2 Sheets—Sheet 1.

T. R. BUTMAN

FURNACE AND BOILER SETTING.

No. 177,467. Patented May 16, 1876.

Fig. 1.

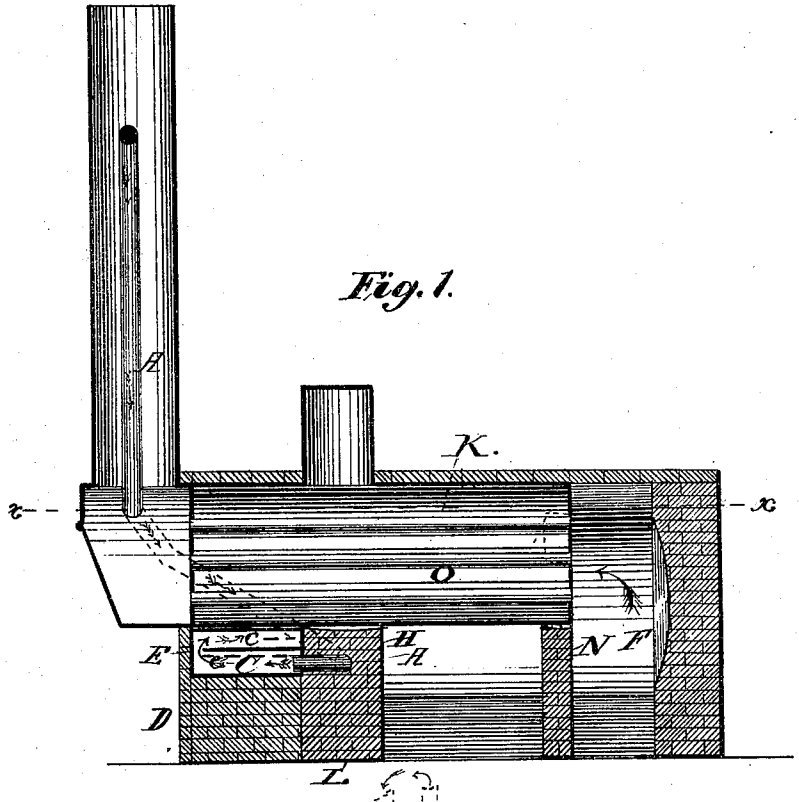
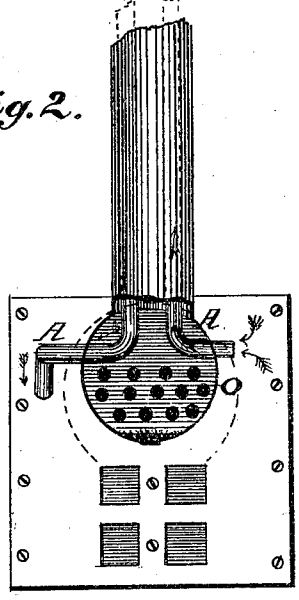


Fig. 2.



Witnesses.

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2 Sheets—Sheet 2.

T. R. BUTMAN.

FURNACE AND BOILER SETTING.

No. 177,467. Patented May 16, 1876.

Fig. 3.

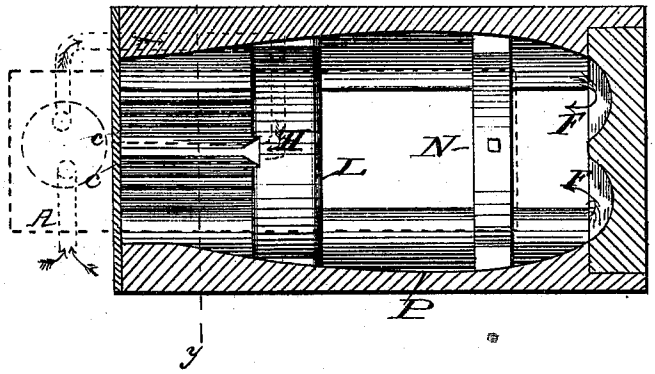


Fig. 4.

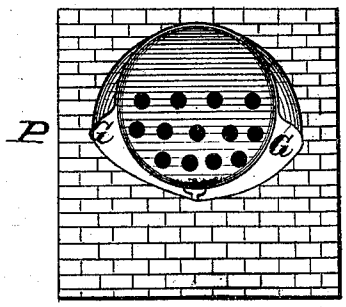


Fig. 5.

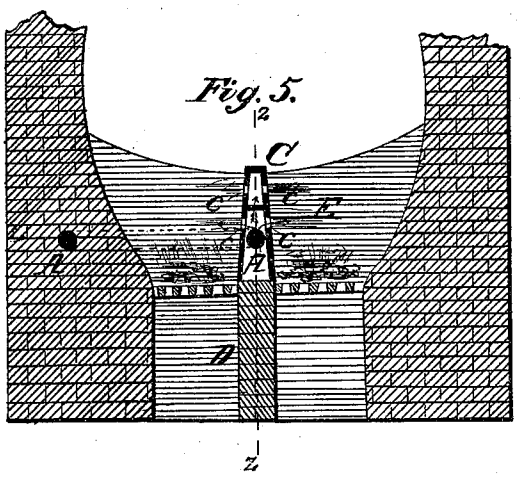
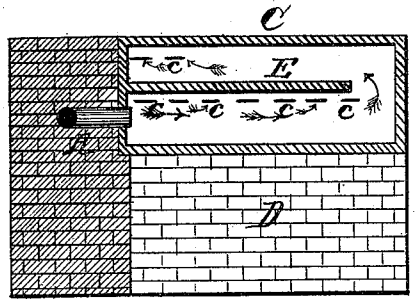


Fig. 6.



Witnesses.
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Thomas R. Butman
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UNITED STATES PATENT OFFICE.

THOMAS R. BUTMAN, OF MILAN, OHIO.

IMPROVEMENT IN FURNACES AND BOILER-SETTINGS.

Specification forming part of Letters Patent No. **177,467**, dated May 16, 1876; application filed March 16, 1876.

To all whom it may concern:

Be it known that I, THOMAS R. BUTMAN, of Milan, in the county of Erie and State of Ohio, have invented certain new and useful Improvements in Furnaces and Boiler-Settings; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it appertains 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 is applicable to a variety of boilers, but I will illustrate it by means of the common cylindrical flue or tubular boiler; and its objects are, first, the avoidance of blistering or burning the boiler where the sediment or incrustation is well known to accumulate; second, the nearly perfect combustion of fuel by the introduction of the proper supply of oxygen, or what is well known as atmospheric air; third, the proper impingement of the flame upon the sides of the boiler; fourth, the disposition of the fuel in such a manner that all the combustible gases will be consumed, and thereby the avoidance of smoke, and economy in fuel.

Figure 1 is a central vertical longitudinal section of a boiler and furnace, showing the division-plate in the hollow division-wall, and also the heating-pipe in the uptake. Fig. 2 is a cross-section through the smoke-box, illustrating the smoke-box partly broken away, and the two branches of the heating-pipe. Fig. 3 illustrates a horizontal central section, showing the concave side and the conical end deflector, by which the heat is fiercely thrown back, and strong impact given to the flow, whereby it is made to impinge with greater force upon the sides and flues. Fig. 4 shows a cross-section at the rear end of the boiler and setting, with the depending diaphragm or partition G extending from the roof of the reverberatory chamber to the top, and extending down the side of the boiler to a point below the water-line. This figure also illustrates the configuration of the concave sides of the flame-chamber in cross-section, and also the form of the reverberatory or dead chamber on upper sides or top of boiler, and back of pendent partition. Fig. 5 illustrates the position of setting before the boiler is put in place, showing plainly the hollow longitudinal division-wall immediately under the vertical center of a cylindrical boiler, the sides of which are perforated with horizontal slits, and the division-plate by which the wall is divided. This figure also shows a cross-section of the grate-bars. Fig. 6 is a longitudinal section of the hollow perforated division-wall, and the location of the separating-plate by which it is divided.

I will now proceed to describe the nature of the first feature of my invention, viz., the blistering or burning of a boiler where the sediment collects or accumulates. As, for example, it is too often the case that the internal deposit is so extensive on the plates acted on by the flame that the heat cannot reach the water before burning the plates, as shown in Figs. 2 and 4, where the sediment settles mostly in a boiler. The effect of this deposit or incrustation on the heating-surfaces is that in proportion to the amount of solid matter accumulated, combined with the non-conductive property, so will the evaporation be retarded, and the relative plate exposed to the action of the flame be burned, so that two evils are produced actually from one cause, viz., the burning of the boiler-plate, and the non-evaporation of steam. Now, to remedy this defect is the object of the first feature of my invention.

In setting my boiler I locate a hollow wall, running longitudinally with the length of the boiler. This wall divides the furnace-chamber or fire-box, and is provided at its sides with horizontal slits, through which air is forced. The wall runs also up to the bottom or central vertical line of the boiler, and the slits arranged above the fire-bed.

Now, the air may or may not be heated, but preferably heated before entering the wall or partition; but, if not, the air in most cases will be sufficiently heated by passing through the hollow wall itself. The air thus supplied to the hollow wall is forced out in thin sheets over the fuel, from both sides of said wall, toward the sides of the fire-box from the vertical axis of the boiler, and, of course, away from the center or bottom, where the sediment most accumulates, and, as a natural con-

sequence, the flame and intense heat are carried with it, and thus the bottom of the boiler is prevented from burning and "pitting" underneath the deposit.

Second, to cause complete combustion, and the acquirement of sensible heat from any combustible that contains latent heat which is released by the evolution of the chemical constituents of which the combustible is composed—coal being the best solid combustible yet known—I will, therefore, simply remark that it is most adaptable to my furnace, and contains the most latent heat, which, when liberated, becomes sensible heat. Oxygen is the gas of the greatest density, and, therefore, heavier than the other gases, and is the chief gas in combustion, and causes flame. Hydrogen is the most inflammable gas, which, when added to oxygen, increases the brilliancy of the flame or ignition.

Now, to properly distribute the above and other gases—whereby the best affinity is effected, and mingling of all the gases to promote the best and most complete combustion—is the object of the second feature of my invention. As before stated, and as will be seen by reference to the drawings, I place in combination two sets of fire-bars, which are fed, chiefly, alternately. I then place my hollow wall between these two sets of grates, and I also divide my ash-pit by a partition-wall running and abutting against another partition-wall running crosswise the furnace ash-pit at right angles to its sides. The upper hollow wall may be called a hollow calorific plate, being provided with a central partition-plate. The calorific plate or wall is also provided with slits, as before described, and the air, being supplied in the required quantity, forces itself through the slits or openings above the incandescent fuel, and then mingles with the gases and other products of combustion, when an affinity at once takes place, and a complete combustion of the whole is produced. As before stated, the air may or may not be heated before entering the calorific box or wall. Thus the emission of smoke is prevented, the gases consumed, and intense heat the result; also a large percentage in the economy of fuel gained.

Having set forth the object and manner of uniting the most prominent combustibles, I will now proceed to describe their action, as produced by my arrangement, and embodies the third feature of my invention: The action of the flame relates to the opportunity of the heat to pass through the boiler-plate to enter the water to generate steam, which, to accomplish in the best manner is that the flame must heat or cause an impact on the plate. With the land-boilers of the Cornish type set in brick-work, the flame acts on the flues or bottom of the boiler in an undulating manner, and, therefore, only one-half of the total surface can be said to be heating-surface, and when the flame reaches the back end, in most cases, divides to act on a portion of that part and then returns through the flues to the forward end. Now, the action of the flame when passing through those flues is entirely dependent on their width, because if they are too wide the flame has space to undulate and glides lightly on the plate, and if they are too narrow the flame is checked on its passage; but with proper width, which I have given by my concave sides and reverberatory top, the flame impinges at an angle upon the plate, and therefore the heat has time—which is opportunity—to enter through the water upon all sides, except, perhaps, the bottom, where the sediment most accumulates. The flame, on turning into the flue, glides fiercely on the plate, because it turns at right angles in its line of progression by means of the back conical deflecting wall and the pendent partition over the rear end of the boiler, the common pitting or indentations being thus avoided. The sediment portions of boiler not being subject to intense heat, the water takes up, through the clean boiler-sheets, the heat to such an extent that the water flashes into steam, the displacement causing great agitation of the water, and swift currents, which are desirable in generating steam.

The fourth and last feature of my invention will be very readily understood. Each set of fire-bars is fed alternately. The ash-pit being divided, the draft can be readily controlled to supply either side of the furnace, as may be desired, by which arrangement the current of air entering at the lower part of the furnace, or through the air-pipe, which I prefer to locate in the chimney or uptake, passes through the calorific plate or double hollow box, and thence between the fire and bridge, and is thus so intensely heated as to continuously produce the entire combustion of the gaseous products of the fuel, and thus prevent the ordinary formation of smoke. It is, in effect, a double furnace, confined to the limits of, and economically applicable to, any common type of boiler; has all the advantages of a hot-blast without the cost of any pneumatic apparatus, if so desired; is so constructed uniformly to distribute and keep up the requisite combustion in boiler-furnaces; and, and while most effectually preventing the annoyance of smoke, and the usual deposit of soot in the flues, it causes an average saving of a large percentage in the quantity of fuel consumed, and also admits of the substitution of the cheapest for that of the dearest quality.

Now, to further explain my invention and the nature thereof, so that those skilled in the art may more readily understand it. I will refer more in detail to the accompanying drawings, and letters of reference marked thereon, and which indicate like parts in all the figures.

A, Fig. 1, exhibits the hot-air pipe located within the uptake or chimney, and by which the products of combustion escaping up chimney are utilized, and which is a great desideratum in the economy of fuel. The end

of the pipe will also be seen in cross-section in Fig. 5, and within the hollow calorific wall, and in side elevation, Fig. 2, illustrating, by means of arrows, the process, the air entering, and course of the same during its heating. C represents the hollow calorific wall—in longitudinal section in Figs. 1 and 6, and transverse section in Fig. 5—E showing the partition running longitudinally near the entire length, and *c* illustrating the horizontal slits. It may be here remarked that these slits should be horizontal, in order that the flame may be forced in a horizontal line from the extreme bottom of boiler and against the concave sides, which, in their turn, deflect the flame fiercely against the sides of the boiler, thereby making them "lick" said sides, while in so doing give up, in a great measure, their entire heat, and upon such portions of the boiler where the sediments do not accumulate. P represents said concave sides. I may also here remark that these concave sides are made of fire-brick or any suitable or refractory material; and when the fire is withdrawn the heat taken up during the operation of the furnace is returned by these sides, and given off while the boiler is at rest or being blown out, so that in the morning, when the fire is started to resume work, the water in the boiler is nearly at boiling-point.

The rear conical deflector F and the reverberatory top also assist in making up the above results. G represents the pendent partition or deflector, the functions of which have been heretofore described. D represents the ash-pit partition-wall, running back and abutting against the transverse wall L. The functions of this wall are to govern the quantity of atmosphereic air which may be allowed to either of the furnaces proper, and at the same time prevent cold air passing under the boiler back of the bridge-wall H. By this arrangement the fire may be more or less intense in either furnace, and the gases of the fresh fuel of one furnace subjected to and commingled with the hot gases of the other, and thus consumed. N represents the back or secondary bridge-wall. This wall and pendent partition-wall, with conical deflector F, perform a very important office in the grand total, viz: the prevention of the flame above the water-line, and at the same time retaining the heat in the reverberatory chamber formed on upper sides or top of boiler, which serves as a superheater for the steam as well as promoting its generation. This chamber, formed by the elements above mentioned, also bosoms the heat, the deflector throwing it back and with great force of impact against the end of the boiler, and into the return-flues.

Thus it will be seen that nearly all if not quite the entire heat of the furnace is taken up and utilized, thereby saving a large percentage of the fuel now wasted.

Having now fully described my invention, and the mode of operating the same, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with one or more boilers, of the calorific hollow wall C, longitudinally arranged, whereby the intense heat is prevented from burning the bottom of the boiler, substantially as described.

2. The combination of the hollow calorific wall C with the two sets of grates and the boiler, said wall being provided with horizontal slits, whereby the proper supply of air is so distributed that all the combustible gases are consumed, substantially as described, and for the purpose set forth.

3. The combination, in a furnace, of the concave side walls and conical deflecting end wall, substantially as described, and for the purpose set forth.

4. The combination of the pendent partition G, the wall F, the secondary bridge-wall N, and the side walls, whereby the intense flame is prevented from impinging upon the boiler above the water-line, substantially in the manner and for the purpose set forth.

5. The combination of the division ash-pit wall D, the hollow calorific wall C, the cross-wall H, with the double fire-grate of the furnace, substantially in the manner and for the purpose set forth.

6. The combination of the hollow horizontal-slitted calorific wall C, the hot-air pipe A, with the boiler, substantially as described.

7. The combination, in the boiler-furnaces, of the longitudinal division-wall D, and transverse wall H, forming the bridge-wall of the furnace, and the cross-partition wall of the ash-pit, whereby the cold air is prevented from passing under the boiler in the rear of bridge-wall, substantially as described, and for the purpose set forth.

8. The hollow slitted wall C, division ash-pit wall D, boiler O, concave side walls P, conical deflecting wall F, pendent partition G, wall N, cross ash-pit wall H, and hot-air pipe A, combined and arranged to operate in the manner and for the purpose set forth.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

THOMAS R. BUTMAN.

Witnesses:
DANIEL BREED,
FRED. G. DIETERICH.