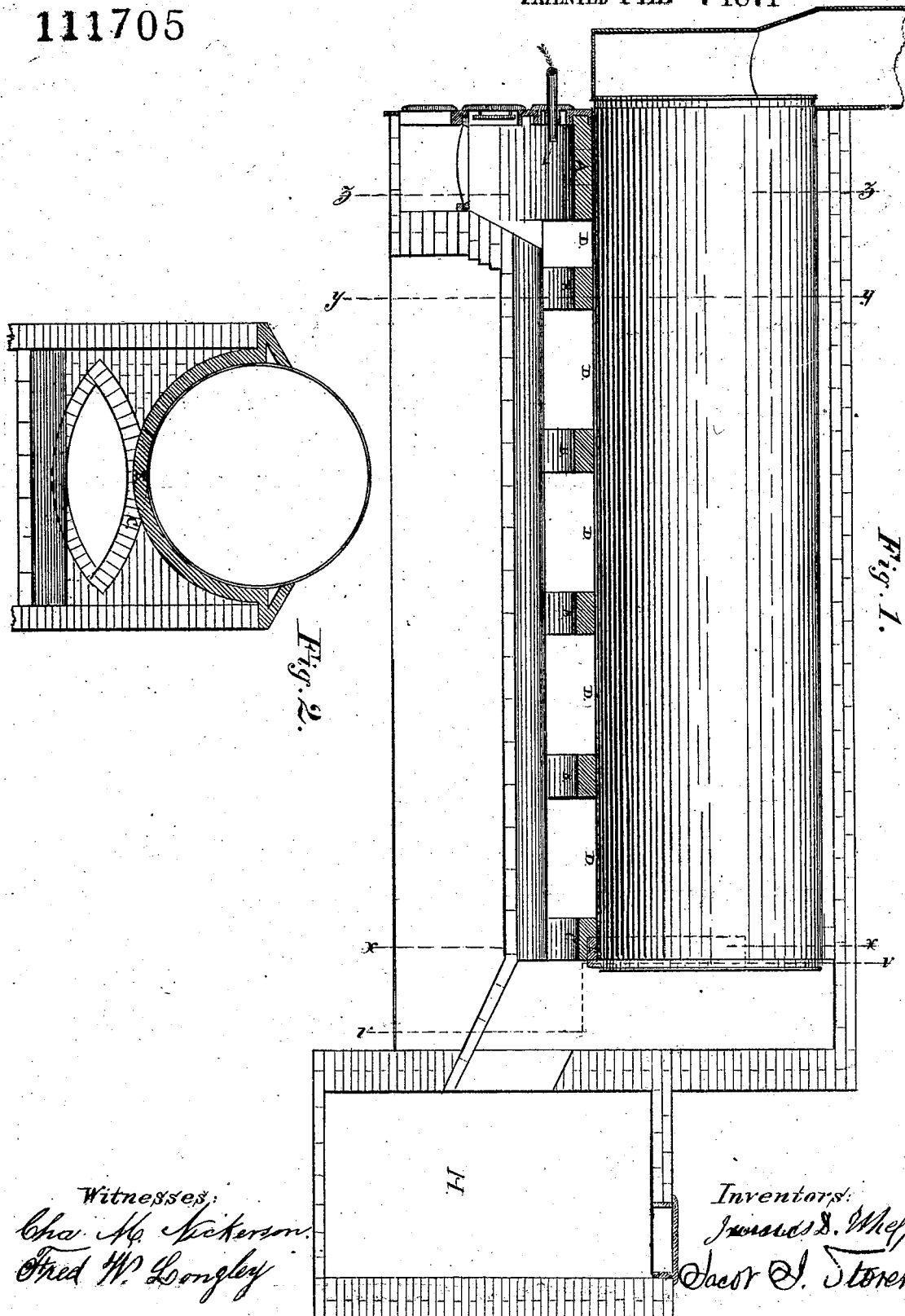


J.D. WHELPLEY & J.J. STORER. 2 Sheets.
Sheet 1.
Furnaces for Burning Pulverized Fuel.
PATENTED FEB 7 1871

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2 Sheets.
Sheet 2.

Furnaces for Burning Pulverized Fuel.

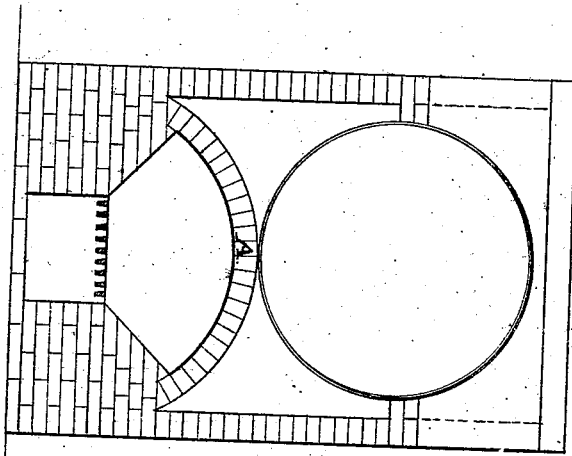


Fig. 3

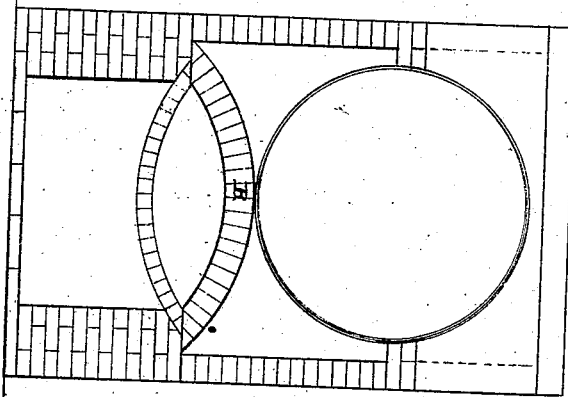


Fig. 4.

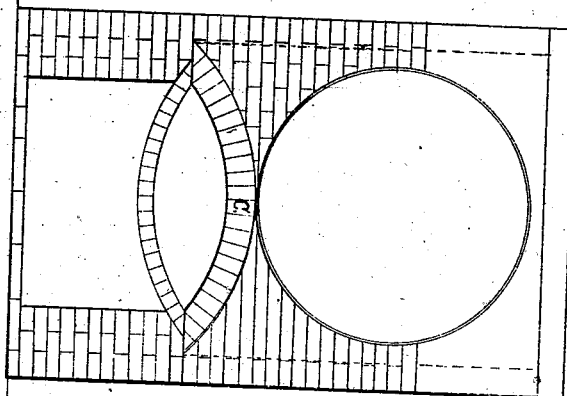


Fig. 5.

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UNITED STATES PATENT OFFICE.

JAMES D. WHELPLEY AND JACOB J. STORER, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN FURNACES FOR BURNING PULVERIZED FUEL UNDER STEAM-BOILERS, EVAPORATORS, &c.

Specification forming part of Letters Patent No. **111,705**, dated February 7, 1871.

To all whom it may concern:

Be it known that we, JAMES D. WHELPLEY and JACOB J. STORER, of Boston, Massachusetts, have made a new and useful Improvement in the Construction of Furnaces and Combustion-Chambers for Burning Pulverized Fuel under Steam-Boilers, &c., and in setting and arranging the flues and passages of such furnaces so as to obtain the best results from the use of pulverized fuel in heating steam-boilers, in distillation of liquids, in evaporating salt brines and saccharine liquids, and similar applications of heat; and we hereby declare the following to be a full and exact description of the same, reference being had to the accompanying drawing, which forms a part of this specification.

In our patent of March 13, 1866, reissued March 1, 1870, No. 3,857, we have described a general method of using pulverized fuel which is adapted to all the ordinary operations requiring heat.

In our Patent No. 76,280, dated March 31, 1868, we have described the construction of furnaces and boiler-settings so as to secure more perfectly the advantages to be derived from the use of pulverized fuel.

Our present invention is a still further improvement upon that covered by the last-mentioned patent.

The first part of our improvement consists in adding to the arched combustion-chamber described in Patent 76,280 a series of other narrow arches under the boiler, so arranged as to deflect and break up the current of fuel and flame as it passes under the boiler or through the combustion-flues; second, in hanging the boiler in such a manner as to have a clear hearth and flue under it, so that the ashes may be more readily removed and the burning of the supports prevented; third, in the arrangement of an ash-pit so as to receive the ashes as removed from the flues; fourth, in the combination of combustion flues and channels having surfaces concave toward the boiler, with a combustion-chamber arranged so as to burn gas and pulverized fuel.

In the drawing, Figure 1 shows a longitudinal section and elevation of a steam-boiler set according to our invention. Fig. 2 shows a method of supporting the boiler so as to leave

the flues and passages unobstructed. Fig. 3 is a cross-section in the line *zz* of Fig. 1. Figs. 4 and 5 are similar cross-sections in the lines *yy* and *xx* of Fig. 1.

The same letters indicate like parts in all the figures.

Our invention may be applied to all kinds of boilers, evaporating and distilling apparatus.

In our patent dated March 31, 1868, No. 76,280, we described, as part of our improvement in the setting of steam-boilers, a brick arch thrown over the fire-place, under the front of the boiler, to serve as a radiator of heat upon the column or jet of pulverized fuel and air projected through the fire-pot.

As our process of applying pulverized fuel to the generation of steam in boilers has become further developed, we have found that great advantages are gained by the following improvements in the setting of a boiler. The plan is especially applicable to flue, tubular, or plain cylinder boilers set horizontally, to which it has been applied. Some modifications, involving, however, no departure from the principle, would be necessary to adapt it to other boilers.

We retain, as features in this our new method, the concave hearth under the boiler, which radiates the heat toward its longitudinal axis, the small fire-box and grate-surface, and the brick arch (preferably without perforations) thrown over the fire-box, to serve as a radiator of heat upon the column of entering pulverized fuel and air and upon the fuel on the grate.

We prefer now to have the arch over the fire-box extend inward from the boiler-front but about eighteen inches to two feet, or only so far as to offer so much heat-radiating surface that the gases of the fuel may be well distilled and ignited before they come under the influence of the heat-absorbing boiler-surface beyond the arch.

In using pulverized fuel the coal particles, upon the distillation of the gases from them, become particles of coke, which burn with more or less readiness while floating along in the projected burning gases.

In a heated furnace, from every portion of the interior walls of which heat is radiated,

these minute floating particles of carbon are quickly consumed, the earthy residuum or ashes, in very fine powder, being carried out of the furnace by the draft. With a boiler containing water the conditions are different.

The bottom of a boiler under which the current of flame holding in suspension the fine particles of unburned coal or coke passes presents so very powerful a heat-absorbing surface that the current of gases and floating carbon coming in contact with the boiler is quickly cooled below the point of combustion, the result being greater or less loss of fuel by escape by the stack, and deposition in ash-pits, tubes, and flues of unconsumed carbon.

When a fire burns under a boiler without blast, with only a natural draft, the column of flame moves along in an almost undisturbed current, presenting only its upper surface in contact with the boiler, and observation has shown its heat is so quickly absorbed by this contact that incandescence ceases within a short distance.

One of the eminent advantages of a blast under the fire-place, according to Professor Rankin and other authorities, is that it breaks up or causes to reverberate this otherwise smoothly-flowing current of flame, and makes it present frequently to the boiler fresh incandescent surfaces. It is evident, then, that to obtain under a boiler the fullest value from the flame it should be made to reverberate as much as possible, in order that it may present to the boiler all the heating-surface it is capable of doing.

Our method of obtaining this desirable result is to build a succession of brick arches or their equivalents as radiators and deflectors, as shown in drawing, at intervals of two feet, more or less, under the boiler throughout its length. These arches or deflectors give excellent results, whether they be four and a half inches or nine inches wide—i. e., the length of a half or of a whole brick—but may be made continuous, with openings to admit hot air to the bottom of the boiler, if desired.

Whether the fuel be consumed in the usual way on grates, or pulverized fuel be used according to our method, the column of flame with irresistible tendency presents its upper surface to the boiler, and almost instantly parts with much of its heat. If interrupted by an arch its forward motion is checked, and it is made to reverberate and roll about, so that it presents a fresh heating-surface to the bottom of the boiler in the exposed space above and between the first and succeeding arch. This action is repeated by each successive arch for the length of the boiler until, to the limits of practicability, the flame has given up its heat.

After a few hours of work the arches become sufficiently heated to radiate heat, thus insuring, as an additional advantage to their disturbance of the flame, a more complete combustion of whatever unconsumed gases and particles of carbon may be passing under

the boiler. By this arrangement the ashes and floating particles of carbon are detained and precipitated upon the hearth, instead of moving forward and depositing in the flues and tubes.

In the drawing, A is the first arch, extending entirely or partially over the fire-place. B B B are the narrow arches, set at intervals of the length of the boiler. C is the last arch, at the rear end of boiler.

The space above the arch C, between it and the boiler, is filled up with brick, to afford a check to the easy passage of the floating dust and ashes into the tubes or flues, and to cause them rather to deposit on the hearth or in the rear ash-pit, and to create full reverberation of the flame.

The arches B B B permit the flame to pass over and under them. D D D are the intervals between the arches, where the flame more readily is presented to boiler-surface.

Usually, standards of cast iron, resting on the hearth, are employed for sustaining the boiler. We dispense with these, and, instead, use a wrought-iron support or supports, E, as shown in drawing. By the use of these the hearth is left clear and without obstruction, so that the ashes lodging thereon can easily be removed by a proper tool; besides, the heat under a boiler set according to our plan would soon destroy the usual standard.

The support E is guarded by the brick arch C. As many of these supports as are required may be used.

H is the rear ash-pit, for the reception of the ashes that may be precipitated into it from the moving column of flame, and for what may be pushed or drawn into it in cleaning the tubes, flues, or hearth.

When using pulverized fuel most of the ashes deposit on the hearth; and when it has accumulated so as to be likely to offer an obstruction to the draft, it must be pushed or drawn into the ash-pit, whence it may be removed after being sprinkled with water to prevent the rising of the dust. This rear ash-pit or depository should have a removable cover; but a pit or pits may be made at either end of the hearth, or at any place under the boiler, in which the ashes may be collected, and whence it can be conveniently removed.

The arches A, B B B, and C, or their equivalents, are of great advantage, whether firing, as is usual, with lump or solid fuel, or with lump and pulverized, as by our method. So, also, is the concave hearth extending under the boiler; but the ash-pit H is of much importance only when our process is applied.

Instead of using a fire-box with solid fuel, a gas-generator may be employed, as described in our Patent No. 109,785, dated November 29, 1870; or the gas-generator and blast-heating apparatus may be combined, as described in our Patent No. 111,288, dated January 24, 1870.

There is, however, usually no special need of intense heat under steam-boilers and evaporators, and therefore the blast-heating appa-

ratus is not always desirable, except as it is useful in securing more perfect combustion.

When a long series of boilers or evaporators are mounted in a single furnace or combustion-chamber, the flame may be re-enforced at as many points as desirable by bringing in additional jets of pulverized fuel and air, or of pulverized fuel and gas and air.

Such devices, being already known, need not be particularly described; but at each place where fresh fuel is added there should be provided, to insure best results, a supplementary arched combustion-chamber, so as to secure perfect burning or gasifying of the fuel, as hereinbefore explained. These improvements, though especially designed for burning pulverized fuel, are also applicable when lump-coal, wood, or other solid fuel is used, and also in the use of gaseous fuel.

Though we prefer the concave hearth under the boiler, in combination with the arches, on account of its superior effect, to the usual flat hearth, or to the common hearth, broken or interrupted by pits or chambers, still we might, under some circumstances, use or retain either of these in combination with the arches.

Having thus described our invention, what we claim, and desire to secure by Letters Patent of the United States, is—

1. The arched combustion-chamber, in combination with grate-bars, and separate blast to the combustion-chamber and under the grate-bars, substantially as and for the purposes described.

2. The arrangement of a series of arches or deflectors under a boiler or evaporator, so as to break up and deflect the current of flame and gas, substantially as described.

3. The combination of the arches B B B and C and the concave hearth, as shown and described.

4. The arrangement of the ash or cinder receptacle with the combustion-flues, as described.

5. The combination of the solidly-arched combustion-chamber with the reverberating-flues and the supporting and deflecting arches, substantially as described.

6. The device shown in Fig. 3, for supporting the boiler over the concave flue, for collecting the cinders, as described.

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