(No Model.)

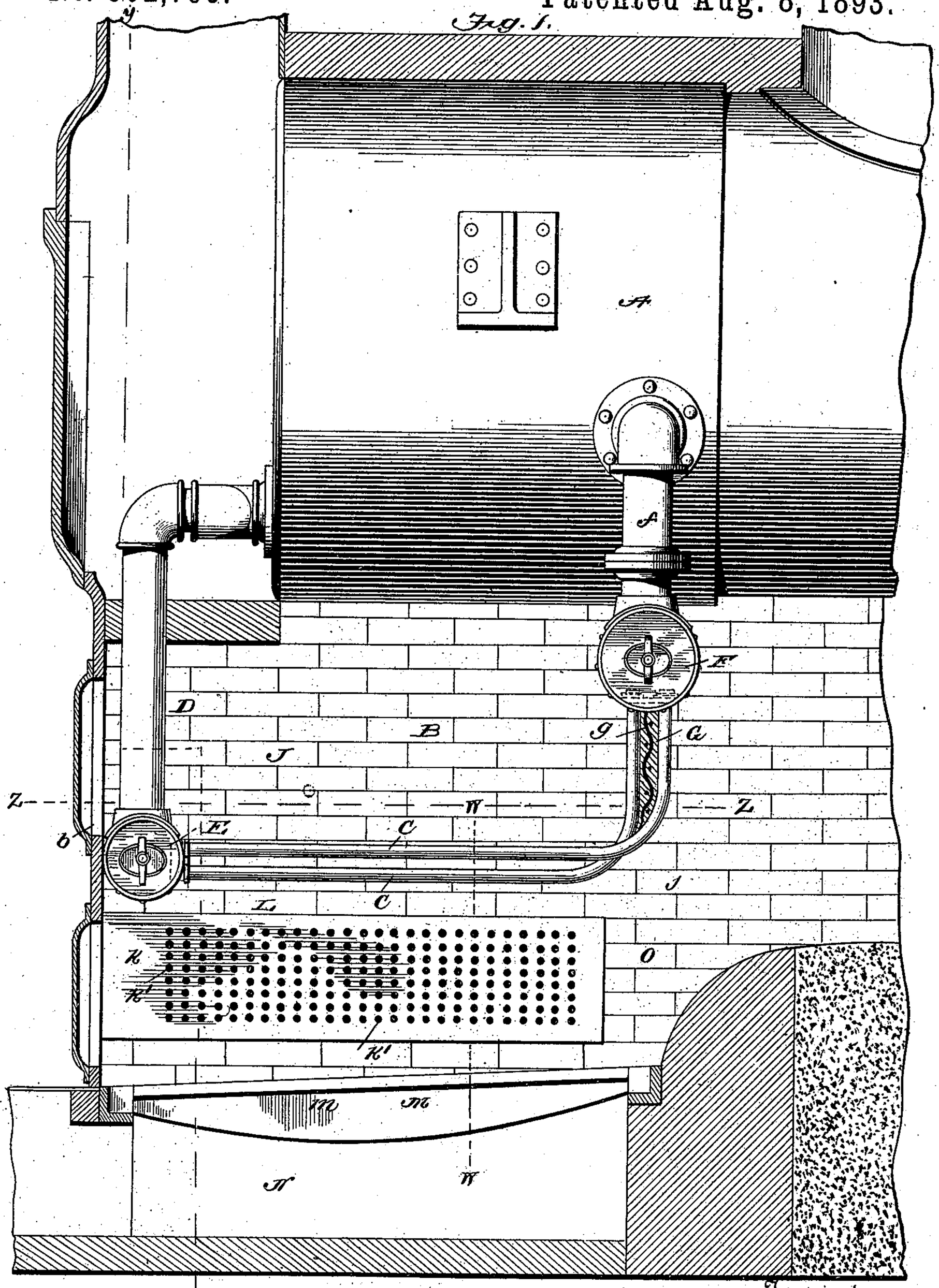
2 Sheets—Sheet 1.

G. H. WATSON.

STEAM BOILER FURNACE.

No. 502,795. Patented Aug. 8, 1893.

Fig. 1.



Witnesses

Inventor

George H. Watson

by Paul & Staley

Attorney

(No Model.)

2 Sheets—Sheet 2.

G. H. WATSON.

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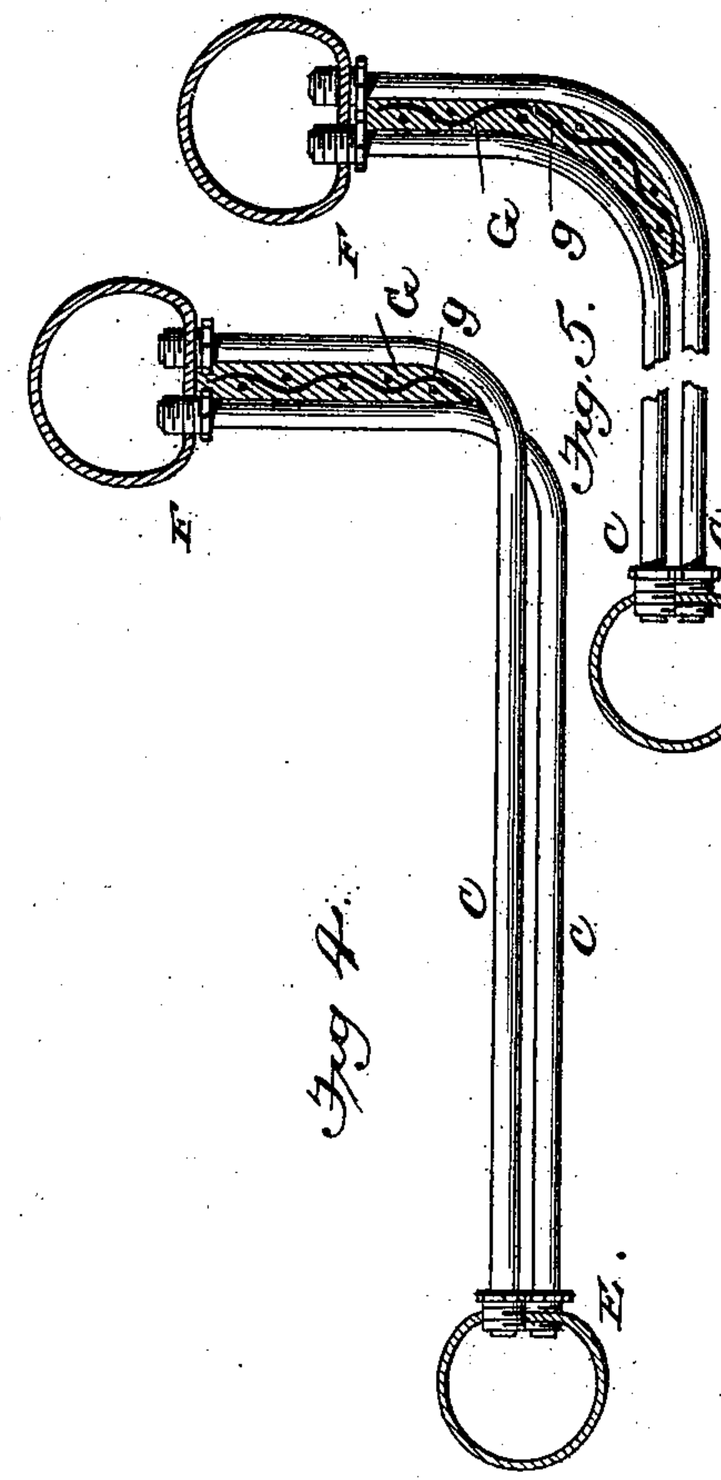

Fig. 4.

Fig. 5.

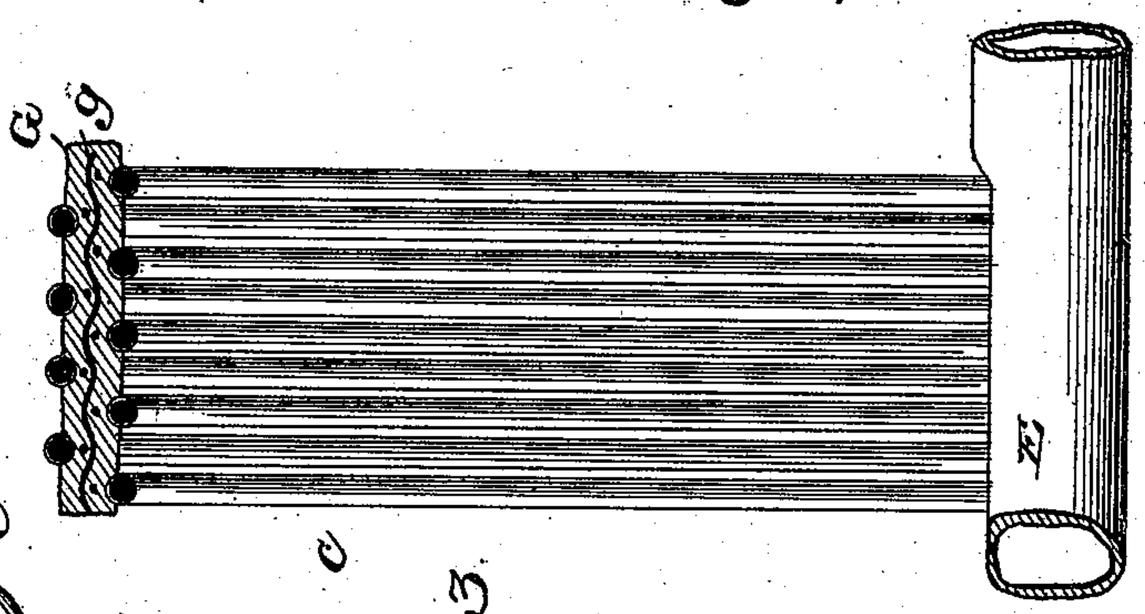

Fig. 3.

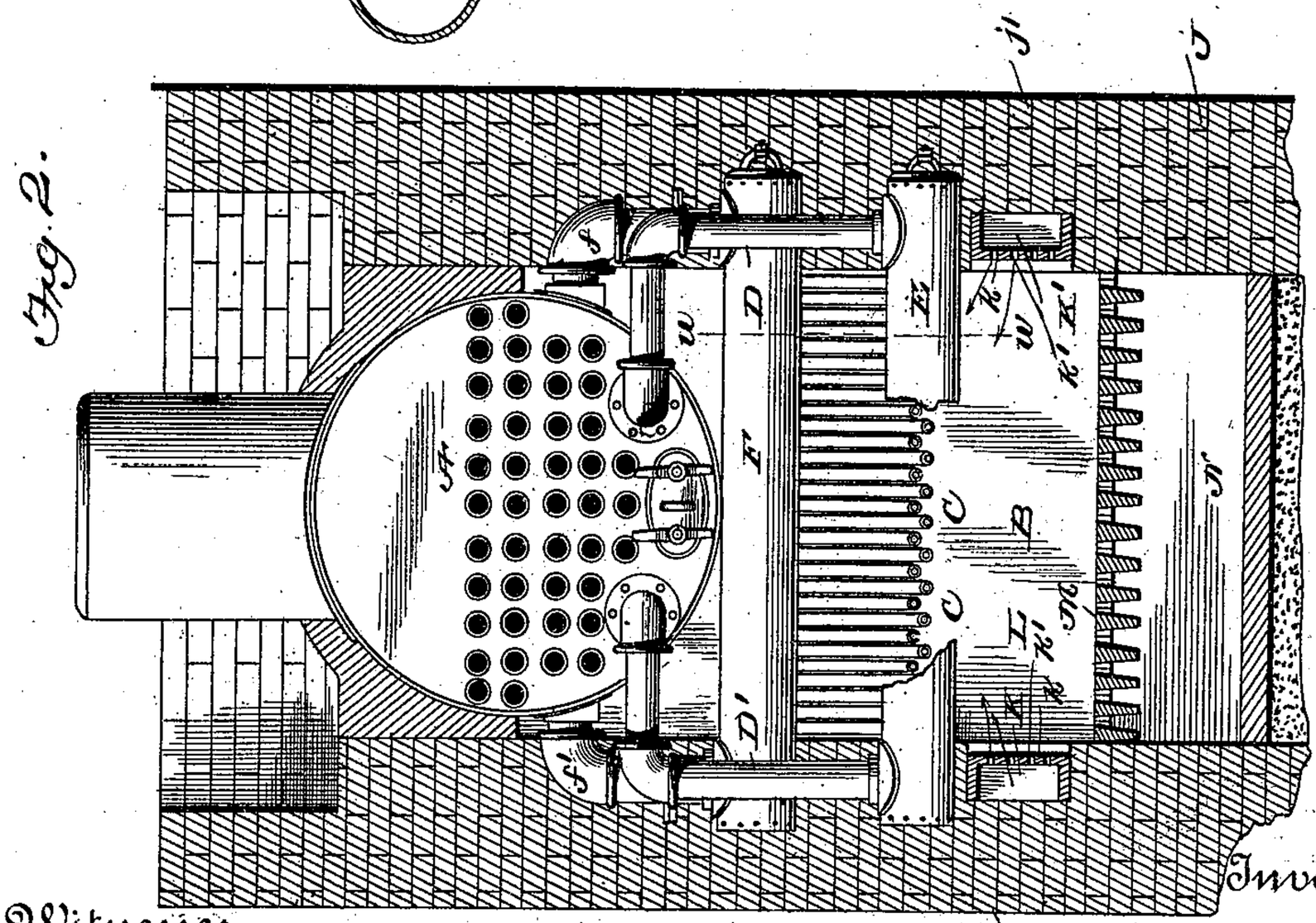

Fig. 2.

Witnesses

Inventor

George H. Watson.

by Paul & Hawley Attorney.

UNITED STATES PATENT OFFICE.

GEORGE H. WATSON, OF ST. LOUIS, MISSOURI.

STEAM-BOILER FURNACE.

SPECIFICATION forming part of Letters Patent No. 502,795, dated August 8, 1893.

Application filed December 30, 1892. Serial No. 456,759. (No model.)

To all whom it may concern:

Be it known that I, GEORGE H. WATSON, a citizen of the United States, residing at St. Louis, in the State of Missouri, have made a new and useful Improvement in Steam-Boiler Furnaces, of which the following is a full, clear, and exact description.

By means of the present improvement the heating surface of the boiler is increased, and also favorably disposed for the application of the heat thereto, the water circulation of the boiler is promoted, the profitable consumption of the fuel provided for, a capacious and exceptionally durable furnace obtained, as well as a downward draft, and all by means of an attachment readily adaptable to any ordinary form of boilers now in use.

My invention consists in general in the constructions and combinations all as hereinafter described and particularly pointed out in the claims, and will be more readily understood by reference to the accompanying drawings in which:

Figure 1 is a view showing improved construction in sectional elevation, the side of the boiler setting or casing being removed. Fig. 2 is a vertical cross section on the line *y—y* of Fig. 1. Fig. 3 is a partial plan view, or detail taken from the line *z—z* of Fig. 1. Fig. 4 is an enlarged cross section on the line *u—u* of Fig. 2. Fig. 5 is a similar view showing the modified arrangement of the upturned end of the hollow grate bars, or tubes.

The boiler, A, shown is of a familar type, saving as it is supplemented or modified by the improvement under consideration. Any other form of boiler to which the improvement is adaptable may be used.

B represents the fireplace of the boiler.

C C represent the water tubes which constitute the bars of the upper grate of the furnace. They are connected at both ends with the boiler to complete a free circuit for water through them. The connection at the forward end of the tubes may be in any suitable manner, and, for instance, as suggested in the drawings, in which pipes, D, D′, are shown leading from the boiler downward and connecting with a manifold, cross tube or chamber, E, arranged within the fireplace front, *b*, at or near the level of the bottom, of the fireplace, and with which the tubes C, are connected, substantially as shown. From their union with said manifold, tubes C, lead backward to the rear end of the fire place, at which point, and unlike the arrangement in previous analogous constructions, the tubes are turned and carried upward at the rear end of the fire place, and at the upper end thereof the tubes are connected with the boiler, and preferably by means of an intervening manifold, cross tube, or chamber, F, in turn, and by means of pipes, *f*, *f′*, united with the boiler, and all so as to provide for a water circulation to and from the boiler through the described tubes and manifold—that is, the tubes, C, form not only the bottom of the fire place, but also the rear wall, or at least a portion of the rear wall, of the fireplace. The only part not so formed is that above the manifold F, between the same and the boiler, which space is usually filled with brick, to compel a downward draft through the horizontal part of the grate and the fuel that may at any time be on the same. I close the spaces between the up-turned ends of the pipes, tubes or bars thus effectually preventing the draft or air current passing over the fuel and through the back of the grate without going down through the fuel. I preferably employ fire clay applying the same in a plastic state to fill the openings between the upright rear ends of the pipes. The water tubes or bars are formed of single pieces of pipe having their rear ends bent or curved upwardly as shown, and each providing an unbroken, uninterrupted passage for the water, separate elbow joints being thus dispensed with. I have however employed long horizontal pipes and short vertical sections connected by elbows, but much prefer the bent pipe shown.

Incidentally I have illustrated the means for making water tight non expansible connections between the manifolds E and F and the ends of the water bars C. The sides of the manifolds are flattened and the threaded ends of the pipes secured in threaded openings in said flattened sides by both internally and externally threaded sleeves or bushings, first backed down on the pipe threads and then after the ends of the pipes have been inserted in the manifolds, turned out into the manifold openings. The matter of

holding the refractory material of fire clay in place upon the upturned part of the down draft grate is of great importance, for it will be seen that in case the material between the pipes or bars C, becomes loosened and drops down or cracks so as to make openings between the pipes the action of the down draft and the results thereof will be almost destroyed.

For holding the refractory material, whether in cement or block form, in place, I make what may be termed a crotch or seat for the lower edge thereof by extending the upturned ends of the upper row of grate bars or pipes through between those of the lower row so that the ends of the upper pipes will stand back of the ends of the lower pipes. The turn or bend of the upper pipes or bars thus forms a seat for the refractory filling which being prevented from moving sidewise by the vertical pipes is at all times firmly held in place. To prevent cracking of the refractory filling G, I preferably bond the same with wire netting *g*, embedded therein. The refractory filling may be held in place between the parallel curved upper end of the tubes or bars as shown in Fig. 5, the space between the vertical parts being larger than that between the horizontal parts. I however much prefer the construction first described.

The intense heat upon both sides of the upright part of the water grate while the furnace is in use renders the use and exposure of such parts very desirable as adding greatly to the heating surface of the boiler and consequently its efficiency. A further advantage of this construction accrues from the substantially horizontal and right angle form of the water grate providing ample space for a large amount of fuel. An additional and important advantage however derived from the described construction of the tubes or grate-bars C, is as follows: By making a bend or turn, substantially as described, in the pipes, and extending them upward to bring the inner, upper, ends of the tubes well above the hottest part of the fire before uniting with the manifold not only is the liability of the pipes to work loose, or to get out of order under the influence of the heating and cooling to which they are subjected, diminished, and the durability of the furnace increased, but the difficulty arising from the slackening of the water circulation, and from the collection of dirt and incrustation in the pipes and connecting chambers, which is liable to occur when the water tubes are not carried upward but are made to connect with a manifold or chamber having more cross sectional area than the tubes at or in the immediate vicinity of the bottom of the fire place, or to connect with a manifold or chamber in such a manner as to form pockets in which dirt or scale can collect, is materially diminished if not obviated. If desired the space L beneath the water grate may serve as an ash pit, but in the present instance I have shown, a lower grate M, used in conjunction with the fire place B—that is, by the introduction of the described lower grate into the construction, a lower upward-burning fire place adapted for receiving and burning fuel is obtained, and when fuel is consumed upon such a lower grate it and the fuel burning in the fire place D mutually operate to produce a more complete and effective combustion in the space L than would be obtained in the case if either fire place were operating by itself. A suitable ash pit, N, is arranged beneath the lower grate.

O represents the escape flue into which the products of combustion and heat currents pass from the space L.

An additional feature of the improvement is shown in Figs. 1 and 2. It consists in admitting air, and particularly in the form of finely divided jets, into the space beneath the tubes C. In the side walls, *j*, *j'*, of the setting J, chambers K, K', are formed which are adapted to receive air and which is admitted to them through inlets arranged preferably at the front of the construction. These chambers are of any suitable construction and proportions suited to the end in view and there is one of these chambers at each side of the space or combustion chamber L, beneath the fire place B. The face or outer wall *k*, of the chambers K, K', is in practice a tile of suitable refractory material, and which has small openings *k'* which establish communication between the interior of the chamber and the space L, and on admitting air into the chambers K, K', it flows thence through the openings *k'* into the space L as indicated by the arrows in Fig. 2, and there promotes the more complete combustion of the fuel.

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

1. A fire place whose grate-bars are in the form of water tubes extending from the front of the fire place toward the rear end thereof and there turned and carried upward, the spaces between the upturned ends thereof being closed to prevent the passage of draft through the same, substantially as described.

2. A fire place whose grate-bars are in the form of two sets of water tubes, an upper and under set, and extending from the front of the fire-place to the rear end thereof and there turned and carried upward, and the spaces between the upturned parts being filled with a suitable refractory material, substantially as described.

3. A fire place whose rear end is partially closed by means of water tubes, and completely closed by the same and a fillng of a refractory material arranged between said tubes, said tubes extending upward and downward, and at the lower end thereof being extended forward to support the fuel, substantially as described.

4. A fire place whose grate bars are in the form of water tubes extending from the front of

the fire place toward the rear end thereof, and there turned and carried upward, all of said tubes being exposed to the direct heat of the furnace throughout their length, and being separated from each other throughout their length, and the spaces between the upturned ends of the tubes being filled with refractory material, substantially as described.

5. The combination in a down draft furnace, of the boiler and the water tubes, said water tubes at their ends being connected with said boiler to enable the water thereof to circulate through them, and said tubes between their ends being bent or turned, and the space between the upturned rear ends of said tubes being filled to prevent longitudinal air currents through the same, substantially as described.

6. The combination of the boiler and the water tubes, said tubes at their ends being connected with said boiler to enable the water thereof to circulate through them, and being extended substantially horizontally to form the grate of the boiler furnace, said tubes at their rear ends being bent and carried upwardly to form with a filling of the refractory material arranged between them, the rear end of the fire box, the outer surfaces of said pipes being exposed, substantially as described.

7. The combination in a furnace of the upper water grate, with a lower grate, an intermediate combustion chamber, an escape duct leading therefrom, draft opening being provided above said upper grate and beneath said lower grate, the inclosing walls, air ducts K arranged in the sides thereof and having the fine perforations leading into the sides of said combustion chamber, substantially as and for the purpose specified.

8. A down draft grate composed of water tubes connected with a reservoir, said tubes being arranged in two alternated sets and all being bent up at their rear ends, the ends of the upper set being projected through between the upturned ends of the lower bars, all in combination with a refractory filling arranged between the upturned ends of said bars or tubes and supported in the crotch or seat so formed, substantially as described.

9. A down draft grate composed of water tubes connected with a reservoir, said tubes being arranged in two alternated sets and all being bent at their rear ends, the ends of the upper set being projected through between the upturned ends of the lower bars, all in combination with a refractory filling arranged between the upturned ends of said bars or tubes and supported in the crotch or seat so formed, and wire netting embedded in said filling as and for the purpose specified.

Witness my hand this 20th day of December, 1892.

GEO. H. WATSON.

Witnesses:
C. D. MOODY,
A. BONVILLE.