C. B. CHACE.

Hot-Air Furnace.

No. 165,712. Patented July 20, 1875.

Fig. 1

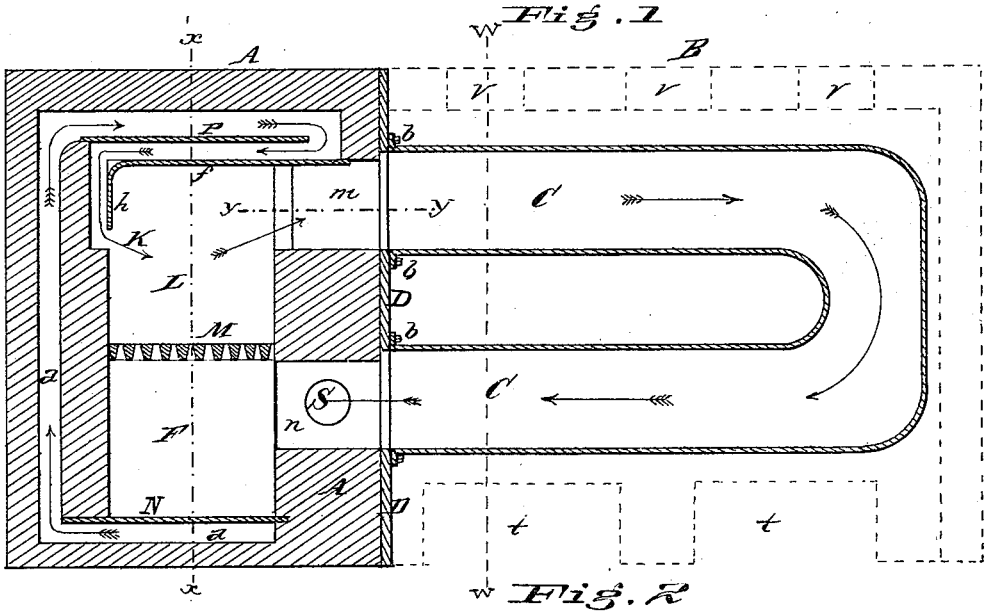


Fig. 2

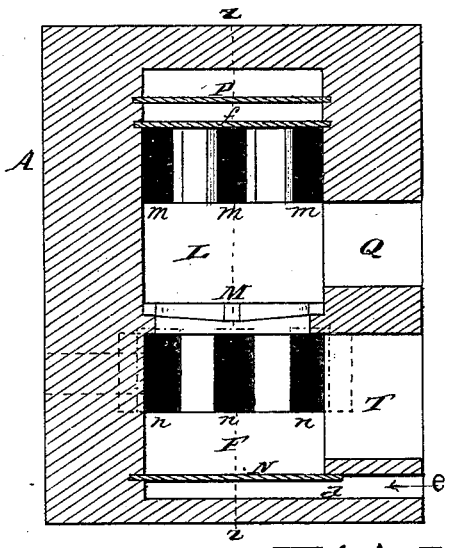


Fig. 4

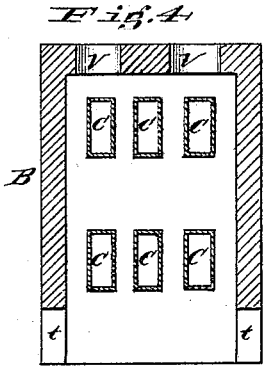
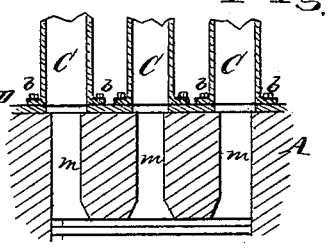


Fig. 3



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UNITED STATES PATENT OFFICE.

CHARLES B. CHACE, OF LOCKLAND, OHIO.

IMPROVEMENT IN HOT-AIR FURNACES.

Specification forming part of Letters Patent No. **165,712**, dated July 20, 1875; application filed November 23, 1874.

To all whom it may concern:

Be it known that I, CHARLES B. CHACE, a resident of the city of Lockland, Hamilton county, State of Ohio, have invented certain new and useful Improvements in Hot-Air Furnaces, of which the following is a specification:

My improvements relate to a new and useful construction of hot-air furnaces, whereby heat is economized, the consumption of fuel is rendered very uniform, the furnace is rendered very durable, and the heated air more healthful.

The improvements consist, first, in the connection of the fire-chamber and smoke-flue, with tubes employed for heating the air, the connection being made in such a manner that the products of combustion shall pass from the fire-chamber through the tubes on their way to the smoke-flue.

Secondly, in giving such a shape, longitudinally, to these tubes that they can expand or contract from or toward the fire-chamber without restraint, and giving these tubes, transversely, such a shape that a cross-section thereof shows the horizontal width or horizontal diameter of each tube to be less than the vertical height or diameter.

The advantages of this part of my invention are that, as the tubes are flat, and their longest transverse diameter is vertical, the largest amount of air can be presented to the heated metal of the tubes, facilitating the passage of air between the tubes and over their surfaces. Furthermore, the flat shape of these tubes enables them to be constructed of boiler-iron and riveted together in a good, substantial, and durable manner. The longitudinal shape of the tubes and their mode of attachment to their supports, permitting them to expand or contract without restraint, prevent the rupture of the tubes or their connections.

Thirdly, in arming the brick wall which divides the fire-chamber from the heating-chamber with a metallic plate on the heating-chamber side, for the twofold purpose of giving support to the smoke-flues, which, being of U-form, are attached to the said plate at both ends, and of making the separation between the fire-chamber and heating-chamber at the joints of the smoke-flues as complete as possible.

A fourth improvement consists in my improved construction of the brick flues opening from the fire-chamber into the heating-tubes, their construction being such that the flues shall, at their point of connection with the heating-tubes, be every way smaller than the adjacent openings of said tubes.

By this arrangement the products of combustion passing through the radiating-tubes do not, at their entrance into said tubes, fall directly or perpendicularly upon the surfaces of the tubes, and, consequently, the tubes are prevented from being burned out, and the heat is distributed with great uniformity over the entire surfaces of said tubes; and, further, the junction of the extremities of the tubes and the sustaining-plate are not exposed to the direct action of the fire, thereby rendering it possible to maintain at said juncture a tight joint.

My fifth improvement consists in a new construction of flues in the furnace, whereby the air which supplies the combustion shall, when desired, and before being admitted to the fire-chamber, be carried through flues in the brick-work of the furnace, and brought into contact with heated surfaces and diaphragms forming part of the fire-chamber, whereby it enters the fire-chamber at a high temperature.

This combination secures a more perfect combustion; secondly, it utilizes much of the heat from the fire-chamber, which would otherwise be dissipated by radiation from the walls.

In the accompanying drawings, Figure 1 is a vertical longitudinal section of a furnace constructed according to my invention, said section being taken at the dotted line Z Z of Fig. 2. Fig. 2 is a vertical transverse section of the same, taken at the dotted line X X of Fig. 1, and presenting to view the end of that section which is on the right hand of Fig. 1. Fig. 3 represents a horizontal section of the brick flues and ends of the radiating-tubes, taken at the dotted line Y Y of Fig. 1; and Fig. 4 represents a transverse vertical section of the radiating-chamber and radiating-tubes therein, taken at the dotted line W of Fig. 1.

A designates the brick furnace, containing fire-chamber L, provided with a door, Q, and separated from the ash-pit F by grate M. The ash-pit is provided with a door, T, and its bottom with a diaphragm, N, preferably of cast-iron, separating the pit from a flue, *a*. Flue *a* commences at the outside of the front of the furnace, and, passing under the diaphragm N and over brick-work beneath, is continued up between the brick-work of that wall of the furnace which is opposite to that connected to the heating-tubes. On reaching the top wall of the furnace-flue *a* turns and runs across the furnace under the top brick-work, and over a diaphragm, P, to that side thereof which is next the heating-tubes. Upon reaching this latter point it returns under the diaphragm P, and over a diaphragm, *f*, which latter forms the top of the fire-chamber, and has a flange or lip, *h*, forming a diaphragm, which extends a short distance down that side of the fire-chamber which is opposite to the heating-tubes. The flue *a* extends down between the flange *h* and the brick-work of the furnace, and enters the fire-chamber at K. *m* designates the flues in the brick-work of the furnace, which connect the fire-chamber and the heating-tubes C, and *n* designates the flue or passage-way in the brick-work which connects the heating-tubes and the smoke-flue S.

It may be here remarked that for convenience of manufacture and erection, and the more facile transmission of heat, the diaphragms P, *f*, and *h* are of cast-iron.

The entrance or mouth of flue *a* is provided with a small door, *e*, to control the admission of air thereto. B designates the walls of the hot-air chamber, containing the tubes C. This latter chamber has entrances *t* at or near its bottom, for the ingress of air, and outlets V, near its top, for the egress of the same. The heating-tubes C are preferably of a ⊃ shape. One mouth of each tube (here the upper one) is attached to the plate D opposite to one of the flues *m*, so that the center of flue *m* shall be opposite the center of the mouth of the tube, and leave an edge of the flue on every side projecting within the edges of the mouth of the tube. The other (here the lower mouth of each tube) is attached to said plate opposite to the flue *m*. Flue *m* is preferably narrower from top to bottom than the adjacent mouths of the heating-tubes opening thereinto, and is so arranged with reference to the tubes that at the top and bottom of the said mouth of each tube an edge of the brick-work of said passage-way projects within the top and bottom edges of the mouths of the tube. The plate D is pierced with holes corresponding with and fitting the mouth of the tubes, so as not to interfere with the draft through them. The plate is preferably of wrought-iron, and the tubes at their mouths are provided with flanges extending outward at right angles to their length. Bolts *b*, or rivets, through these flanges, secure the tubes to the plate D. Plate D is fastened to the brick-work by anchor-bolts, or by it forming one side of a sheet-iron covering, inclosing the entire brick-work of the fire-chamber.

The heating-tubes C may be made of any suitable material. When made of wrought-iron, the tubes may be made in four lengths, one for each side, two of the lengths opposite to one another being flanged outwardly at right angles, and the edges of the other sides opposite to one another being riveted to said flanges. The shape in cross-section of these tubes is of a figure longer vertically than across horizontally.

The mode in which a furnace containing my improvements operates is as follows: A fire is first made in chamber L. Should the passage of cold air through the flue *a* be prevented by means of the flue-door *e* aforesaid, and the ash-pit door T be opened, the air to supply combustion will pass through the grate M, and, with the products of combustion, will pass into the flues C, and, passing through them into passage-way *n*, find their way thence into smoke-stack S.

When the door T of the ash-pit is closed, and the flue-door *e* aforesaid is open, the air to supply combustion will enter the flue *a*, immediately below the door T, pass under diaphragm N, up through the wall of the furnace, along under the top of the furnace, and over diaphragm P, thence back between diaphragms P and *f*, thence down between the brick-work and diaphragm *h*, thence it passes into the fire-chamber at about its middle altitude. This air, in passing through flue *a*, has successively come into contact with the heated surfaces of the walls and diaphragms, and has taken up a considerable portion of their heat, and hence, at the time it reaches the fire-chamber, has become highly heated. It has thus taken up from the walls and diaphragms heat that would otherwise have been wasted. This highly-heated air entering the fire-chamber facilitates combustion. The products of combustion now pass directly through the flues *m* into the tubes C. These flues, being smaller than the mouths of the tubes, the products of combustion do not impinge against the places of juncture of the tubes and the plate D, but pass some distance into the tubes before they strike the interior of the sides of the tubes, and then impinge thereon at a very oblique angle and very gently, and their heat is very uniformly and thoroughly distributed over the interior of the sides of the tubes. The juncture of the tubes and the plate is thus preserved from burning out. The products of combustion now pass directly through the tubes, communicating to the latter their heat, and pass into the passage-way *n*. As the top and bottom edges of the passage-way, respectively, project within and beyond the adjacent edges of the exit-mouth of the tube, said edges are also preserved from burning out. The products of combustion pass from the passage-way *n* into the smoke-flue S. The shape of the flues allows them to expand or con-

tract without rupture, as the tubes are perfectly free to move away from the fire-chamber or toward it.

The particular shape of tubes here employed is not the only feature of this part of my invention; but the principle of my invention includes flues of any shape, whose mouths are attached to a common side of the wall inclosing the fire-chamber, and whose shape permits them in expanding to move from, and in contracting to move toward, other points of attachment at the fire-chamber wall without restraint.

The air which is to be heated for entering the apartments enters the hot-air chamber B through the entrances *t*, and passes up between and around the tubes C, and makes its exit through the openings V, from which it is conducted where desired by suitable conduits.

The flat shape of the tubes, as shown in cross-section, enables the largest amount of heating-surface to be presented to the ascending currents of air.

What I claim as new, and desire to secure by Letters Patent, is—

1. The air-induction flue *a*, formed by furnace bottom, wall, and top, and diaphragms N, P, *f*, and *h*, substantially as and for the purposes set forth.

2. The furnace A, and heating-chamber B, in combination with the smoke-tubes C, shaped so that, regarding them in cross-section, the height of each is more than its width, arranged in vertical rows, and having their ingress and exit mouths attached to a common side of the fire-chamber, and free to expand from or contract toward said chamber.

3. The combination of the flue *m* and the tube C, the flue being every way smaller than the tube, and so arranged upon the latter that the edge of the tube is on every side set back from the edge of the flue, as and for the purposes set forth.

4. The sustaining-plate D, substantially as described, in combination with the ⊃-shaped heating-tubes, and the side of the fire-chamber, for the purposes set forth.

5. The combination of the hot-air chamber B, forming a chamber distinct from the furnace, and constructed with ⊃-shaped smoke-flues C, by which the entire work of heating the air for the distributing-pipes is performed, cold-air inlets *t*, and hot-air distributing orifices V.

6. In combination the chamber B, tubes C, sustaining-plate D, and a fire-chamber, substantially as and for the purposes specified.

7. In combination, a fire-chamber, flue *m*, plate D, ⊃-shaped tube C, in a hot-air chamber, and smoke-passage way *n*, substantially as and for the purposes set forth.

8. In combination, fire-chamber L, ash-pit F, flue *a*, formed by furnace and diaphragms N P *f h*, flues *m*, plate D, tubes C in hot-air chamber B, and smoke-passage way *n*, substantially as and for the purposes set forth.

CHARLES B. CHACE.

In presence of—
D. P. KENNEDY,
CHAS. MUNROE.