4 Sheets—Sheet 1.

G. B. FIELD.

Furnaces.

No. 212,366. Patented Feb. 18, 1879.

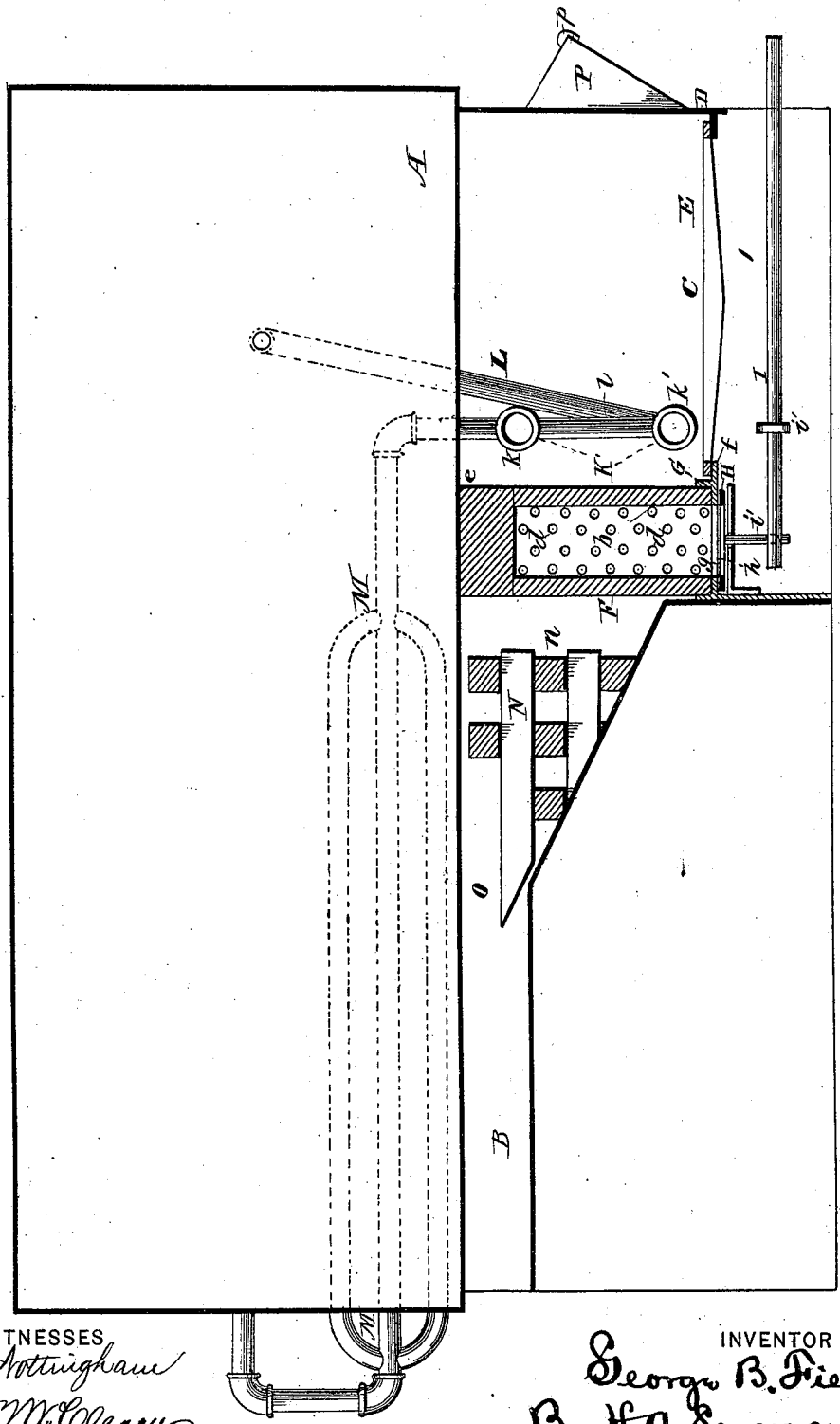

Fig. 1.

WITNESSES
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4 Sheets—Sheet 2.

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Fig. 3

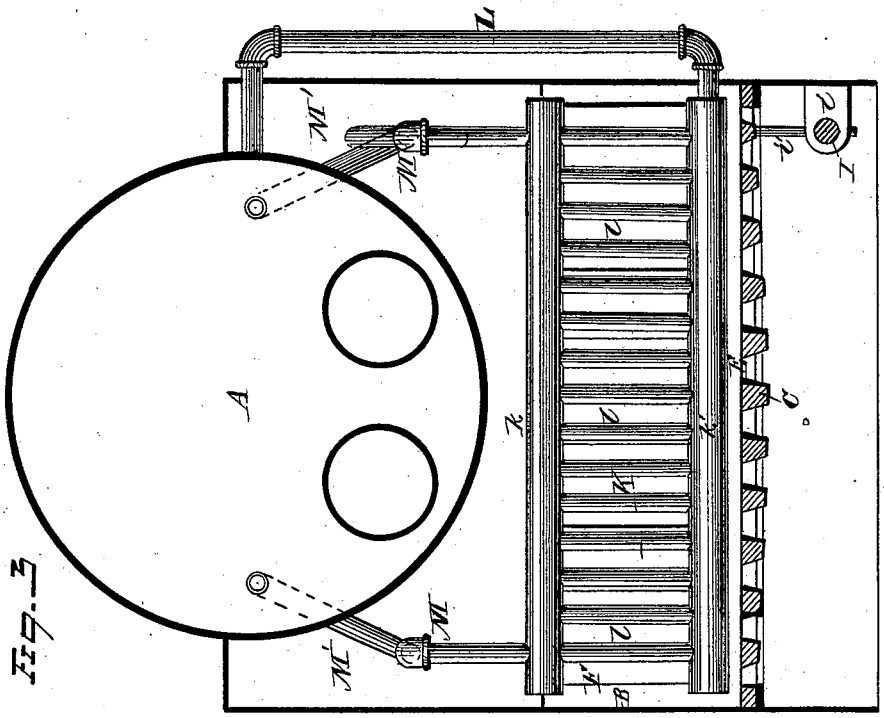
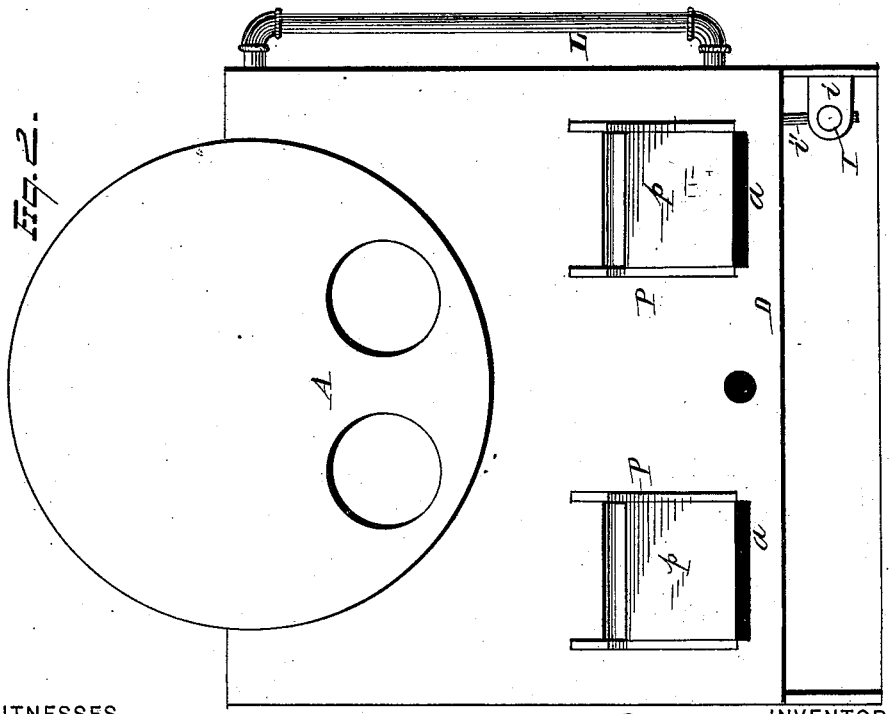


Fig. 2.



WITNESSES

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Fig. 5.

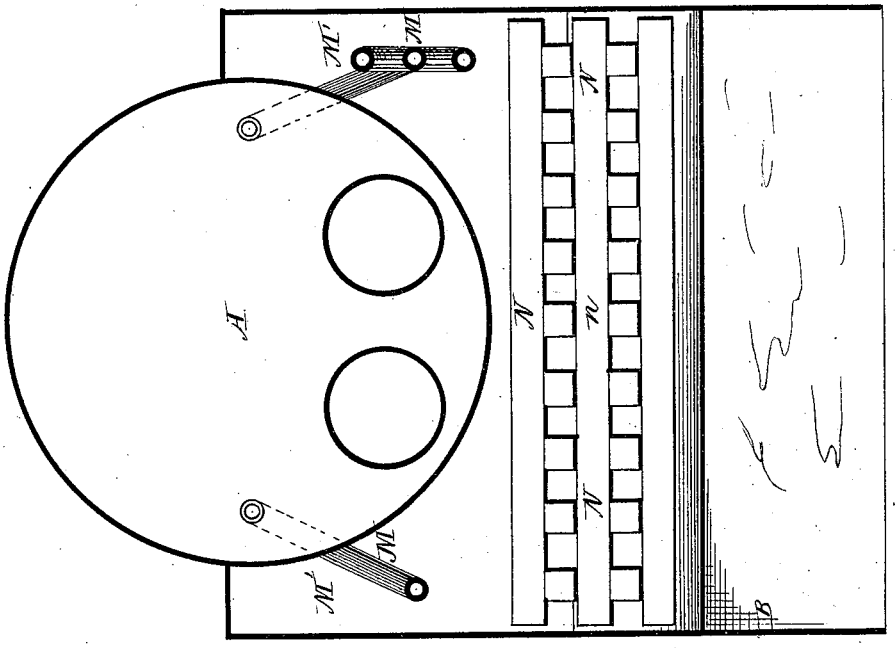
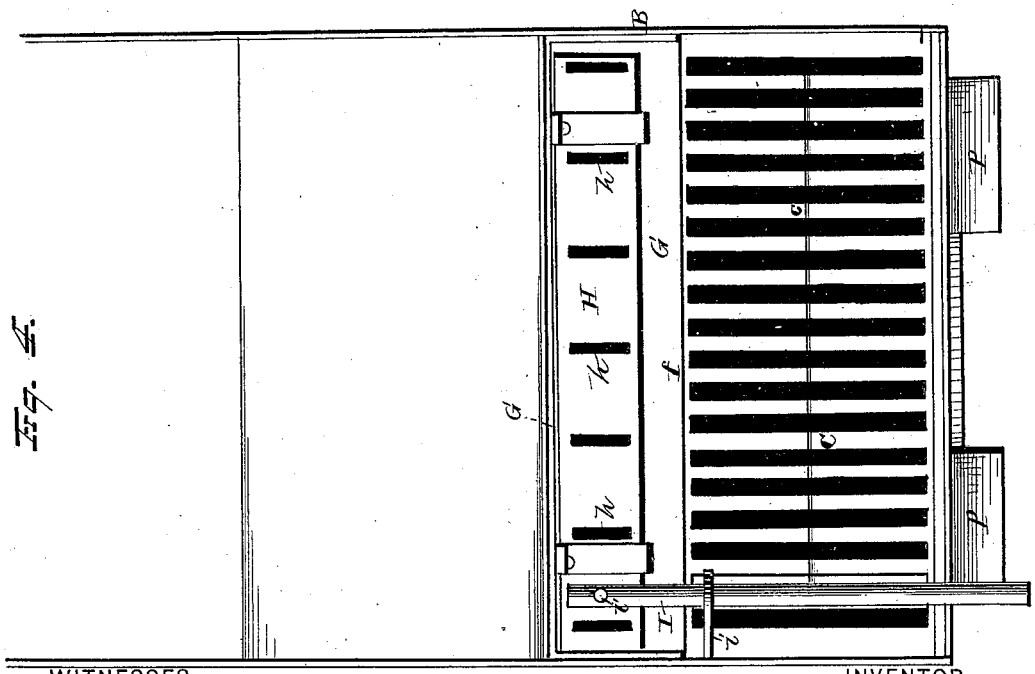


Fig. 4.



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No. 212,366. Patented Feb. 18, 1879.

Fig. 6.

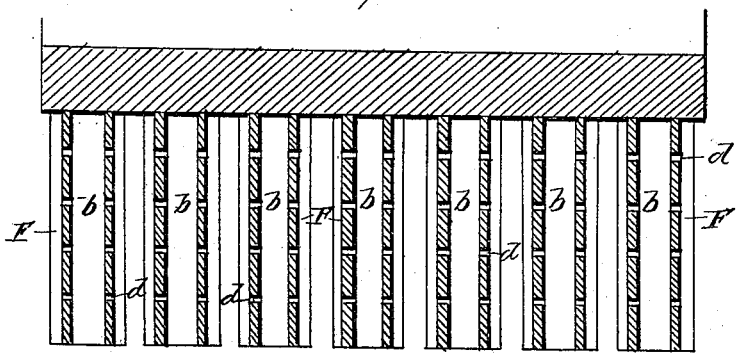


Fig. 7.

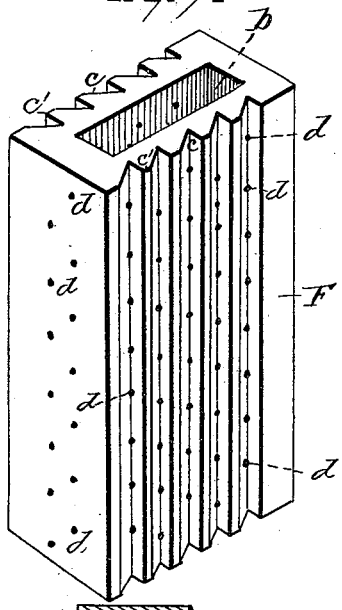


Fig. 8.

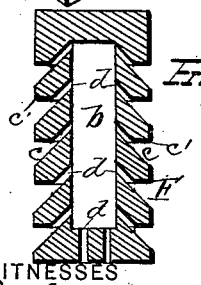


Fig. 9.

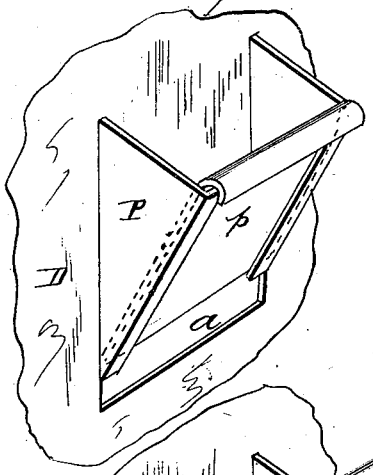
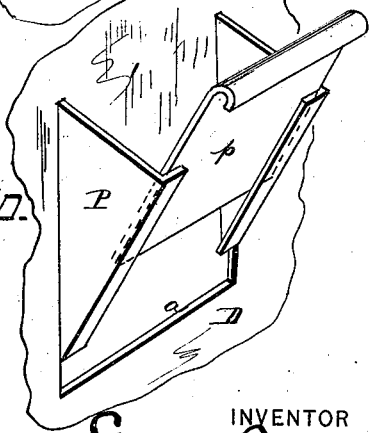


Fig. 10.



WITNESSES

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UNITED STATES PATENT OFFICE.

GEORGE B. FIELD, OF NEW YORK, N. Y.

IMPROVEMENT IN FURNACES.

Specification forming part of Letters Patent No. **212,366**, dated February 18, 1879; application filed June 29, 1878.

To all whom it may concern:

Be it known that I, GEORGE B. FIELD, of New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it pertains to make and use it, reference being had to the accompanying drawings, which form part of this specification.

My invention relates to an improvement in furnaces for steam-boilers and other purposes.

The object of the invention is to commingle air in jets with the gases escaping from the burning fuel, whereby all unconsumed products of combustion contained in the gases as they flow from the main or primary chamber may be ignited and consumed in the throat of the furnace.

A further object of my invention is to regulate the supply of air to the hollow perforated air-receptacles located in the combustion-chamber, in order that the desired amount of oxygen may be supplied to the gases resulting from the combustion of fuel in the furnace.

A further object of the invention is to supply heated jets of air to the fire-box of a furnace at a point below the surface of the fuel, and thus cause the air to become thoroughly heated and impregnated with carbon before it commingles with the flame of the burning fuel.

Another object of the invention is to thoroughly protect the perforated air-receptacles from contact with the fuel, and thus prevent slag or cinders from adhering to and clogging the apertures in said air-receptacles.

A further object is to conduct water from the boiler through suitable pipes or conduits located in front of the air-receptacles, and discharge the steam from said pipes into the steam-space of the boiler.

Another object of my invention is to store heat in a bridge-wall in rear of the air-receptacles, for reheating the air and gases as they are commingled and flow through and over said bridge-wall, and to the several ends in view as above specified.

My invention consists, first, in the combination, with the fire-box of a furnace, of a series of hollow air-receptacles having small apertures, leading through the walls thereof, the lower portions of said air boxes or receptacles being located nearly or quite in the same plane as that of the grate-bars, whereby air is supplied to the air-receptacles and issues therefrom in jets into the fuel, and also into the space above the fuel, in close proximity to the bridge-wall of the furnace.

My invention further consists in the combination, with the fire-box of a furnace, of heated air-receptacles having corrugated or serrated sides, and small apertures extending from the interior of said receptacles into said corrugations or serrations, whereby the gases as they flow between said air-receptacles are deflected by the corrugations and intimately intermixed or commingled with the small jets of heated air issuing from the air-receptacles.

My invention further consists in the combination, with the fire-box of a furnace, of a series of hollow air-receptacles and a damper or regulator, for supplying air to each one of air-receptacles of the series, as aforesaid.

My invention further consists in the combination, with a series of hollow perforated air-receptacles located in the rear portion of a furnace fire-box, of a water-grate placed in front and in close proximity to said air-receptacles, said water-grate serving to prevent the direct contact of the burning fuel with the air-receptacles, and thus obviate the collection of cinders or slag upon the outer surface of the air-receptacles, and prevent the free flow of air therefrom.

My invention further consists in the combination, with a series of hollow perforated air-receptacles located in the rear portion of a fire-box, of a water-grate placed in front and in close proximity to said air-receptacles, and a water-supply pipe leading from the boiler to one end of said water-grate, and a steam-supply pipe extending from the other end of said water-grate to the steam-space of the boiler.

The invention further consists in the combination, with the fire-box of a furnace, having hollow perforated air-receptacles located in the rear portion thereof, of an open-work

bridge-wall in rear of said air-receptacles, for imparting heat to the air and gases flowing through the same.

My invention further consists in the several details in construction and combinations of parts, as will hereinafter be described, and be pointed out in the claims.

In the accompanying drawings, Figure 1 is a longitudinal vertical section of a furnace embodying my invention. Fig. 2 is a front elevation, and Fig. 3 a transverse vertical section, of the fire-box. Fig. 4 is a plan view of the bottom of the fire-box. Fig. 5 is a transverse vertical section taken on a line passing between the perforated air tubes or receptacles and the bridge-wall. Fig. 6 is a transverse vertical section through the perforated air-receptacles. Fig. 7 is an enlarged view, in perspective, of one of the air tubes or chambers. Fig. 8 is a vertical section of the latter. Figs. 9 and 10 are enlarged views of the feeding hoppers or chutes.

A represents a steam-boiler, of any desired form, and B are the walls of a furnace. C represents the grate-bars, which may be stationary, or provided with means for shaking the same, as desired. Through the front wall, D, of the fire-box E is formed an opening, *a*, on a plane with the grate-surface, for the admission of a slicing-bar, to remove the clinkers from the grate.

F represents air tubes or receptacles, made of fire-clay or other suitable heat-resisting material, the construction of which is clearly illustrated in Figs. 7 and 8. Each tube F is formed with an interior chamber, *b*, extending from its lower end nearly to its upper end.

The outer sides of the tubes or chambers are provided with any desired number of corrugations or serrations, *c*, the outer edges, *c'*, of which project toward the fire-box when the tubes are in proper position.

d are small perforations, leading in a diagonal direction from the interior chamber, *b*, to the series of corrugations *c*. Any desired number of tubes or chambers F are arranged on the supporting cross-bar or plate G, while their upper ends rest in contact with a partition, *e*, of fire-clay, which extends upwardly around the boiler, and prevents the passage of gases from the fire-box at a point above the perforated air tubes or chambers. The cross-bar or plate G is firmly secured to the side walls of the furnace, and is preferably provided with a flange, *f*, which serves as a support for the rear ends of the grate-bars, although a separate cross-bar may be employed for such purpose. Supporting-plate G is formed with air-ports *g*, which correspond in number and size to the openings or chambers in the air-tubes F, and register therewith.

To the lower surface of the supporting-plate is secured, by suitable lugs or equivalent devices, a sliding damper, H, which latter is also provided with openings *h*, equal in size and number to the openings or air-ports *g* in the supporting-plate G. Sliding damper H may be operated by a bar or rod, I, fulcrumed in the perforated post *i*, and adapted to be connected with a stud, *i'*, on the lower side of the damper; or, instead of having the damper-rod extend beneath the grate-bar, it may be placed on the outer side of the furnace-wall, and have one of its ends connected with the sliding damper by a link.

I do not limit myself to any particular means for operating the damper, as many devices may be resorted to for such purpose.

By opening the damper, so that its air-openings will register with the air-ports in the supporting-plate, warm air from beneath the burning fuel on the grate-surface will flow upwardly into the several air tubes or chambers, and from thence issue, in small minute jets, into the passages *j* between said air-chambers. The jet-openings are arranged diagonally, for the purpose of increasing their length, and thus subject the air to greater heating-surface as it flows through the fire-clay heating chambers or tubes. As the jets of highly-heated air come in contact with the gases of combustion, which contain a large percentage of unconsumed carbon, the air and said gases are thoroughly commingled and intermixed, thus causing the ignition and complete combustion of all unconsumed products of combustion in the gases flowing from the main or primary combustion-chamber.

By reason of the fact that the air-jets issue from the corrugations formed in the outer surfaces of the air tubes or chambers, a more thorough blending and intermingling of the air and gases is insured, as the gases are deflected, by the ridges forming the corrugations, into the grooves, from whence issue the innumerable minute air-jets, and the gases are momentarily detained or confined, while the jets of air force the inflammable mixture outward into the spaces between the tubes or chambers.

As the air-supply tubes or chambers practically form the rear wall of the fire-box they are consequently subjected to an intense heat, which is requisite to raise the temperature of the air to the required degree to promote the most perfect combustion. The level of the burning fuel is but slightly below the upper ends of the air-supply tubes or chambers, and hence the air must percolate through the incandescent coal before it passes through the spaces between the air tubes or chambers. If the coal should be piled up against the air-supply chambers the intense heat would soon operate to deposit clinkers and slag upon the surface of the air-chamber, and, by clogging the minute air-openings, soon render the apparatus inoperative. To obviate this difficulty I place a grate, K, immediately in front and in close proximity to the air-chambers, for the purpose of preventing the burning fuel from coming in immediate contact with the air-tubes.

When my improved furnace is not employed in generating steam the grate may be com-

posed of fire-clay, of such construction that it may be readily renewed when necessary. When the furnace is connected with a steam-generator grate K is hollow and filled with water from the boiler. It may be formed of upper and lower cross-pipes, *k k'*, and vertical connecting pipes or tubes *l*, although if constructed to other like forms it will answer the desired purpose. The lower pipe of said water-grate K connects with the water-space of the boiler at its forward end by a pipe, L, while the upper cross-pipe is provided with pipes M, which extend through the heat-flue M', beneath the boiler, and connect with the steam-space of the boiler. Any number of pipes M may be located in the flue M'. As the water from the boiler is conducted to the water-grate and fills the same it serves several important purposes: First, it prevents the grate from being destroyed by the intense heat to which it is subjected, as it is placed in immediate contact with the burning fuel. Again, the water-grate preserves the air-chambers from contact with the burning fuel, and hence obviates the deposition of clinkers or other substances on said tubes, which would have the effect of clogging the air-openings in said tubes. Again, the water is heated and converted into steam by the heat, which would be but partially utilized otherwise, thus allowing of increased heating-surface to be added to a boiler at a small increased expense. By adding to the number of pipes M the heating-surface can be increased until all available space in the flue M' is utilized. Again, this arrangement of water-grate and connecting-pipes insures the most perfect circulation of water in the steam-boiler, as well as in the water-grate itself, and thus prevents the accumulation of scale in such parts.

N represents the bridge-wall, the front face, *n*, of which is perpendicular. Said wall is composed of a lattice or open brick-work, whereby the air and gas, after flowing through the spaces between the air-supply tubes or chambers, enter into a secondary combustion-chamber, O, between the bridge-wall and the rear surfaces of said air-tubes. The bridge-wall is made perpendicular instead of on a rearward incline, as is common, in order that the air and gases shall be upwardly deflected and mingled together within the chamber O. By constructing the bridge-wall of open brick-work the air is caused to percolate through the wall; and as a large amount of heat may be stored in the open brick-work, the temperature of the air and gases will be kept equable and at the highest practical point of temperature.

P are hoppers or feeding-chutes attached to the front of the furnace, and are employed in lieu of doors. Each hopper is provided with a sliding front plate, *p*, which may be raised or lowered, as desired to regulate the draft. Instead of the sliding plates they may have a swinging, revolving, or sliding damper, combined with a rigid front plate. The fuel is placed in these hoppers, one or more being used, and from there forced into the fire-box without the necessity of admitting cold air to the fire-box. As the hopper or chute should always be kept filled, the air entering through the hoppers must pass through the fuel contained therein. By raising the front plates, *p*, more or less air will be admitted directly to the surface of the grate-bars. This method of feeding fuel to the furnace is an important feature in connection with my other improvement hereinbefore referred to, as it is desirable that the sides of the fire-box shall be practically closed, in order that any excess of air over and above that which passes through the grates shall be admitted to the fire-box in minute jets and in such quantities as shall promote the most perfect combustion of all unconsumed products of combustion, which ordinarily escape through the stack. As heretofore stated, the exact quantity of air necessary for this purpose can be regulated and admitted by means of my improved air-chambers and dampers connected therewith.

My improvement is adapted to be applied to any style of furnace, either for the boilers of stationary, portable, or locomotive engines, or for furnaces used for purposes other than the generation of steam; and in use it is most effectual in preventing smoke, by reason of the fact that the unconsumed products of combustion in the gases flowing from the fire-box are all ignited and consumed before they reach the uptake.

I would have it understood that I do not limit myself to the exact construction and arrangement of parts shown and described, as many slight changes might be resorted to without departing from the spirit of my invention.

I make no claim to the particular construction of feeding-chutes in this patent; but reserve the right to secure a separate patent for the same.

Having fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination, with the fire-box of a furnace, of a series of air-supply chambers located in the rear end thereof, and arranged to form intervening spaces for the passage of the gases from the fire-box to the smoke-stack, said air chambers or tubes having interior chambers and small perforations leading therefrom through the wall or walls of the tubes or chambers, the lower ends of said tubes being placed below the upper surface of the bed of fuel on the grate-bars, substantially as set forth.

2. The combination, with the fire-box of a furnace, of a series of air-supply tubes or chambers arranged to form intervening passages for the escape of the gases to the smoke-stack, located opposite the fuel-space and in front of the bridge-wall of the furnace, substantially as set forth.

3. The combination, with a supporting-plate

having any desired number of air-ports therein, of a series of hollow perforated air chambers or tubes having their open lower ends arranged to register with the air-ports in the supporting plate or bar, substantially as set forth.

4. The combination, with a series of hollow perforated air-supply chambers or tubes, of a supporting-plate, provided with air-ports, and a sliding damper attached to said supporting-plate and adapted to regulate the admission of air to the hollow perforated chambers, substantially as set forth.

5. The combination, with a series of hollow perforated chambers or tubes, the lower ends of which are practically on the same plane as the grate-bars, of a close partition between the boiler, the furnace-walls, and upper ends of the air-chambers, substantially as set forth.

6. The combination, with the fire-box of a furnace, of a series of hollow perforated air-supply chambers located at the rear end of the fire-box, the outer surfaces of which are wholly or partially corrugated in vertical lines, substantially as set forth.

7. The combination, with the fire-box of a furnace, of a series of air-supply chambers located in front of the bridge-wall, and arranged to form intervening spaces for the passage of the gases from the fire-box to the smoke-stack, said air-chambers provided with vertical corrugations on their outer surface, and with diagonal air-passages leading from the inner chambers to said corrugations, substantially as set forth.

8. The combination, with a series of hollow perforated air-supply chambers or tubes arranged opposite the fuel space in front of the bridge-wall of a furnace fire-box, of an open-work grate or shield located in close proximity to said chambers, and serving to prevent the fuel from resting against said chambers, substantially as set forth.

9. The combination, with a series of hollow perforated air-supply chambers located in front of the bridge-wall, of a hollow water grate or shield located in close proximity to said chambers, and furnished with water from the steam-boiler, substantially as set forth.

10. The combination, with a series of hollow perforated air pipes or chambers located in front of the bridge-wall, of a hollow grate located in close proximity to said chambers, and pipes connecting said grate with the steam and water spaces of a steam-boiler, substantially as set forth.

11. The combination, with a series of air-supply chambers or tubes located in front of the bridge-wall and a hollow grate located in close proximity thereto, of a pipe for conducting water from one end of the boiler to the grate, and one or more pipes for connecting the shield with the steam-space at the opposite end of the boiler, substantially as set forth.

12. The combination, with a series of air-supply chambers located in front of the bridge-wall, of a hollow grate and steam-pipes of any desired number, leading from the grate through the flue beneath the boiler to the steam-space of the steam-boiler, substantially as set forth.

13. The combination, with a series of hollow perforated air-supply pipes or chambers, of an open brick-work bridge-wall in rear of said air-supply pipes, substantially as set forth.

14. The combination, with a series of hollow perforated air-supply tubes or chambers, of an open-work bridge-wall and an intervening combustion-chamber, substantially as set forth.

In testimony that I claim the foregoing I have hereunto set my hand this 24th day of June, 1878.

GEORGE B. FIELD.

Witnesses:

THOS. P. RITCHIE,

ALF. VALLAT.