

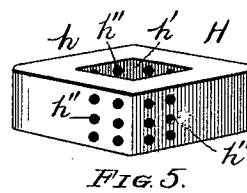
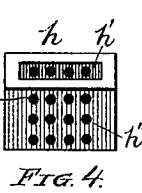
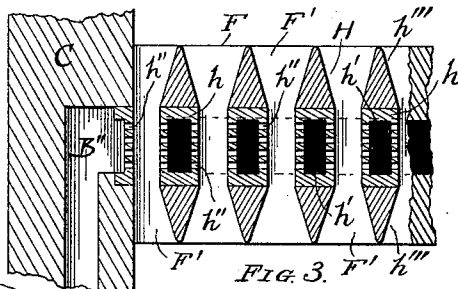
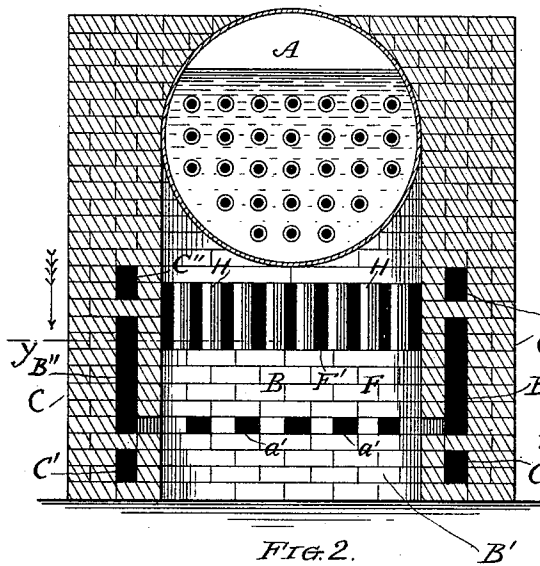
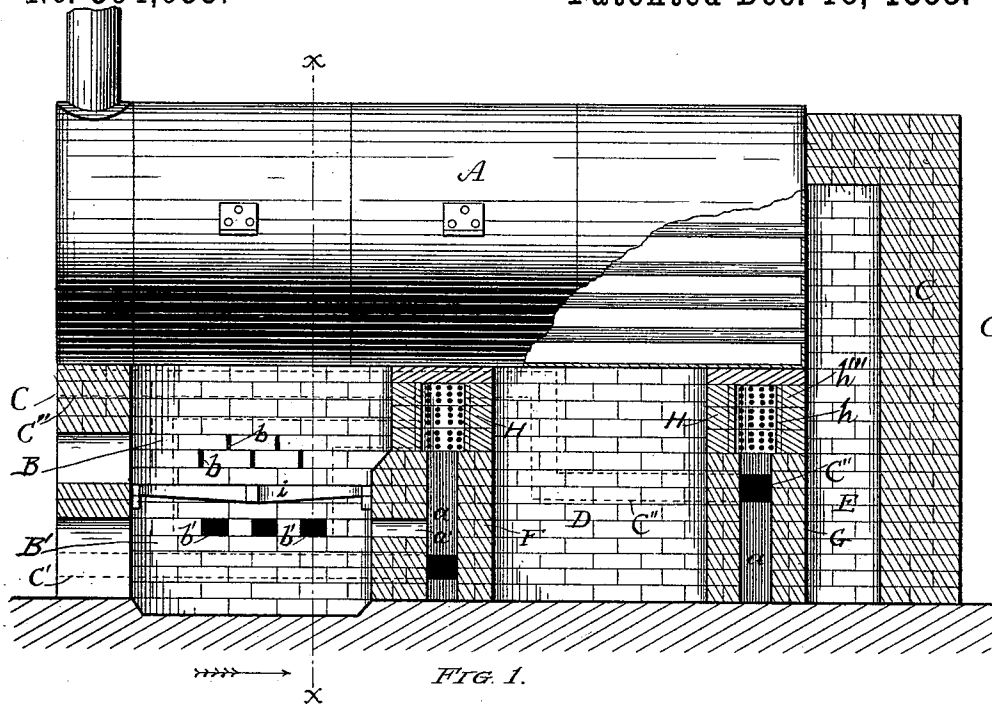
(No Model.)

D. P. KAYNER.

SMOKE PREVENTING FURNACE.

No. 394,655.

Patented Dec. 18, 1888.



Witnesses
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UNITED STATES PATENT OFFICE.

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SMOKE-PREVENTING FURNACE.

SPECIFICATION forming part of Letters Patent No. 394,655, dated December 18, 1888.

Application filed June 14, 1888. Serial No. 277,099. (No model.)

To all whom it may concern:

Be it known that I, DAVID PORTER KAYNER, a citizen of the United States, residing at St. Charles, in the county of Kane and State of Illinois, have invented new and useful Improvements in Double Combustion Smoke-Preventive Furnaces for Steam-Boiler Settings, of which the following is a specification, reference being had to the accompanying drawings.

My invention is based upon the division of the burning gases and carbon vapor into thin sheets of flame, into which a sufficient number of small jets of heated air are commingled during their passage through a series of long narrow perpendicular flues between the piers of the continuous bridge-wall above the fire-bed and nearly up to the boiler to produce complete combustion, the whole so constructed as to form two or more distinct combustion-chambers within the furnace.

It consists in erecting in a furnace from the bottom of the ash-pit up to the boiler a continuous hollow bridge-wall, terminating above the level of the fire-bed in a number of smooth wedge-pointed perpendicular hollow piers of refractory hollow tile having a series of long narrow flue-spaces between them, the interior channel in the hollow piers connecting through air-passages in bridge-wall and side walls with direct openings into the ash-pit and through the outer wall, and through the numerous small perforations along their lateral sides with the interior of the flue-spaces, by means of which the air heated on its passage through the piers is introduced at right angles in numerous fine jets to commingle with the carbon in the thin sheets of flame while passing through the narrowest part of the flue-spaces. The top of the hollow bridge-wall piers is covered with tile up to the boiler to protect it at that point from the intensified flame, leaving only the narrow flue-spaces, through which it can pass to the next combustion-chamber.

To render the first combustion more complete, a space connected with external openings is left between the side walls over the grate and the inside lining of the furnace, and narrow open spaces communicating therewith are left between the ends of several of the lining-brick to admit heated air over the burning coal, and in return-flue boilers a sec-

ond bridge-wall constructed like the former is placed at the rear end of the boiler, thus forming two or more distinct combustion-chambers for the more perfect conversion of the carbonic oxide into carbonic-acid gas and the hydrogen of the fuel into the vapor of water, thereby preventing the formation of soot and smoke the whole, constituting a complete double combustion smoke-preventive furnace.

The purpose of the second hollow bridge-wall with its piers of hollow perforated tile and narrow flue-spaces placed at the rear of the furnace is to supply air to "consume" any carbon that has escaped combustion in passing the first bridge-wall, thus insuring a nearly perfect combustion of the remaining particles of fuel, thereby furnishing increased heat for raising steam and preventing smoke by burning what would otherwise make it. I obtain these results by the special construction and combination of the different parts of the furnace, as illustrated in the accompanying drawings, in which—

Figure 1 is an elevation and vertical section of a furnace and part section of boiler, showing the hollow walls, bridge-walls, and hollow perforated tile in place in the piers, and also the different combustion-chambers. Fig. 2 is a vertical section of Fig. 1, taken on the line *x*, showing the piers, flue-spaces, openings into the bridge-wall from the ash-pit, and channels in side walls, through which air is admitted to the interior of the bridge-walls and heated on its passage. Fig. 3 is a sectional detail, enlarged, taken on line *y*, showing the hollow piers and flue-spaces. Fig. 4 represents the hollow perforated tile of refractory material, as used with wedge-brick at each end to complete the piers. Fig. 5 shows the tile of similar material complete in one piece. The tile are made and used both ways.

Similar letters refer to similar parts throughout the different views, and the following is a description of the parts and workings of the furnace.

Air is admitted through the openings *a' a'* under the grate *i*, Figs. 1 and 2, and also through the channels in the side walls, *C C*, as shown at *C'*, to the perpendicular space *a* in the bridge-wall *F*, Figs. 1, 2, and 3, connecting with the hollow perpendicular piers *H H*, composed of the perforated tile *h*, Figs. 1, 3,

4, and 5, erected above the level of the fire-bed as a continuation of the bridge-wall F, Figs. 1, 2, and 3, so as to leave the narrow flue-spaces F', Figs. 2 and 3, between them for the division of the flame into thin sheets, into which the air rising through and heated in the interior of the tile h', Figs. 3, 4, and 5, is introduced in small jets through the numerous perforations h'', same figures, in the sides of the tile lateral to the flue-spaces and at right angles to them.

The tops of the perpendicular channels a a in the first and second bridge-walls, F and G, Fig. 1, are covered at the bottom of the flue-spaces, as shown at F', Fig. 3, so that no air can get into the flame while passing in divided sheets through the narrow flue-spaces, except through the many small perforations in the lateral sides of the hollow tile, h, of which the piers H H are constructed.

At the openings b' b' in the ash-pit B', Fig. 1, air is admitted to the channel B'' in the side wall, part of which enters the fire-box B, above the burning fuel, through open spaces b b between the ends of the lining-brick. The remainder goes to increase the supply to the bridge-wall F.

B and D, Fig. 1, represent the first and second combustion-chambers, and in flue-boiler settings, as shown in Fig. 1, a second bridge-wall, G, constructed like the first, is placed at the rear part of the boiler, and is supplied with air through the channel C'', (represented by dotted lines in Fig. 1 and shown in section in Fig. 2,) constituting a third combustion-chamber at E, for the conversion of the remaining oxide into carbonic-acid gas before reaching the return-flues of the boiler A. Through this combination, construction, and adjustment of the different parts of the furnace to the scientific principles involved, by admitting the air in a heated state in numerous fine jets into the hot combustible products evolved from the burning fuel while in a state of vapor and in thin divisions, wherein the heated oxygen of the admitted air can meet, mingle, and combine in numerical equivalents with each and every particle of carbon thus prepared for chemical action, all the available heat units of the fuel are economized, leaving for smoke only the sootless products of complete combustion.

I am aware that many patents have been issued for the employment of heated air introduced into the interior of furnaces in many different ways, and more especially one to myself for double combustion hot-air furnaces, No. 218,982, dated August 26, 1879; but I distinctly aver in the present application I do not know and I do not believe that the combination and improvements herein specified and claimed have ever been patented in any country.

The distinction from all others of the improvements herein claimed consists in the more thorough division of the flame into thin sheets while passing through the long narrow

flue-spaces between the smooth wedge-pointed perforated hollow piers forming part of a continuous hollow bridge-wall extending from the ash-pit up to the boiler, in the continuous hollow bridge-wall with the air-passages a' a' opening into it directly from beneath the grate-bars in the ash-pit and the channels c c in side walls with the opening c' through the brick-work, and the openings b' b' into them through the lateral ash-pit walls, and in the series of smooth wedge-pointed perforated hollow bridge-wall piers communicating with those air passages and channels, which piers act to keep the combustible materials hot while passing them, and being thoroughly mixed with the heated air poured into them at right angles from both sides of the flue-spaces in minute jets through the numerous fine openings in the sides of the hollow tile forming the wedge-pointed bridge-wall piers; also in a secondary set of perforated tile or bridge-wall piers at or near the rear end of the boiler and in two or more combustion-chambers. By this combination the proper conditions are supplied to expose more fully to contact and chemical action the gaseous and vapory products of combustion to the oxygen of the air thus introduced and to promote thereby almost complete combustion on natural principles.

The proper adjustment of air-passages into and through the bridge-walls and side walls and in the ash-pit with the channels and perforations in the hollow wedge-pointed bridge-wall piers to correspond with the flue-spaces between the piers and the flues through the boiler renders the device entirely automatic, as air will always rush toward the highest heated center. It therefore follows that the more fuel used and the hotter the piers become in consequence the greater the draft of air will be to meet, mingle, and combine with the increased amount of carbon introduced, promoting a second combustion, and by the rapid expansion of the gases in the combustion-chambers beyond will increase the draft by hastening the reignited gases on through the flues, free from condensed carbon, soot, or black smoke.

It is the combination of continuous hollow bridge-walls and side walls with direct openings into them from the ash-pit and through the furnace-walls for passages to convey air to the smooth, hollow, perpendicular, wedge-pointed, and perforated bridge-wall piers, and the many long narrow flue-spaces between them into which the numerous perforations open at right angles on both sides, and the similar set of secondary perforated tile as herein described, that secures a more perfect division of the flame into thin sheets and the more intimate mixture with hot air while thus divided than any other device, which constitutes the real value of my invention; also, the erection of a second bridge-wall or its equivalent in a furnace as part of the combination to promote complete combustion,

constructed as above described, constitutes another new and important feature of my invention.

The channeling of furnace-walls connected with external orifices to admit air therein and introducing it into the fire-box over the fire is not new, having been used by myself in 1857, and by others before and since that time; but the combination of those air-channels and open flue-spaces through continuous hollow bridge-walls with direct openings into the ash-pit and terminating above the level of the fire-bed in a number of smooth, wedge-pointed, hollow, perpendicular piers of perforated hollow tile forming a series of long narrow flue-spaces between them, extending through the bridge-wall, through which narrow flue-spaces alone the carbon vapor and burning gas can pass, and introducing that air in minute jets into the divided flame at right angles through the numerous perforations in the sides of the hollow tile forming the bridge-wall piers lateral to the flue-spaces, and in the narrowest part thereof, and then, by widening the spaces between the ends of the piers, giving the reignited gases unimpeded opportunity to pass quickly and expand rapidly in the second combustion-chamber as they hasten on with the increasing heat through the boiler-flues toward the uptake impelled by the expansive force of the increased heat resulting from the second combustion, is new.

The above combinations with two or more distinct combustion-chambers, together with the employment of the wedge-pointed hollow tile or tile and wedge-pointed brick in constructing the bridge-wall piers to materially enlarge the entrance and exit of the flame through them, and the smooth, perforated, hollow tile as used in my invention to perfect the necessary combination, are essentially different from all others.

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

1. In a furnace for steam-boilers, a number of long narrow perpendicular flue-spaces through a continuous bridge-wall between a series of smooth, wedge-pointed, hollow piers of perforated tile, communicating with a fire-box and combustion-chambers, and through hollow perforated tile with air-channels in side walls and bridge-wall, as shown, and for the purposes set forth.

2. In a furnace for steam-boilers, a bridge-wall, F, having an interior space, *a*, air-supplying channels, and hollow wedge-pointed piers H H, having lateral perforations *h'' h''* opening into the passages F' F', as shown, and for the purposes set forth.

3. In a furnace for steam-boilers, a bridge-wall, F, having narrow flue-spaces F' F' passing through it above the level of the fire-bed, between its hollow perforated piers, with an interior space or channel, *a*, communicating with said passages, and the air-supply channels *a' a'* and C C, as shown and described.

4. In a furnace for steam-boilers, a continuous hollow bridge-wall, its upper portion so divided by a series of smooth, hollow, wedge-pointed piers as to separate the flame into many divisions without hindering its transit while passing between them, said piers being supplied by natural draft, through passages in bridge-walls and side walls, with air, which flows naturally into the flue-spaces at right angles to them, through the numerous perforations in the lateral sides of the refractory hollow tile forming the piers, in minute jets into both sides of the narrow sheets of flame, to saturate them while at their highest heat with oxygen and hasten them on to the combustion-chamber beyond with the increased rapidity of the expansive force of renewed combustion.

5. A double combustion-furnace for steam-boilers, having a fire-box, B, into which air is admitted over the burning fuel through the spaces *b b* between the ends of some of the brick of the side-wall lining from the channel B'' and openings *b' b'* into the ash-pit B', together with two continuous hollow bridge-walls crowned with or terminating in hollow wedge-pointed piers of perforated tile, having numerous narrow flue-spaces between them, also connecting with air-passages and with two distinct combustion-chambers, so combined as to produce a free mixture and expansion of the hot air, carbon vapor, and gases, and complete secondary combustion of the unconsumed fuel products, as specified and shown.

6. In a furnace for steam-boiler settings, with a fire-box and combustion-chambers, the hollow bridge-wall F, continued up to the boiler through a number of hollow piers, the series of long narrow perpendicular flue-spaces between the piers, the secondary set of bridge-wall piers or perforated tile, the perforated tile of refractory material, the tile-covered, wedge-pointed, perforated, hollow piers of the same forming part of a continuous hollow bridge-wall of a furnace, extending between the bottom of the ash-pit and the boiler, said piers having numerous small perforations at right angles to the flue-spaces, connecting through the interior channels or spaces in the tile with outer air-channels and opening interiorly into the flue-spaces between the piers, the said air-channels and perforations sufficient in size and number to admit the suitable amount of air into the narrow sheets of flame and vapor passing through the flue-spaces to produce complete combustion within two or more combustion-chambers, substantially as set forth.

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

DAVID PORTER KAYNER.

Witnesses:

N. A. AMES,
L. M. COBURN.