaces beneath the arches, whence, owing to the direction of the draft, they are whirled downward against or in close proximity to the incandescent bed of fuel along the inner edges of the grates K, causing approximately complete combustion, all as set forth at length in my aforesaid Letters Patent.

The blocks I, forming the body portions of the arches and having high heat-storing properties, tend when once thoroughly heated to facilitate decomposition of the products of combustion beneath the arches, and in the present construction, to aid combustion in the upper portion of the spaces beneath the arches, I prefer wherever practical to provide draft-passages L in the bridge-wall extending from the ash-pit to the rear end of the fire-chamber beneath the arches. The draft-passages L terminate in preferably horizontal narrow elongated openings L', formed in metal plates or blocks set into the bridge-wall, as shown in Fig. 3, the openings tapering in the direction of the fire-chamber to increase the force of the draft, which is thus thrown far forward in the fire-chamber, supplying air to support combustion throughout the upper part of the spaces beneath the arches. It is found in practice that the draft-openings L' aid materially in effecting complete combustion.

I prefer to construct the bridge-wall of or substantially of the crescent shape shown, whereby the space between it and the boiler is largest below the center of the latter and becomes gradually reduced toward the upper end at the sides of the boiler. Thus the greatest draft will be below the central portion of the boiler instead of at the sides, as is commonly the case, and I have found in practice that I gain very materially in steam production by this construction.

The arches, constructed as herein shown and described, are designed to supersede the water-arches shown and described in my former patent above referred to. By preference the arches are given a slight downward inclination from the front to the rear of the fire-chamber. The circulation of water from the boiler is downward through the pipes $r^3$ $r^2$ and water-head $H^2$ or pipes $r$, thence through the tubes or cylinders $t\,t'\,t^2$, and thence through the pipes $s\,s^2$ back to the boiler. Where a water-arch comprising a single chamber, as in my aforesaid patent, is employed, the capacity of the chamber is so much greater than the pipes passing to and from it that the circulation through the chamber is necessarily slow, whereby over a very hot fire steam may be produced so rapidly therein as to tend to create a back pressure against the inlet-pipes and retard the circulation. In the present construction the tubes or cylinders $t\,t'\,t^2$ have all the capacity necessary to cause the water passing through them to be raised to the desired high temperature and effect rapid circulation without danger of creating a back pressure against the water entering at the pipes $r^2$. The pipes $r$, employed in the construction in Figs. 2, 3, and 4, and the tubes $t^3$ join the cylinders near the lower sides of the latter. By removing the screw caps or plugs $t^4$ brushes or scrapers may be readily inserted and passed along the base portions of the cylinders and through the pipes to clean them when desired.

By employing the supports $p^2$ and plate $p^3$ I dispense with a center wall in the ash-pit, which would not only increase the expense of construction, but also interfere more or less with the air-currents in the ash-pit.

The inclined side grates K' prevent the undue accumulation of fuel along the outer edges of the grates, their tendency being to cause the fuel as it is fed to roll or slide toward the center. Furthermore, they tend to produce a more or less horizontal side draft which stirs up the products of combustion in a way to greatly facilitate combustion.

The plate $p^3$ and its supports $p^2$ operate as a draft-deflector to prevent air-currents from entering the updraft-passage without first rising in the spaces beneath the arches. As before stated, to effect the best results the

deflector should be of a width not less than the distance between the inner vertical lines of the adjacent edges of the arches. By supporting the deflector, as stated, the central wall usually provided in the ash-pit is dispensed with. This wall not only adds to the cost of construction, but by separating the currents entering the furnace to supply combustion it is apt to render the currents which flow to the two grates, respectively, unequal in volume, thereby causing unequal combustion. In my improved construction the deflector has a clear space beneath it for the circulation of air throughout the ash-pit, whereby the objection to the presence of the wall is overcome.

The arches H, constructed as described, are a very desirable improvement. The tubes $t$ $t'$ $t^2$ form circulating-conduits which are always filled with water and practically indestructible, being rendered so more especially by providing them, first, of a capacity not too great to permit the water heated or steam generated therein to pass readily through the pipes $s^2$ to the boiler, and, second, by inclining them, as described, whereby the tendency of the current under the pressure generated in the tubes will be in one direction to maintain a constant circulation. The blocks or sections I, forming the body portions of the arches, store the heat and tend to neutralize the chilling effect produced by the circulating-tubes upon the hot products of combustion which rise under the arches. When it is desired for any reason to replace any of the sections with new ones, this may be done quickly and easily without disturbing the tubes or the other sections.

I do not limit my invention to the employment of two arches, and, if desired, two, only one, or more than three tubes may be provided in the arch to effect the desired circulation. I prefer, however, to employ two arches of the form shown, each constructed with three tubes or water-conduits, mounted as stated, and capable with their pipe connections of maintaining a circulation of sufficient volume and rapidity through the boiler to prevent deposits, and consequent formation of scale, upon the boiler sheet and flues.

I do not confine my invention to use in connection with a steam-generator, nor when so employed to any particular form of generator, and while I prefer to construct my improvements throughout as shown and described they may be variously modified 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 grate, an arch inclining downward in the backward direction and spanning said grate, and a discharge-passage at one side only of said arch and in a plane between the lower edge of the arch and upper surface of said grate, the arch being formed of a frame, comprising longitudinally-extending water-circulating tubes in communication at opposite ends with the boiler, and a body portion of refractory material supported upon the frame and filling out the space between said tubes, substantially as described.

2. In a boiler-furnace, the combination of two grate-surfaces separated by a close longitudinally-extending bed, an arch spanning each of said grate-surfaces, an updraft-passage between the arches above said bed, discharge-passages at the adjacent sides of said arches only leading to the updraft-passage, the arches being formed of frames, comprising longitudinally-extending water-circulating tubes in communication at opposite ends with the boiler, and body portions of refractory material supported upon the frames and filling out the spaces between the tubes, substantially as described.

3. In a boiler-furnace, the combination of two grate-surfaces separated by a close longitudinally-extending bed, an arch spanning each of said grate-surfaces, an updraft-passage between the arches above said bed, discharge-passages at the adjacent sides of said arches only leading to the updraft-passage, the arches being formed of frames, having parallel longitudinally-extending water-circulating tubes, $t$ $t'$ $t^2$, inclined downward in the backward direction, and in communication at opposite ends with the boiler, and body portions of refractory material supported upon the frames and filling out the spaces between the tubes, substantially as described.

4. In a furnace, the combination of an arch, comprising longitudinally-extending water-circulating conduits and a body portion formed of sections of refractory material fitting against and supported by the conduits, a grate-surface spanned by said arch, and a discharge-passage at one side only of said arch and in a plane between the lower edge of the arch and said grate-surface, substantially as and for the purpose set forth.

5. In a furnace, the combination with the ash-pit and two parallel companion arches separated by an updraft-passage and having outlets at their adjacent lower sides only communicating with said passage, of a grate below each said arch and spanned thereby, and a draft-deflector between the grates centrally beneath said passage and extending longitudinally above the ash-pit, the deflector being supported to leave an open-air circulating-space beneath it, and being of a width not less than the distance between the inner lines of the adjacent edges of the arches, substantially as and for the purpose set forth.

6. In a furnace, the combination of an arch, closed at the rear end, a grate-surface spanned by said arch, a discharge-passage at one side only of said arch and in a plane between the lower edge of the arch and said grate-sur-

face, a feed-opening for fuel at the front end of the space covered by the arch, and a draft-opening at the rear end of the said space above the plane of the said discharge-passage, substantially as and for the purpose set forth.

7. In a boiler-furnace, the combination with a horizontally-disposed cylindrical boiler, of a fire-chamber below one end portion of the boiler, and a bridge-wall at the end of said fire-chamber, of substantially crescent shape at its upper edge, whereby it extends below and up opposite sides of the boiler, and the space between it and the boiler is largest below the center portion of the boiler, substantially as and for the purpose set forth.

ORLAND D. ORVIS.

In presence of—
J. H. LEE,
R. T. SPENCER.