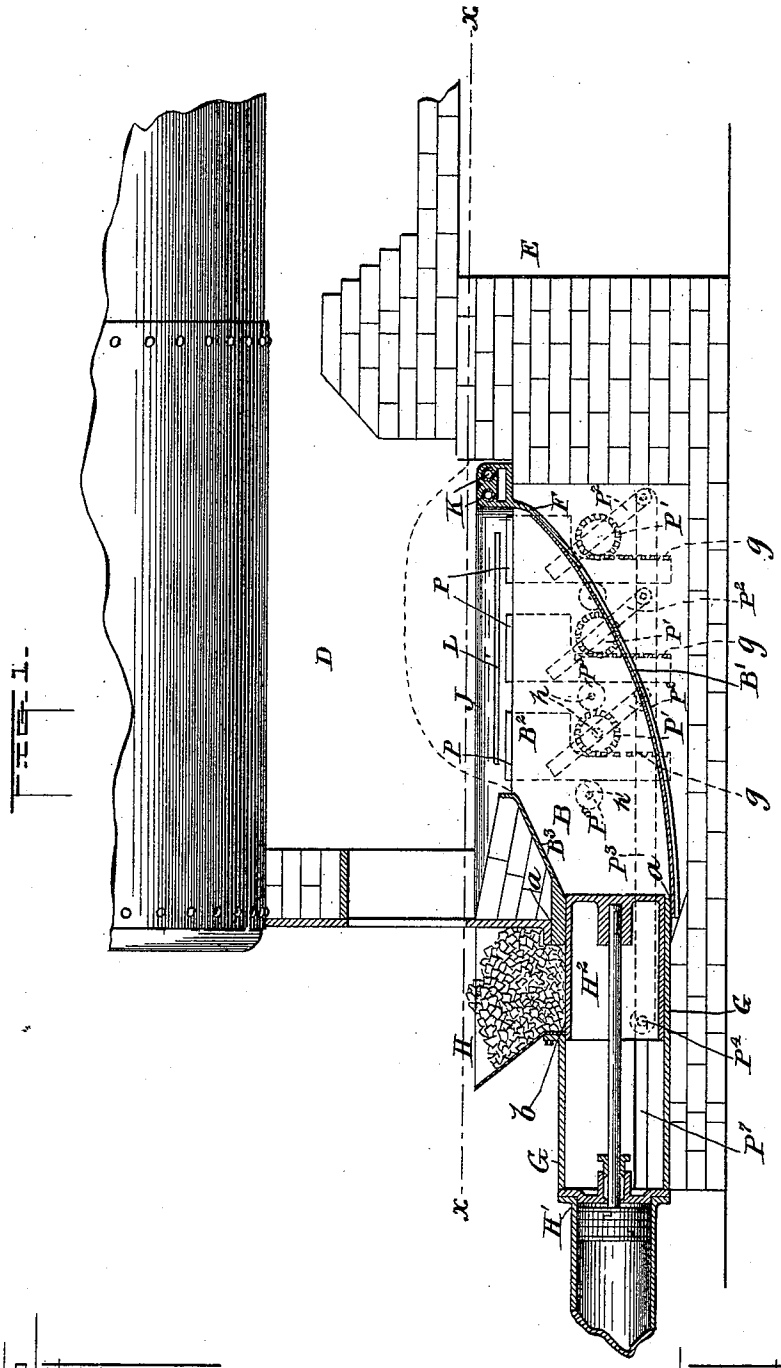
(No Model.) 6 Sheets—Sheet 1.

E. W. JONES.

BOILER OR OTHER FURNACE.

No. 470,052. Patented Mar. 1, 1892.



Witnesses:
Hoverance.
E. T. Fennock

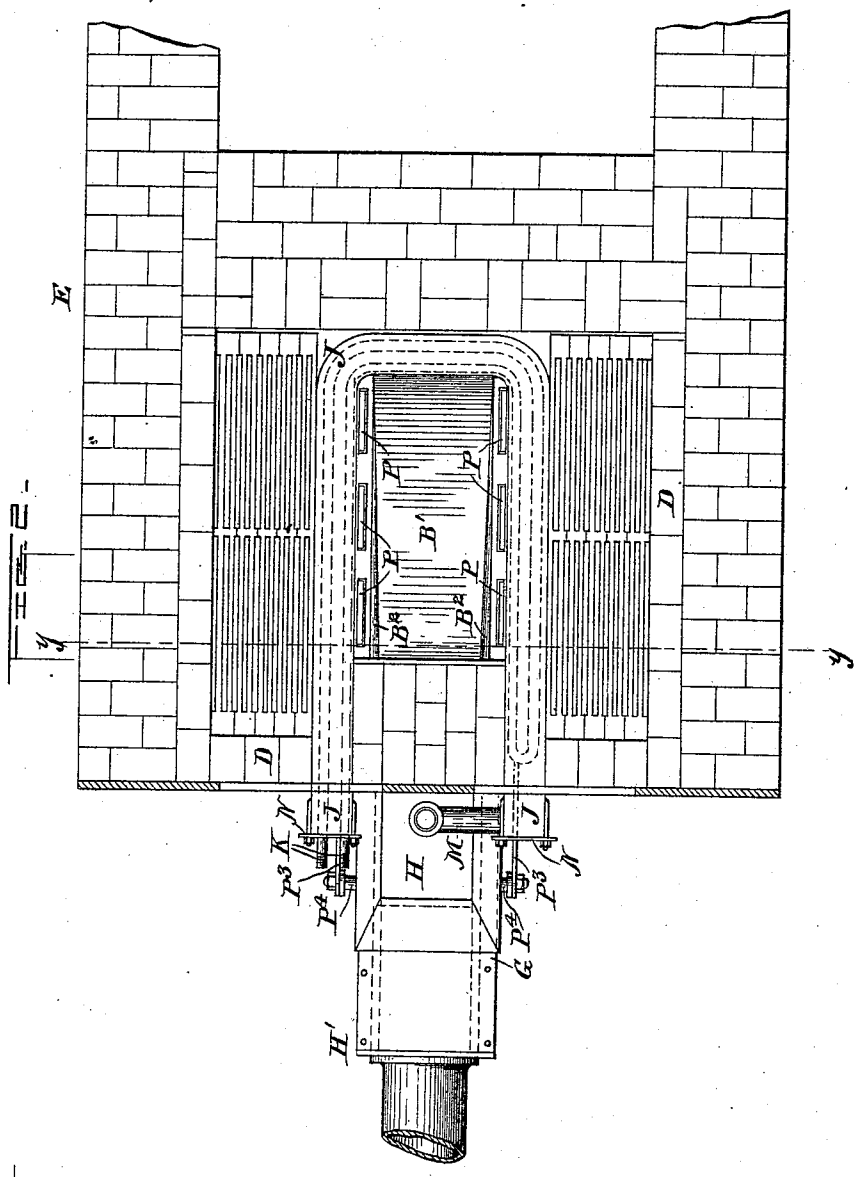
Inventor:
Evan W. Jones
by his Attorneys
Mason, Fennock & Lawrence

(No Model.) 6 Sheets—Sheet 2.

E. W. JONES.

BOILER OR OTHER FURNACE.

No. 470,052. Patented Mar. 1, 1892.



Witnesses:—
Geverance.
E. T. Fennick

Inventor:—
Erwin W. Jones
by his Attorneys
Mason, Fennick & Lawrence

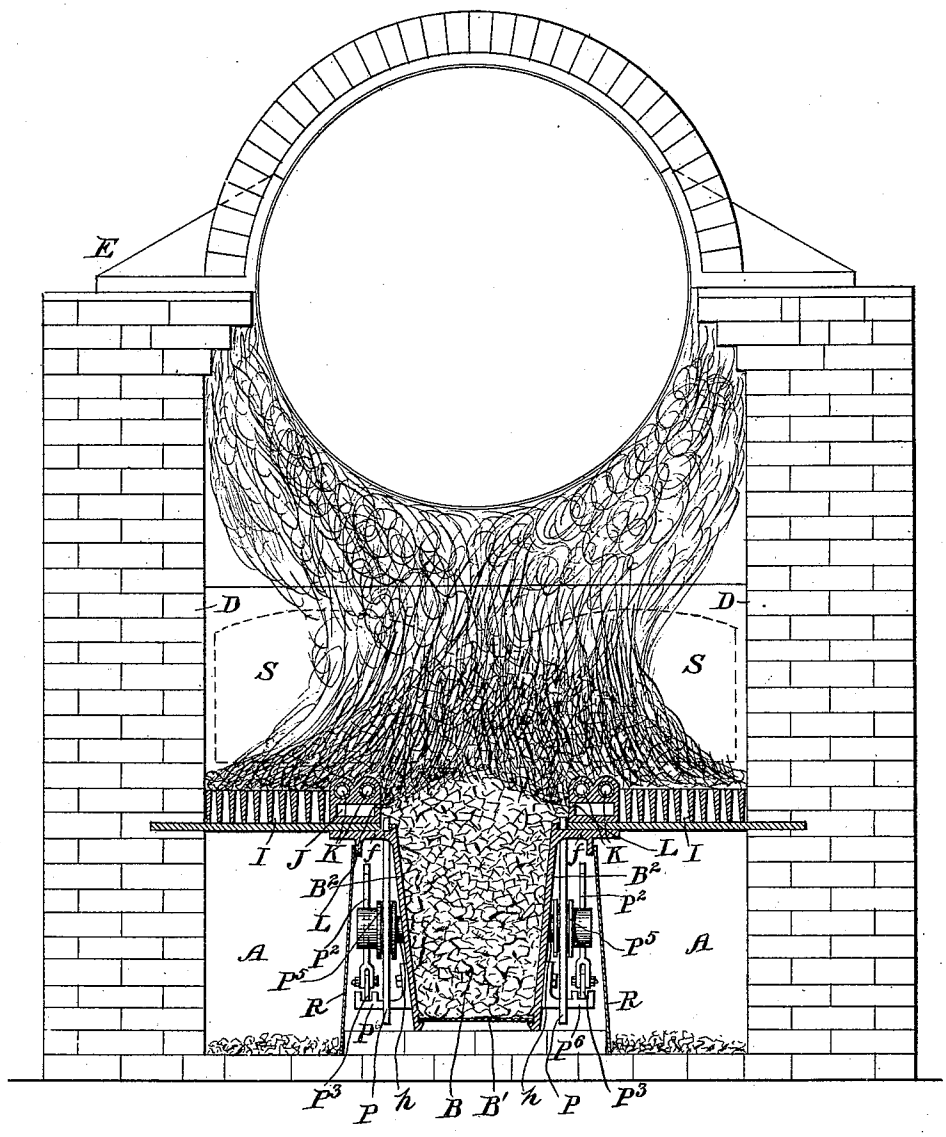
(No Model.) 6 Sheets—Sheet 3.

E. W. JONES.

BOILER OR OTHER FURNACE.

No. 470,052. Patented Mar. 1, 1892.

FIG. 3.



Witnesses:
Geverance
E. J. Fenwick

Inventor:
Evan W. Jones
by his Attorneys
Mason, Fenwick & Lawrence

(No Model.)

6 Sheets—Sheet 4.

E. W. JONES.

BOILER OR OTHER FURNACE.

No. 470,052. Patented Mar. 1, 1892.

Fig. 5.

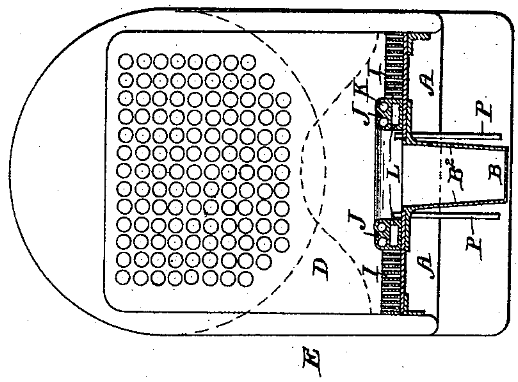
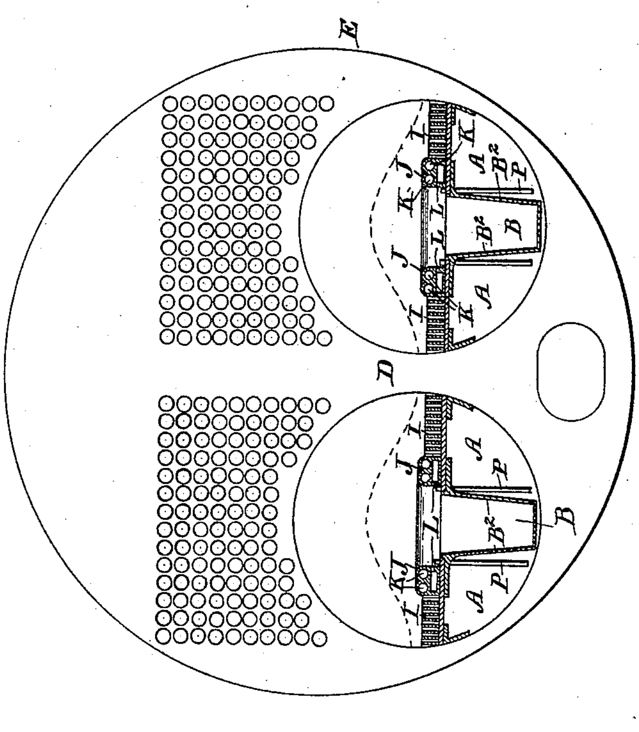


Fig. 4.



Witnesses:—
J. Severance.
E. J. Fenwick

Inventor:—
Evan W. Jones
by his Attorneys
Mason, Fenwick & Lawrence

(No Model.) 6 Sheets—Sheet 5.

E. W. JONES.

BOILER OR OTHER FURNACE.

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FIG. 6.

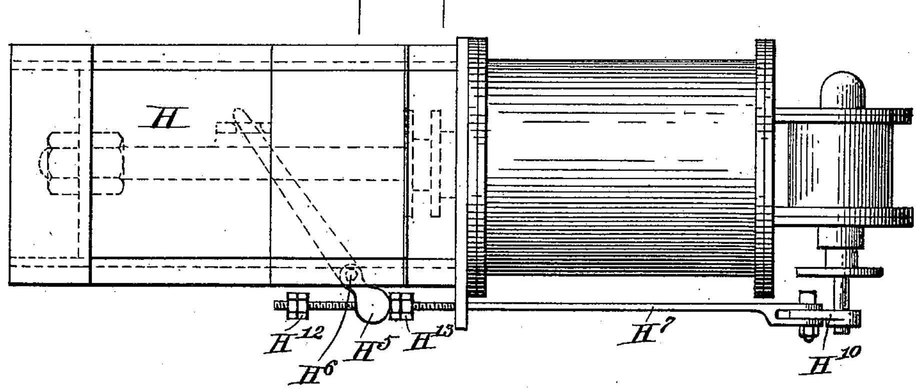


FIG. 8.

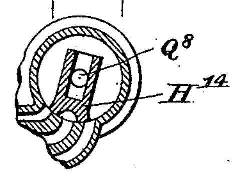
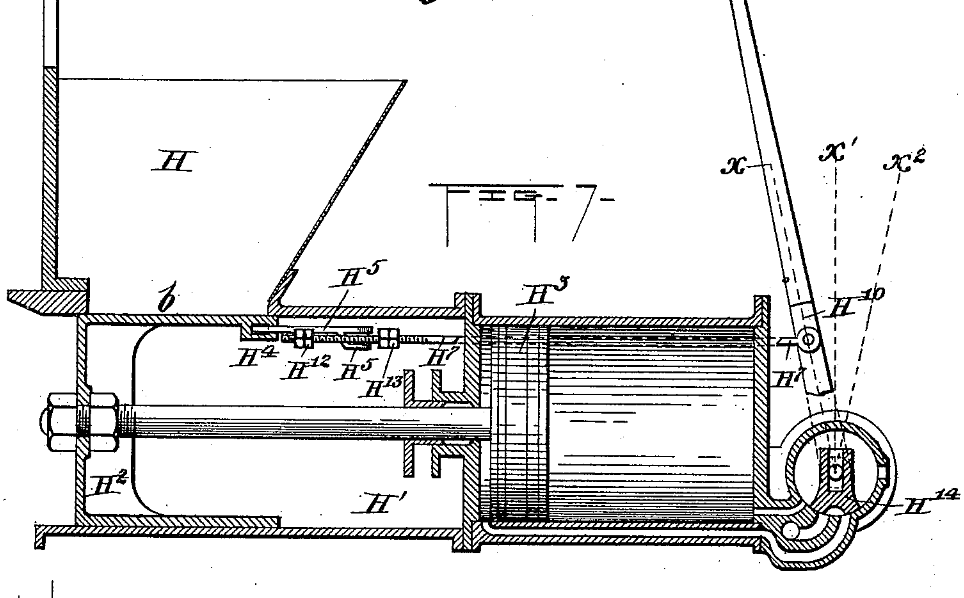


FIG. 7.



Witnesses:
J. Severance
E. J. Fenwick

Inventor:
Evan W. Jones
by his Attorneys
Mason, Fenwick and Lawrence

(No Model.) 6 Sheets—Sheet 6.

E. W. JONES.

BOILER OR OTHER FURNACE.

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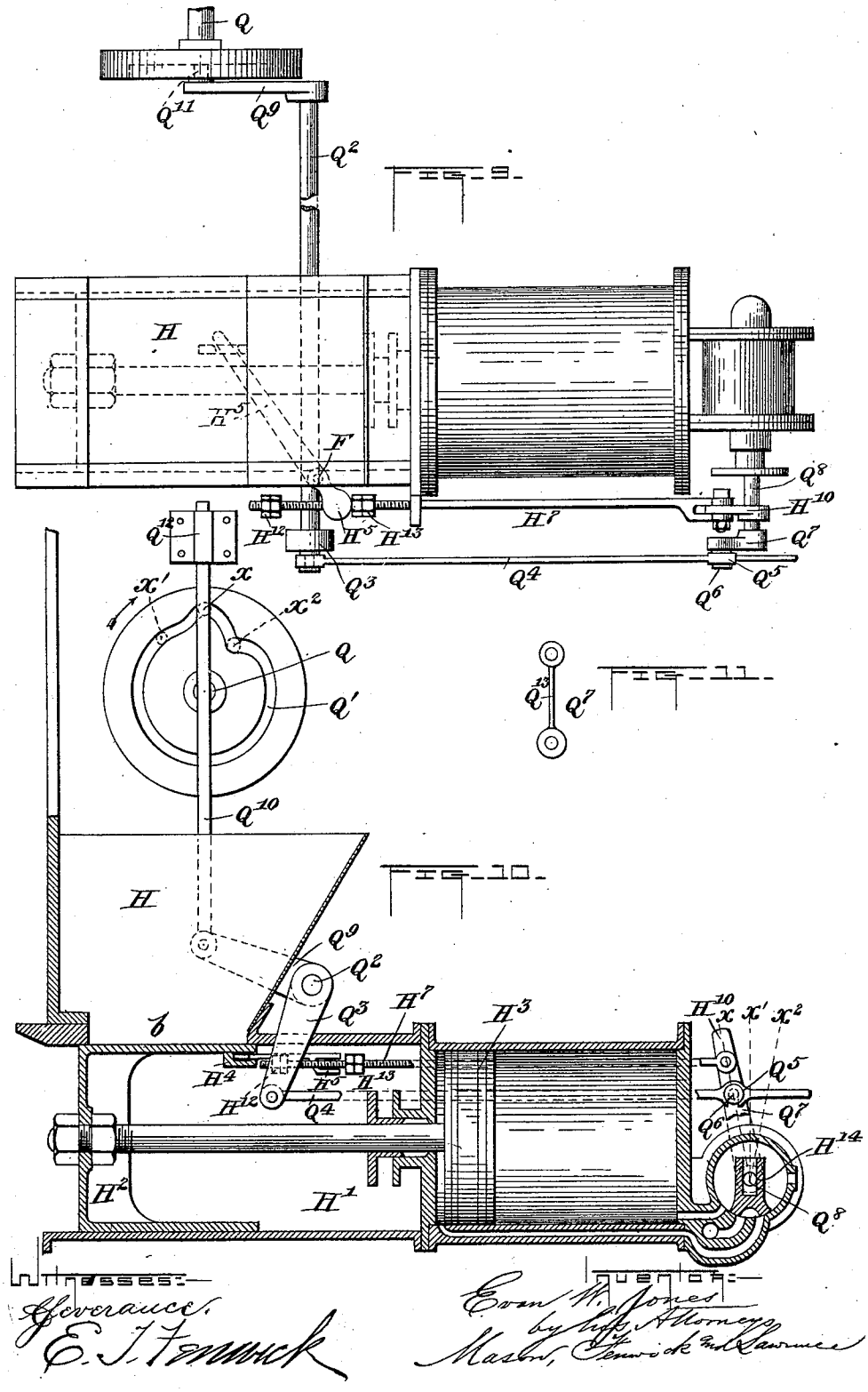

Witnesses:
Florance C.
E. T. Fenwick

Evan W. Jones
by his Attorneys
Mason, Fenwick & Lawrence

UNITED STATES PATENT OFFICE.

EVAN W. JONES, OF PORTLAND, OREGON.

BOILER OR OTHER FURNACE.

SPECIFICATION forming part of Letters Patent No. 470,052, dated March 1, 1892.

Application filed June 24, 1891. Serial No. 397,339. (No model.)

To all whom it may concern:

Be it known that I, EVAN W. JONES, a citizen of the United States, residing at Portland, in the county of Multnomah and State of Oregon, have invented certain new and useful Improvements in Boiler or other 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 appertains to make and use the same.

My invention relates to an improvement in boiler or other furnaces, and especially to that type of furnace patented to me August 27, 1889, No. 409,792.

My invention consists in a novel construction, combination, and arrangement of means in furnaces in which the fuel is forced into the mass of burning coals from a point below said mass instead of being discharged on top of said mass of burning fuel, said means serving to force the supply of air directly over the fresh or green fuel and at the same time under the mass of burning fuel, thereby causing the gases from the green fuel and the air supplied to become thoroughly mixed before they pass through the burning fuel and off into the flue or flues, said means also serving to regulate this supply of air, and thus insure complete combustion, said means also serving to prevent inconvenience from the formation of clinkers and avoid the waste of fine coal, they providing for the destruction of clinkers in the event of such being formed, and the construction and combination being such that the fire can be run for a very long period without ashes or clinkers interfering with its perfect operation, and all the fuel shall be practically burned before it reaches the grates of the furnace. The said improvements are illustrated in the accompanying drawings, in which—

Figure 1 is a broken vertical longitudinal section illustrating my invention as applied to a brick boiler-furnace. Fig. 2 is a horizontal section of the furnace shown in Fig. 1 on the line $x\ x$ of said figure. Fig. 3 is a vertical cross-section in the line $y\ y$ of Fig. 2. Fig. 4 is a vertical cross-section of a marine-boiler furnace with my improvement; and Fig. 5 is a similar section to Fig. 4, illustrating the mode of applying the invention to a water-leg fire-box boiler. Fig. 6 is an enlarged plan view of the steam-ram, fuel-hopper, and the top plate of the fuel-opening of the fire-box as arranged for being operated by a hand-lever. Fig. 7 is a vertical section of a portion of the fire-box, fuel-hopper, and the steam-ram shown in Fig. 6. Fig. 8 is a detail sectional view of the valve for controlling the influx and efflux of the steam. Fig. 9 is a similar view to Fig. 6, the hand-lever being substituted by an automatic means for controlling the influx and efflux of the steam. Fig. 10 is a similar view to Fig. 7, the hand-lever being substituted for the automatic means shown in Fig. 9, and Fig. 11 is a detail view of the arm for operating the valve of the automatic mechanism.

Referring to the drawings, A A in Fig. 3 indicate ash-pits arranged on the side of the fuel-feeding magazine B, said magazine being provided with an upwardly-curved bottom B′, upwardly-flared closed sides B^2, and an inwardly and upwardly extended hood or overhanging top portion B^3. The fuel-feeding magazine has a mouth coinciding in size with the feed-entrance opening *a* in the front wall of the fire-chamber D of the furnace E, said mouth being fitted into said opening as illustrated in the drawings or in any other suitable and substantial manner, while the forward end of said magazine is firmly supported upon a casting F, mounted upon the brick-work of the bridge-wall of the furnace and substantially secured in position.

Outside and coinciding with the mouth of the magazine B a fuel-box G is provided, and just over an opening *b* in the top of said box a fuel-hopper H is arranged, the same being of a size which adapts it for containing the requisite quantity of fresh fuel. Connected to the fuel-box is a ram H′ for forcing the fresh fuel into the magazine B and therefrom upon side grates I, which are on a plane somewhat lower than the apex of the mass of fuel when the same is fully on fire at the top of the magazine, about as illustrated in Fig. 2 of the drawings. The ram H′ may be similar to that in my aforesaid Letters Patent, and operate in substantially the same manner, and the power employed for actuating the plunger-head H^2 of the ram may be either steam,

compressed air, or hydraulic pressure, or a cam, eccentric, crank, rack and pinion, or screw; but the preferable means are those represented in either Figs. 6, 7, and 8 or in Figs. 9 and 10, a description of which will be presently given. When the ram-plunger H^2 is drawn back, the fuel in the hopper falls into the fuel-box G under the hopper H, and on the return stroke of the ram-plunger the fresh fuel is forced into the magazine B and during the operation of the furnace and the burning away of the fuel previously supplied the fuel will be forced up higher and higher until it reaches and becomes completely impacted against the mass of burning fuel above it, and thus becomes a part of the burning mass of fuel, but always occupying a position beneath the mass of live coals.

The bottom of the fuel-magazine can be of iron or brick, and it can be curved on a slight incline, or the incline may be straight and of any angle suitable for insuring the free gliding up of the fresh fuel which is being forced in by the ram.

The construction and operation of the piston H^3, that controls the forcing-ram H′, are as follows:

Referring to the drawings, Figs. 6, 7, and 8, it will be seen that on the under side of the upper flange of the plunger-head H^2 of the ram H′ is a slotted projection H^4, and that through this flange passes loosely the end of a lever H^5, which is fulcrumed at H^6 and has one of its ends bifurcated so as to admit between its prongs a rod H^7. The result of this construction and combination is to give (through the bifurcated end of the lever H^5) a reduced reversed motion to the plunger H^2. The rod H^7 is connected to the arm H^{10}. On the end of rod H^7 are adjustable tappets H^{12} H^{13}. When the valve H^{14} is placed in the position shown in Fig. 7, the pressure forces the piston to the end of the stroke and the end of the lever H^5 will strike the tappet H^{13} and place the valve in the position shown in Fig. 8, thereby closing the exhaust and putting pressure on both sides of the piston at the same time. The same result is attained at the other end of the stroke, the lever H^5 striking the tappet H^{12}. The object of this construction is to cushion the piston and avoid slamming of the same at each end of the stroke.

Now, referring to Figs. 9, 10, and 8, it will be seen that when the valve H^{14} is to be operated automatically it can be done by the addition of certain parts shown in said Figs. 9 and 10. In this arrangement the shaft Q and grooved cam Q′ are caused to make the desired number of revolutions, said parts being located at any convenient point, so as to give a vibrating motion to the shaft Q^2. It will be seen that the shaft Q^2 carries an arm Q^3, to one end of which is attached a rod Q^4, which carries a hook Q^5 on its outer end, said hook catching over the wrist-pin Q^6 of the arm Q^7. Both arms H^{10} and Q^7 are secured to the valve-stem Q^8. To an arm Q^9 is secured the lower end of the vertical rod Q^{10}, and to this rod a roller Q^{11} is secured, said roller working in the groove of the cam Q′. The upper end of the rod Q^{10} works through a guide Q^{12}. It will now be seen that when the cam is caused to revolve in the direction of the arrow and the roller Q^9 is brought into the position x the valve H^{14} will be brought into the position shown in Fig. 10, and as the cam continues to revolve the valve is soon brought into the position x' or that shown in Fig. 8, which closes the exhaust and places pressure on both sides of the piston at once. It will be seen from the shape of the groove of the cam that the valve is held in this position until the cam reaches the point x^2, at which stage the valve is placed in the position x^2 and admits steam to the opposite side of the piston. It will be seen from this construction and combination that when the cam Q′ is caused to make any desired number of revolutions it will produce an intermittent vibrating motion of the shaft Q^2, which in turn will operate valve H^{14}, so as to produce a quick opening and closing of the ram H′, with an interval of rest while closed. The object of the hook Q^5 is to allow the rod Q^4 to be detached from the pin Q^6, whereupon the valve H^{14} can be operated by the hand-lever H^{10}. The arm Q^7, Fig. 11, is made thin, as shown at Q^{13}, so as to spring a little when the lever H^5 strikes the tappets H^{12} H^{13} at each end of the stroke. The tappets H^{12} H^{13} can be adjusted to give the ram H′ any desired stroke or opening, so as to allow more or less fuel to fall in front of it at each stroke. In practice it is contemplated to have the shaft Q connected with the motor that drives the blower or compressor which supplies the air to the furnace and to cause said shaft Q to revolve only when the blower is running. Then, when it is desired to increase the quantity of coal that is fed into the furnace and to increase the speed of the shaft Q and also the speed of the blower at the same time, thus either giving more air with more coal or less air with less coal, this object will be attained by having an independent steam-engine or other motor to operate the blower and shaft Q, so that when the speed of the engine is reduced the speed of the blower and the speed of the shaft Q will also be reduced at the same time, thus proportioning the amount of air to the amount of fuel being consumed. The shaft Q^2 can be extended so as to operate any suitable number of valves or feeders.

On top of the sides of the magazine B a suitable air-pipe or tuyere J is applied. The upper side of the air-pipe is exposed to the intense action of the fire. Within the air-pipe is fitted a pipe K for the circulation of water, as shown. By means of the water-pipe the upper side of the air-pipe is protected, this being effected by the circulation of water through the pipe. The pipe K is of wrought-

iron and shaped as shown in dotted lines in Fig. 2. When in position, the wrought-iron pipe is connected with the feed-pump or with the water in the boiler or to any other suitable source of water-supply. The air-pipe or tuyere might also be of wrought-iron, with a hollow shell for the circulation of water over the air-space, as shown in Figs. 4 and 5. The air-pipe or tuyere J has oblong slots in its inner surface, which allow the air under pressure to penetrate the fuel at these points. Instead of the slots a series of holes may be made in the pipe or tuyere. To the outer end of the pipe or tuyere another pipe M is connected, and this may be connected to an air-supply apparatus under any suitable pressure. The pressure of the air may be controlled by a suitable valve in the pipe M. The air-pipe J can be made in independent sections, and any number of such pipes may be placed in a furnace. At the outer end of the tube J a removable cap N is placed for the purpose of blowing out any cinders or dirt that may pass into the pipe through the slots L and tend to clog the same.

P indicates vertical slice-bars operated by pinions P′ and levers P^2, bars P^3, and wrist-pins P^4, said mechanism being connected to the ram-plunger H′. The slice-bars P pass through suitable openings in flanges *f* on the sides of the magazine B. The lower front edges of the slice-bars have rack-teeth *g*, which engage in the pinions P′, while the rear edges of said bars bear against small double-flanged rolls P^5, said rolls and pinions turning freely upon studs, as *h*, fixed in the inclined sides of the magazine. The hubs of the pinions P′ are provided with slots cored through them, through which the levers slide freely, the said slots being outside of the studs upon which the pinions turn. The lower forked ends of the levers P^2 connect loosely to the sliding bars P^3, and said bars in turn are connected by means of the wrist-pins P^4 to the ram-plunger H^2. The bars P^3 are supported in grooved bracket-guides P^6, and the wrist-pins play in slots P^7. From this description it is evident that when the ram-plunger H^2 is drawn out to receive a fresh supply of fuel the slice-bars P will be forced up past the slotted surface of the air-pipe and push up any clinkers that may have collected at that point, and that on the return stroke of the said ram-plunger the bars will be lowered to their normal position out of the live coals, and the fresh fuel will be forced in and that forced upward will lift the clinkers higher above the air-pipe until they are finally crowded over with the other incombustible débris and ashes upon the side grates I to be removed by being ground down through the grates or drawn out through the front door once or twice a day, as occasion may require. It will be understood that the side grates I are not depended upon for the supply of air to carry on combustion, and therefore the ashes and other débris may be allowed to pile over upon them to any reasonable depth. The side grates may be stationary or they can be made to shake and grind down the ashes and clinkers, which are prevented from getting in contact with the slice-bars and their connections by means of guard-plates R. By the construction of the magazine with closed side walls, which are inclined outwardly from their lower to their upper edges, the fuel is packed tight between the walls of the magazine from bottom to top and is allowed to expand after it is forced up to a plane on a level with or above the air-pipes. The air that is forced under pressure through the slots in the air-pipe will meet with less resistance from above than below. Consequently the air will go up through the fuel instead of down into it, and the result is that combustion takes place over or above the slots in the air-pipe with the hottest part of the fire on top and next to the boiler, while the coal or fuel about the slots will be coking and expanding into a spongy mass, thus allowing the forced currents of air from the slots in the air-pipe to penetrate the whole mass of the fuel over and in close contiguity with said slots, and said currents of air will carry with them the gases from the fresh fuel through the hot coals above, and thereby effect complete combustion.

The plunger of the ram may have its forward end protected by a fire-brick lining, as in my aforesaid Letters Patent.

In the furnace herein described the fresh or green fuel is forced up into the body of the fire, and the gases which are liberated from this fuel pass through the body of burning coal which is above the fresh fuel, and the air for promoting combustion is supplied at the points where the fresh fuel is supplied to the mass of burning fuel above it; and the said furnace herein described, as well as that of my aforesaid patent, differs essentially from other furnaces which are provided with fuel-forcing means, and the fuel-chambers of which do not constitute both supporting fire-beds for the underlying mass of fuel as well as the superincumbent mass and do not serve for conducting the fresh fuel directly up within the fire-chamber amid the mass of burning coal during the operation of forcing the fresh fuel from the fuel-box into the fire-chamber by the ram.

For the purpose of starting the fire and removing any clinkers that cannot be destroyed by the slice-bars, doors S, as shown in dotted lines in Fig. 3, may be provided in the furnace above the grates.

What I claim as my invention is—

1. A furnace provided with a fuel-opening below the line of the fire, a supporting-bottom for the fuel within the fire-chamber sloping upward and backward from the supply-opening and having flaring sides which, with the bottom and the furnace-wall, form a chamber or magazine for the fresh or green fuel directly under the means for supplying air for

promoting combustion, and a forcing means entering through the wall of the furnace whereby the fuel may be forced up into the fire through the opening at the lower end of the sloping bottom of the magazine, said sloping bottom forming a support for the fuel independent of the position of the feeding mechanism, substantially as described.

2. A furnace provided with a downwardly-contracted chamber having a solid inclined or curved bottom forming at all times a firm support for the fuel and provided with air-supply passages at the top, an opening at the bottom of the incline, and a ram for forcing the fuel through the opening, said fuel being forced up into the fire by sliding it up the inclined bottom of the fuel-magazine between the solid flaring sides thereof, substantially as described.

3. A furnace provided with a fuel-chamber directly under means for supplying air for promoting combustion, said chamber having upwardly and outwardly inclined closed sides, a concaved or inclined bottom, means for forcing the fuel up into the fire, means for forcing air under pressure directly over the fuel-magazine, side grates near the top of said fuel-magazine, ash-pits below said grates on each side of the fuel-magazine, and air-pipes located near the top of the magazine under the mass of burning coals for the purpose of supplying air under pressure under said coals and over the green fuel in the magazine, substantially as described.

4. A furnace with a fuel-chamber having an upwardly-expanding cross-section and located below the line on which the air is forced into the fuel, slice-bars for breaking loose clinkers and loosening up the fire, and means for operating said bars by power, substantially as described.

5. A furnace provided with a concave or inclined bottom and flaring sides which with the furnace-wall form a fuel chamber or magazine, a ram for forcing the fuel into the furnace, and slice-bars to break up the clinkers and loosen up the fire connected to and operated by said ram, substantially as described.

6. A furnace with a fuel chamber or magazine and provided with perforated pipes or tuyeres connected with a pipe of an air-supplying apparatus whereby air is forced under pressure directly over said fuel-chamber and under and through the burning coal, and with a device for forcing the fresh coal up into the fire, substantially as described.

7. The furnace provided with the air-pipe or tuyere and with the water-circulation pipe to protect the same from action of the fire, and with removable caps for admitting access into the air-pipe, substantially as described.

8. The furnace provided with a chamber or magazine, side grate-bars, slice-bars, and mechanical devices for operating said bars, whereby clinkers can be broken up near the air-supply pipes, substantially as described.

9. A furnace provided with an upwardly-expanding chamber closed at bottom and sides and having connection with an air-supplying apparatus at or near its top, whereby the fresh or green fuel is confined while air is being forced first over the top of the fresh fuel below the mass of burning fuel and through the burning fuel, in combination with a device for forcing fresh fuel up into the burning fuel, substantially as described.

10. A furnace provided with a ram for forcing in the fuel and devices comprising a valve mechanism for operating said ram with a variable stroke, this combination being such that the mechanism for producing the variable stroke can be operated either by steam or hand power, so that more or less fuel can be forced in at each stroke, substantially as described.

11. The combination, with the forcing-ram, of the projection H^4, lever H^5, fulcrumed at H^6 and having one of its ends bifurcated, rod H^7, arm H^{10}, adjustable tappets H^{12} and H^{13}, and valve H^{14}, substantially as and for the purpose described.

12. The combination, with the forcing-ram, of the projection H^4, lever H^5, fulcrumed at H^6 and having one of its ends bifurcated, the rod H^7, arm H^{10}, adjustable tappets H^{12} H^{13}, valve H^{14}, shaft Q, cam Q′, shaft Q^2, arm Q^3, rod Q^4, hook Q^5, wrist-pin Q^6, arms Q^7 and H^{10}, valve-stem Q^8, arm Q^9, vertical rod Q^{10}, and roller Q^{11}, substantially as and for the purpose described.

In testimony whereof I hereunto affix my signature in presence of two witnesses.

EVAN W. JONES.

Witnesses:
W. H. WOOD,
CHAS. PHILLIPS.