(No Model.) 2 Sheets—Sheet 1.

O. D. ORVIS.

STEAM BOILER FURNACE.

No. 524,029. Patented Aug. 7, 1894.

Fig 1.

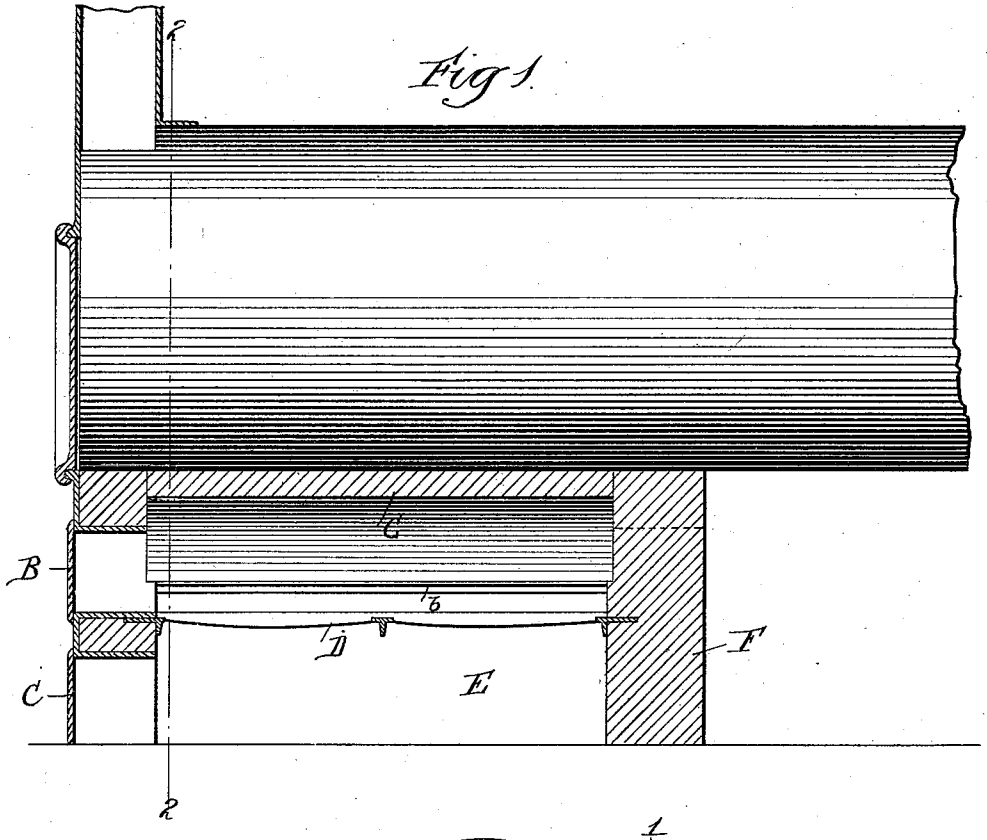
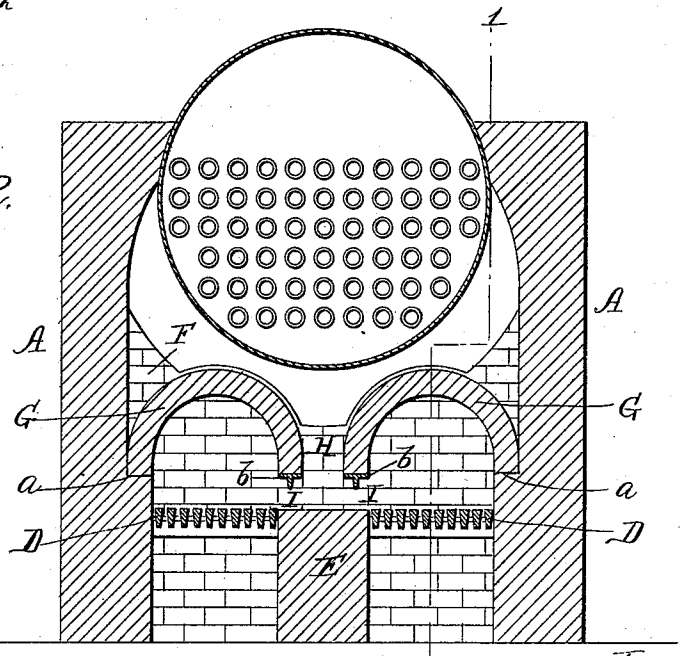


Fig 2.



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(No Model.) 2 Sheets—Sheet 2.

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Fig 3.

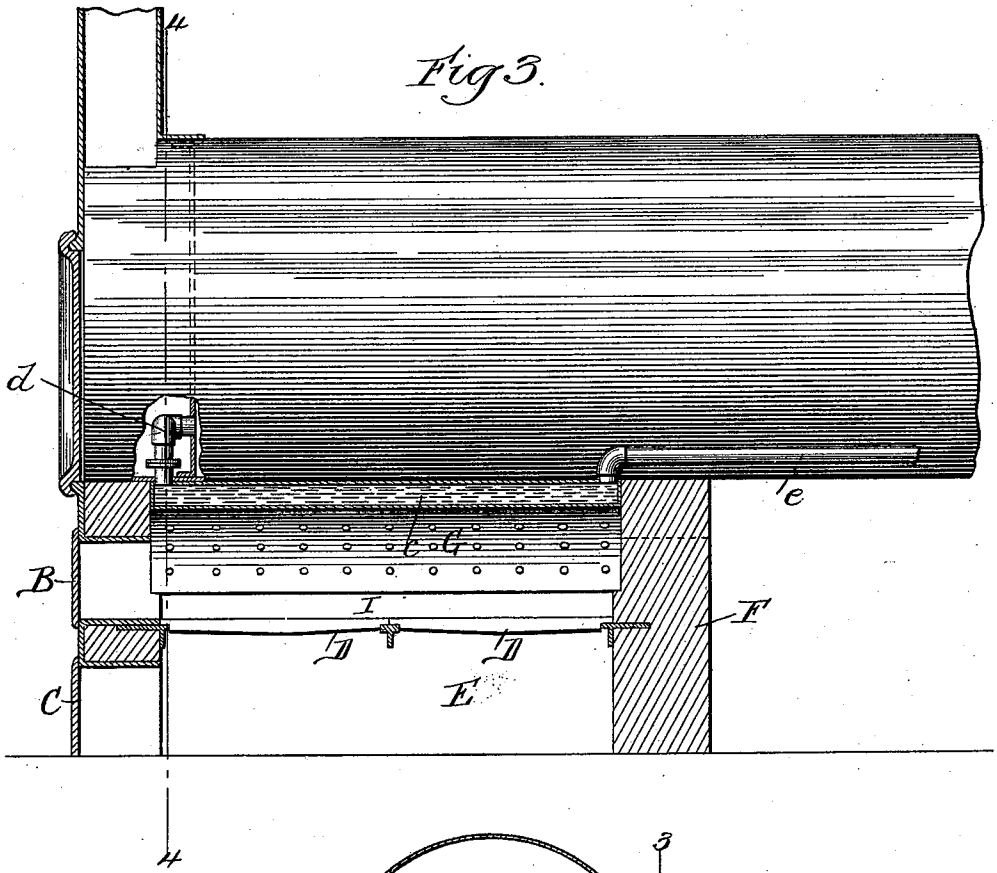
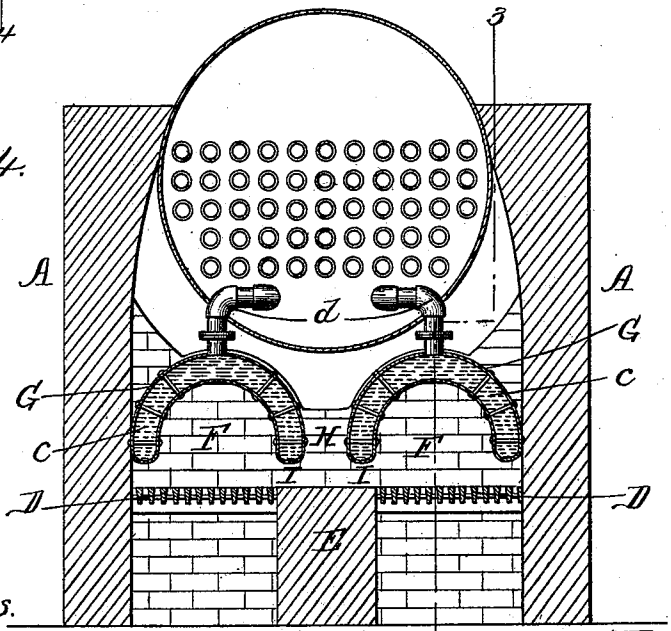


Fig 4.



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ORLAND D. ORVIS, OF CHICAGO, ILLINOIS.

STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 524,029, dated August 7, 1894.

Application filed August 24, 1893. Serial No. 483,971. (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 certain new and useful Improvements in Steam-Boiler and other Furnaces, of which the following is a full, clear, and exact specification.

This invention relates to improvements in steam boiler and other furnaces for promoting combustion and draft, and more specifically in that class of furnaces in which a boiler or other surface to be heated is, by means of an arch or arches, isolated from cold air conducted to the fire chamber for promoting combustion and draft, or unavoidably admitted thereto while raking down and firing, and also isolated from direct exposure to a bed of incandescent fuel on the grate bars whether burned or refractory fuel is used thereon.

The importance of my invention and the thereby securing of the objects hereinafter stated, may be appreciated when it is borne in mind that complete combustion and rapid draft in the presence of each other, are the essentials to a successful furnace, and that complete combustion in the absence of rapid draft reduces the efficiency of a furnace to practically the same degree as does incomplete combustion in the presence of rapid draft.

Absolutely complete combustion as nearly as may be obviously occurs in downdraft furnaces when properly operated, because all of the evolved products of combustion must pass downwardly through the bed of incandescent fuel on the grate bars before escaping from the fire chamber whereby they are maintained in the presence of the necessary degree of heat for and fully igniting them, but it is equally obvious that what is gained by complete combustion is substantially lost in the operation of the furnace owing to the unavoidable retardation of the draft due to conducting the products of combustion downwardly through the incandescent fuel before their escape into the updraft passage.

With all of the advantages of operation gained in a down draft furnace by having the updraft passage lengthwise of and adjacent to the fire chamber as shown and described in my joint patent, No. 486,122, granted November 15, 1892, and my sole patent, No. 503,214, granted August 15, 1893, there is still an absence of rapidity in draft and combustion to a degree rendering such furnaces objectionable when it is desirable to have the highest degree of heat diffused with maximum rapidity over a steam boiler or other surface to be heated.

Rapid draft exists almost without limit in updraft furnaces, but perfect combustion is impossible therein for that owing to this rapid draft a substantial portion of the evolved products of combustion are discharged from an igniting degree of heat before they have time to ignite, and are thence swept over the bridge wall and escape from the furnace without being utilized.

The securing of the rapidity of draft of an updraft furnace in down draft furnaces in which the updraft passage is at the rear end of the fire chamber would be a substantial advantage, but obviously nevertheless an advantage not to be compared with that of securing such a draft in a down draft furnace wherein the updraft passage is lengthwise of and adjacent to a single fire chamber structure because of the shorter, freer and quicker discharge into said updraft passage of the ignited products from the fire chamber in the latter construction as compared with the former, to say nothing of the increased boiler surface to which draft heat is directly applied by the latter.

Now while my invention includes the combining with all classes of down draft furnaces a so-called direct draft passage, it is obvious or will be later on, that in no single-arch structure having an updraft passage can combustion be absolutely complete because at best a small portion of the products of combustion will be swept out of the fire chamber without ignition, and hence some means must be provided for their ignition at a point beyond the fire chamber if absolutely complete combustion in the presence of rapid draft is to be secured. Absolutely complete combustion in the presence of this rapid draft however, may be secured by the use of a double fire chamber structure having lengthwise of, adjacent to and between said chambers an updraft passage, owing to the fact that all

products of combustion escaping unignited from the fire chambers must pass through the combined heat and flame of both fire chambers while impinging against each other in the updraft passage, and inevitably thereby be fully ignited before contact with the surface to be heated as is demonstrated by the practical operation of furnaces embodying the invention disclosed herein.

My invention therefore still more specifically relates to that class of down draft furnaces in which two fire chambers are employed, between which fire chambers, lengthwise thereof and adjacent to which is an updraft passage through which all products of combustion from both fire chambers must escape to a steam boiler or other surface to be heated.

The object of my invention generally stated is to combine in a furnace all the advantages of both a so-called down draft furnace and an updraft furnace without including in such structure any of the disadvantages of either, or in other words, to combine in a furnace all of the advantages of the perfect combustion in a down draft furnace and the rapid draft of an updraft furnace.

More specifically stated, the object of my invention is to provide for conducting the products of combustion evolved and ignited in an arch inclosed fire chamber from without the same to the updraft passage of a furnace without passing them downwardly through the incandescent fuel, but in such a manner that they shall be rapidly brought in contact with incandescent fuel on the grate bars immediately prior to their escape so as to insure their more nearly complete ignition.

Another object is to provide for conducting products of combustion from a double fire chamber of arched construction without passing said products through the bed of incandescent fuel but in rapid and direct contact therewith, and directly to an updraft passage lengthwise of, adjacent to and between said fire chambers whereby the resultant impinging of the flames and combining of the heat discharged from both fire chambers shall ignite all products of combustion escaping from either of said fire chambers unignited.

I attain these objects by features illustrated in the accompanying drawings, in which—

Figure 1 represents a longitudinal section of a furnace on line 1—1 of Fig. 2 embodying my invention showing its use in connection with a steam boiler. Fig. 2 is a transverse section of the same on line 2—2 of Fig. 1. Fig. 3 is a longitudinal sectional view on line 3—3 of Fig. 4, of a steam boiler furnace embodying my invention wherein the fire chamber is inclosed by a water arch connected with the boiler, and Fig. 4 is a transverse section of the same on the line 4—4 of Fig. 3.

Similar letters of reference indicate similar parts in the several figures of the drawings.

A A indicate the side walls of a furnace of the usual construction provided with an ordinary door or doors B, ash pit door or doors C and one or more grate surfaces D, which grate surfaces are separated by a wall E rising from the bottom of the ash pit to a plane with the upper surface of the grate bars and extending from the front wall of the furnace to a bridge wall F, but it would be no substantial departure from my invention to omit the wall E and have the grates contiguous to each other.

As shown in the drawings the grate surfaces are spanned by arches G closed at their rear ends by the bridge wall F which said arches join the side walls A A of the furnace, but at their opposing sides are separated by an updraft passage H which extends the length of the arches or fire chamber and is adjacent thereto and is the common and only updraft passage for the products of combustion of both fire chambers. These arches are supported in their operative positions in any suitable manner as for example, at one end by the bridge wall and at the other end by the front wall of the furnace, and are closed at their rear ends by the bridge wall F as shown, but may have closed ends of their own. Between the adjacent side edges or bases of these arches and the grate bar surface is a discharge passage I through which the products of combustion are discharged from the fire chamber into the updraft passage which said discharge passage preferably extends the entire length of the fire chamber and is of such a depth as to permit a free discharge of the products of combustion from the fire chamber to the updraft passage and at the same time, deflect said products against the incandescent fuel adjacent thereto to insure as nearly as possible the ignition of such products by contact with the surface of incandescent fuel, or in other words, to pass said products over the surface of the incandescent fuel in sheets sufficiently thin to insure their ignition to the highest degree consistent with a perfect freedom of their discharge from the fire chamber to the updraft passage, and also to prevent cold air admitted to the fire chamber in firing from chilling the crown sheets of the boiler or other surface to be heated, and any substantial volume of ignited products escaping from the fire chamber to the updraft passage.

In Figs. 1 and 2 the arches are shown of a solid construction with the outside bases of the arch supported by ledges *a* in the furnace wall and at their inner edges by bars *b* which may be embedded in the arch structure to better protect them from the destructive influences of direct heat, but said arches may be supported in any other suitable manner and be constructed of any material commonly employed or adapted for such purposes.

In Figs. 3 and 4 the arches are of a hollow construction, preferably of steel, but may be of any other material so as to form a water chamber constituting a water arch *c* over the

fire chamber and connected with the boiler by pipes *d e* at opposite ends thereof as shown in Fig. 3, so arranged that a perfect circulation of water between the arch and boiler is maintained, and the arches utilized as a supplementary heating surface for water, but the water heated in such arch may be used for any other purpose when the boiler is not used in connection with a furnace of my present invention.

The employment of the water arch in the manner shown and described is however the preferred construction for steam boiler purposes for the reason that the water heating surface of the steam boiler furnace is materially and substantially increased and the direct heat of the fire chamber is utilized for heating boiler water without any possible injury to the boiler, and besides such a circulation of water is maintained in the boiler that injurious precipitations and coating of the boiler thereby are substantially less than when no circulation exists.

In the practical operation of my furnace with an incandescent bed of burning or refractory fuel on the grate surfaces the products of combustion evolved or ascending through said incandescent bed as may be, rise in the chamber formed by the arches and then, owing to the draft, are caused to descend through the discharge passage I and impinge against each other in the updraft passage H, the depth of the discharge passages as before stated, being such that as far as possible all unignited products shall be brought in contact with the surface of the incandescent bed of fuel immediately prior to their discharge through the passages I.

An extended practical operation of my furnace however demonstrates that a maximum degree of rapid draft is not secured without a small portion of the products of combustion escaping unignited from the fire chamber, but that by having the flames of double fire chambers impinge in the updraft passage as before described and particularly at the moment of their discharge from the fire chamber, a degree of heat is produced through which none of the products of combustion can escape without being ignited, and hence, that by the use of the double fire chamber structure with an updraft passage common to both and arranged between and lengthwise of said chambers, the result is absolutely complete combustion with a maximum rapid draft in the presence of each other, and therefore that I am enabled by my furnace to supply heat to a steam boiler or other surface to be heated to the best advantage and with maximum economy. In this connection it is proper to observe that this advantage and economy accrue to the use in the fire chamber of liquid and gaseous fuel as well as solid fuel as will be understood by bearing in mind that ignited products of combustion whether from solid liquid or gaseous fuels, will, when ignited, rise in the fire chambers, and descend thence through the discharge passages thereof and impinge against each other in the updraft passage precisely the same, and therefore that in the operation of my furnace with any of these fuels, complete combustion in the presence of rapid draft being the result, my invention is not limited to the use of burning fuel on the grate bars as might possibly be inferred from the construction shown.

While the double fire chamber structure and the intermediate updraft passage common to both have the advantage of diffusing the heat from the center simultaneously to both sides of the surface to be heated and also that of such an impingement of the heat and flames of both fire chambers as to render combustion absolutely complete, it would be no departure from my invention to employ a single arch fire chamber with a draft passage adjacent to and extending lengthwise of one or both sides thereof, nor to have a fire chamber discharge passage between the grate surface and the end edge of an arch inclosing the fire chamber in a furnace wherein the updraft passage is at the rear end of said fire chamber, for my invention includes any single or double arch inclosed fire chamber construction provided with a discharge passage therefor substantially below the apex crown or top of said chamber and in a plane with or above the grate surface.

A prolonged practical operation of my invention as embodied in Figs. 3 and 4 of the drawings, herewith, demonstrates it to produce absolutely perfect combustion as nearly as may be, that the natural draft in and through the fire chamber is substantially as rapid as in any updraft furnace, that it will burn the cheapest soft coal and waste coal without producing smoke at the chimney, that it will diffuse a greater number of a given number of units of heat over the surface to be heated with better effect than any other structure even when such other structure is provided with an artificial or forced draft, that it will more quickly heat and evaporate a greater number of pounds of water with a pound of coal than any other furnace.

In conclusion it may also be observed that in a furnace of my invention the draft and the application of heat to the steam boiler or other surface to be heated are so full and complete that there is so little radiation of heat against the front of the furnace and even from the fire chambers during firing that a fireman experiences no discomfort when standing even for an unusually prolonged time immediately in front thereof, when with all other furnaces so heretofore employed the radiation of heat from the front of the furnace when standing at the same distance is unbearable for a comparatively short time, and the importance of this absence of radiation from the front of a furnace embodying my invention increases as the number of furnaces are increased in the battery, and as un-

avoidably or otherwise ventilation in the boiler room is decreased.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a furnace the combination of an arch, a grate surface spanned by said arch and a discharge passage at one side only of said arch and at a point between the lower edge of the arch and said grate surface, substantially as described.

2. In a furnace the combination of an arch, a grate surface spanned by said arch, a discharge passage at one side only of said arch at a point between the lower edge of the arch and grate surface, and an up draft passage adjacent said discharge passage, whereby all the rising products of combustion must descend in the fire chamber and discharge into the said up draft passage in a plane above the surface of the grate bars and substantially below the crown of the arch and thereby be subjected to a draft of maximum rapidity and maintained in an igniting degree of heat a sufficient time for the ignition of substantially all said products, substantially as described.

3. In a furnace, the combination of an arch, a grate surface spanned by said arch, and a discharge passage at one side only and extending longitudinally of said arch which said discharge passage is at a point between the lower edge of said arch and the grate surface, whereby a discharge passage of maximum length and minimum depth is provided for the fire chamber and all of the rising products of combustion therein are caused to discharge in a thin sheet from the fire chamber in a plane with or above the grate surface and substantially below the crown of the arch, substantially as and for the purpose set forth.

4. In a furnace, the combination of two or more arches, grate surfaces therefor spanned by said arches, discharge passages at one side only of each of said arches and at a point between the lower edges thereof and their respective grate surfaces and up draft passages adjacent said discharge passages, substantially as described.

5. In a furnace, the combination of arches arranged side by side, grate surfaces spanned by said arches, opposing discharge passages, at one side only of said arches, at a point between the lower edge thereof and the grate surface, an updraft passage extending lengthwise of and between the arches, and a wall rising from the bottom of the ash pit to a plane with the grate surfaces and separating said grate surfaces, substantially as and for the purpose described.

6. In a furnace, a double fire chamber embracing individual grate bar surfaces, circulating water arches inclosing the fire chamber, and an updraft passage lengthwise of and between said arches, in combination with a fire chamber discharge passage directly connected with said updraft passage, which said discharge passage is substantially below the crown or top of the fire chamber and in a plane with or above the grate bar surface, whereby a water arch furnace structure is subjected to the heat of perfect combustion in the presence of a maximum degree of rapid draft, substantially as described.

7. In a furnace, a double fire chamber embracing individual grate bar surfaces, circulating water arches inclosing the fire chamber, an updraft passage lengthwise of and between said arches, and a steam boiler connected with said arches in combination with a fire chamber discharge passage directly connected with said updraft passage which said discharge passage is substantially below the crown or top of the fire chamber and in a plane with or above the grate bar surface whereby a water arch furnace structure is subjected to the heat of perfect combustion in the presence of the maximum degree of rapid draft, substantially as described.

8. In a furnace the combination of the arches G G, grate surfaces D D, spanned by said arches, discharge passages I I at one side only of said arches, and at a point between the lower edge of the arches and the grate surfaces, and the up-draft passage H between and extending the entire length of both of said arches, substantially as and for the purpose described.

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