BENJAMIN FRANKLIN.

Stove Grate for Admitting Air to Sides and Body of the Fuel.

No. 125,040. Patented March 26, 1872.

Fig: 1.

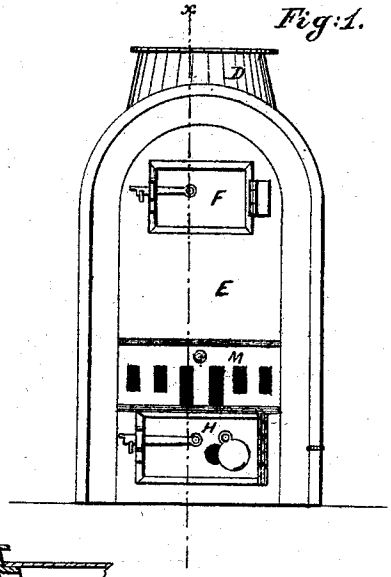


Fig: 2.

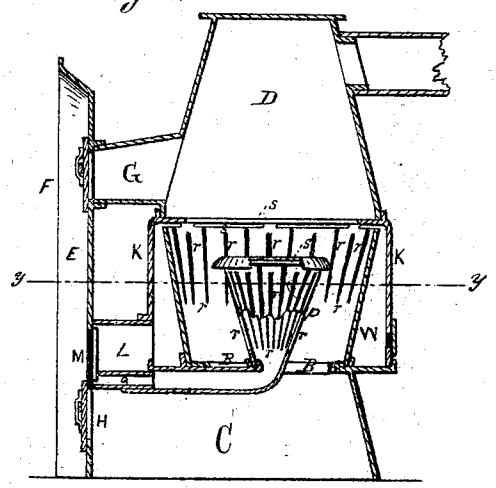
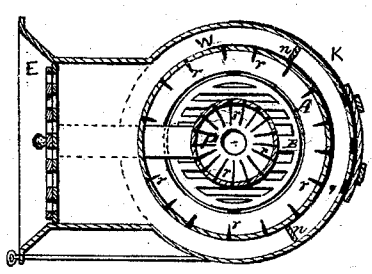


Fig: 3.



WITNESSES

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BENJAMIN FRANKLIN, OF INDIANAPOLIS, INDIANA.

IMPROVEMENT IN STOVE-GRATES FOR ADMITTING AIR TO SIDES AND BODY OF THE FUEL.

Specification forming part of Letters Patent No. 125,040, dated March 26, 1872.

SPECIFICATION.

I, BENJAMIN FRANKLIN, of Indianapolis, in the county of Marion and State of Indiana, have invented an improved apparatus for preventing smoke in stoves or furnaces of all descriptions by consuming the particles escaping unconsumed from the incandescent fuel in the fire-pot or chamber thereof, of which the following is a specification:

My invention relates to the supply of currents of warm or hot air to the gases and to the unconsumed particles which may escape from burning fuel while said gases and particles are still in such a heated state as to readily flame and burn in the presence of a proper supply of oxygen, and before they have so cooled or condensed as to form smoke and become difficult of ignition without being again subjected to a very intense degree of heat; it being an established fact that smoke once formed requires nearly twice as much heat to make it flame as it does at the instant immediately preceding its formation. Again, all existing methods in obtaining great volumes and long runs of flame incur a wasteful expenditure of fuel; coals, for example, are often melted into "clinker" and ruined, because the supporter of combustion has not been supplied to the materials of combustion in due proportion, of proper temperature, and at the right time and place. My invention seeks to avoid these evils and attain the most desirable results by the constructions and methods and combinations, as hereinafter described. In other words, my invention relates to improved devices constructed and arranged so as to deliver pure warm air into a furnace in proper division, and at the proper time and place, to prevent the formation of smoke, in the stead of admitting the air into a column of smoke already formed, as has been heretofore done.

In carrying out my invention, practically, I first lead a channel from the outer air to the base of a hollow space or chamber constructed with sides or circumference either parallel or flaring, and placed within the fire-chamber of a stove or furnace, in the midst of the fuel therein, and which I term an "injector." When made flaring the smaller end of this "injector" is placed downward; otherwise, or if made in any other shape, it would be subject to the danger of filling or choking with the dust of coal or ashes. This "injector" is capped with iron or other refractory material, and is furnished with a rim projecting far enough over its sides to prevent dust from falling into the orifices formed therein, as is hereinafter described. The "injector" has a horizontal open space just under the cap, and is penetrated by orifices of any convenient shape extending from or near this space down to and below the level of the fuel. A continuous narrow slit is the best form for these orifices. The cap on top of the injector should be usually lower than the upper edge of the fire-pot or chamber, and just high enough to be always above the level of the fuel. The air coming in through the channel and rising in the "injector" will blow out into the fuel and just above it, so as to meet the lighter products of combustion at the instant they are set free, when the air from below through the fuel has lost all or most of its oxygen. At that instant they will most readily inflame. An instant after smoke would be formed and the difficulty of inflaming would, in rapid combustion, be nearly doubled, and in slow combustion made economically impracticable. I may multiply "injectors" to any extent in proportion to the area of the fuel-surface, and may place them in any situation, feeding them with air through one or more channels. I may also place valves or registers in or at the mouth of the channel or channels, so as to control, at will, the amount, speed, or force of the current of air passing into the "injectors." In combination with this "injector," or independently thereof, I also form a hollow air-space or chamber within or without the sides or walls of the fire-chamber of the stove or furnace, either to surround the same wholly or to embrace only a portion thereof, which said chamber shall be provided with outer openings for the admission of fresh air at points thereof remote from the point at which the fuel in the fire-chamber flames. This air-space will prevent contact of the outer air of a room with overheated iron, and thus avoid the vitiation of the atmosphere to be breathed. At or near the upper edge of this air-chamber I open a narrow horizontal space or slit to communicate with the fire-chamber, and also

numerous vertical orifices, which, starting below the rim or top of the fire-pot or chamber, extend down below the full level therein, so as to deliver heated air from the air-chamber to the outside or circumference of the mass of fuel or materials of combustion, essentially as above described in the case of the injector. I may partition off this jacket or air-chamber so as to feed it from many points and deliver air from more than one space. My invention consists, further, in combining these two methods of injecting air into a fire-chamber, by which they mutually aid each other in mingling the supporter with the materials of combustion, and thus secure the most complete and economical results without impeding the draught or blasts. The air-supplying channels of either the injector or air-jacket may be connected with a blast mechanically produced, and the invention thus adapted to metallurgic or steam-generating furnaces and to open grates. By thus combining the admission of air to the circumference of the mass of the fuel and to its upper surface with the ordinary draught or blast of air from below, through the mass of the fuel, I am enabled, by properly regulating and controlling the feeding of air both below and above, to effect the utmost economy of fuel. By this means, also, the waste or injury caused by a melting of the fuel and by the formation of "clinker" would be very much lessened or entirely prevented.

In the accompanying drawing I have illustrated the application of my invention to a heating-furnace. Figure 1 is a front elevation of the furnace; Fig. 2, a central vertical section in the line *x x* of Fig. 1, illustrating the application of a "jacket" and "injector" to the furnace for the purpose of producing smoke-preventive flame-draughts; and Fig. 3 is a horizontal section in the line *y y* of Fig. 2.

A is the fire-pot; B, the grate; C, the ash-pit; and D, the upper radiating-chamber of a stove or furnace of any approved form. E is the facing-plate; F, the fuel-door; G, the feeding-spout; and H, the ash-pit door of a furnace fitted with my improved smoke-preventing devices. The fire-pot may be made flaring, as shown in Fig. 2, and surrounded by a cylindrical jacket, K, to form a concentric air-chamber, W, gradually contracting toward the top, so that as the air passes upward through it the current will be drawn through a narrower space, and consequently brought into closer and more direct contact with the wall of the fire-pot. In some cases it may be well to make the fire-pot perpendicular or even wider at the bottom than the top, the jacket remaining cylindrical. A narrow aperture or slit, *s*, indicated by black lines in the drawing, is formed in the wall of the fire-pot or chamber, over the top of the fuel when at its proper level, so as to permit the air heated within the chamber W (formed by the jacket K) to flow in a thin sheet into the fire-pot directly over the fuel, for the purpose hereinbefore explained; and, for use in combination therewith, narrow apertures or slits *r r* are formed to extend vertically from or near the upper slit *s*, so as to reach nearly to the grate.

L is an air-channel, extending from the face-place of the furnace to the concentric chamber W to supply air to said chamber. The mouth of said channel is covered by a register, M, to control the admission of air thereto. To produce a more uniform supply and diffusion of air around the fire-pot I contemplate a division of the air-chamber formed by the jacket K into two or more compartments by means of vertical partitions *n n*, as shown in Fig. 3, in which case each compartment is supplied with air by an independent opening, controlled by a separate register, although all the registers may, if desired, be so connected as to operate simultaneously by a movement of one of them. In large furnaces, where rapid combustion is required, the air-chambers should be less contracted than in the case of stoves and heating-furnaces; but in all cases the orifices through which the air is discharged into or over the fuel must be small in area and closely approximated, so that the injected air shall mingle thoroughly and readily with the particles to be consumed. Instead of making the air-chamber concentric, to inclose the fire-pot as illustrated, it may be formed at one side or at one end only of the fire-box. P represents an air-chamber formed within the fire-pot of the furnace, so as to be partially surrounded by the fuel placed therein, (as shown in Fig. 3,) and which I have termed the "injector." This chamber may be circular and sloping, or flaring from bottom to top, so as to be wedged or pyramidical in shape, as illustrated in Fig. 2. Its upper end is placed just above the highest level to which the fuel should be placed in the furnace, and its lower end, extending downward nearly to or below the grate, communicates with the outer air through a tube or channel, Q, which, for the sake of convenience, is carried forward under the air-channel L of the jacket, so as to be opened and closed by the same register M. Its sides are provided with a series of narrow slits or apertures (indicated by black lines in the drawing) extending nearly to its lower end, and its top is covered by a cap-plate, which preferably is made to project over its sides. Under this cap-plate is left a horizontal open space, through which the air heated within is projected into the fire-space over the fuel in opposition to the currents of air injected from the air-chamber about the wall of the fire-box, to produce thereby a more complete intermingling of the warm fresh air with the incandescent particles escaping from the burning fuel under the operation of the draught passing up through the same.

I contemplate using in larger furnaces two or more of these interior air-chambers or "injectors," either alone or in combination with one or more exterior air-chambers, as shown in the drawing. I construct these "injectors" usually of iron, in sections or otherwise, so that they can be readily and cheaply renewed. In some

cases, as in blast-furnaces, or others, where the central heat is very great, I construct them of brick or stone, or any other suitable material, but always so that great defects can be readily and cheaply repaired. They will bear, however, a great amount of heat without injury, because even holes would not impair their usefulness. In certain cases, however, I might protect them in a manner analogous to that used with the tuyeres of blast furnaces. I provide against the falling of dust and small particles of coal into the "injector" not only by the shape thereof, and by the cap, as above described, but when burning dust or slack I further provide against that great evil by suitable cap-plates placed over the slits not only of the injector, but also in the sides of the fire-pot. I prefer that the air-supply channels or chambers shall in no case open into or communicate with the ash-pit, as dust and ashes will in such cases inevitably rise and choke more or less the small orifices by which air must be fed to the fire, an evil that may destroy the whole use and value of the "injector" and air-jacket, inasmuch as the orifices must be small and numerous in order to effect that prompt and complete mingling of the "supporter" with the materials of combustion, upon which the success in utilizing those materials with the greatest ease and economy absolutely depends. By means of my arrangements of air-channels I not only supply thoroughly oxygenated air, but keep my feeding air clean, and thus avoid all danger of choking or impeding the smallest orifices; and further, by blowing in clean air in a heated condition, I cause the particles of dust of coal to mass together, and thus make them too large to choke or impede the flow of air through said orifices. The horizontal space under the cap of the "injector" induces the air to strike the cap, and thereby partly protects it against the effects of excessive heat; it also allows the throwing in of a ring of air to meet and inclose the jets of combustion effected by means of the orifices below, thus gathering up any stray portions and promoting that outward flow, which makes the injector also valuable in combination with the feeding of air to the circumference of the fuel from the jacket. In locomotive and other boiler furnaces, in metallurgic glass furnaces and the like, I lead channels for air along the sides, ends, and sometimes roof, to communicate with the air-delivery jackets or chambers, or with the injectors, always delivering the air, as herein described, at the point where the air from below through the fuel begins to be exhausted and the smoke is just ready to form; or the air-chambers may be so divided as to form return flues, in which the current will pass back and forth over the heated surface in its course toward the draught openings, and thus be very highly heated before its injection upon the fuel. The division of the flame-draughts through the numerous apertures of the air-chambers prevents a blast at any one point sufficient to blow or carry away the ignited particles unconsumed, which would be especially the case were the mass of fuel at a comparatively low temperature. In this my invention the formation of vaporous pyroligneous acid, which, when once formed, deadens combustion, is prevented, and its constituents consumed before they unite.

I claim as my invention—

1. A series of narrow air-delivery slits or apertures formed in the walls or sides of the fire-pot or chamber of a stove or furnace, to extend from a point at or below the lowest level to which the burning fuel will in proper practice be allowed to fall, to a point at or above its highest practical level, and communicating with one or more air-supplying spaces formed about the fire-pot or chamber, and combined with one or more horizontal air-delivery apertures formed in or over the upper edge of the fire-pot or chamber, substantially as and for the purpose herein set forth.

2. In combination with the subject-matter of the foregoing claim, one or more "injectors" or hollow chambers constructed with parallel or upwardly outwardly-flaring sides, and pierced with a series of up-and-down narrow slits or perforations in the sides thereof, and with one or more narrow horizontal slits or apertures over or in the top edge thereof, combined with one or more air-feeding channels, and placed within the fire-pot of a stove or the fire-chamber of a furnace, substantially as and for the purpose herein set forth.

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Witnesses:

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