(No Model.)

2 Sheets—Sheet 1.

E. B. COXE.

FURNACE.

No. 517,645. Patented Apr. 3, 1894.

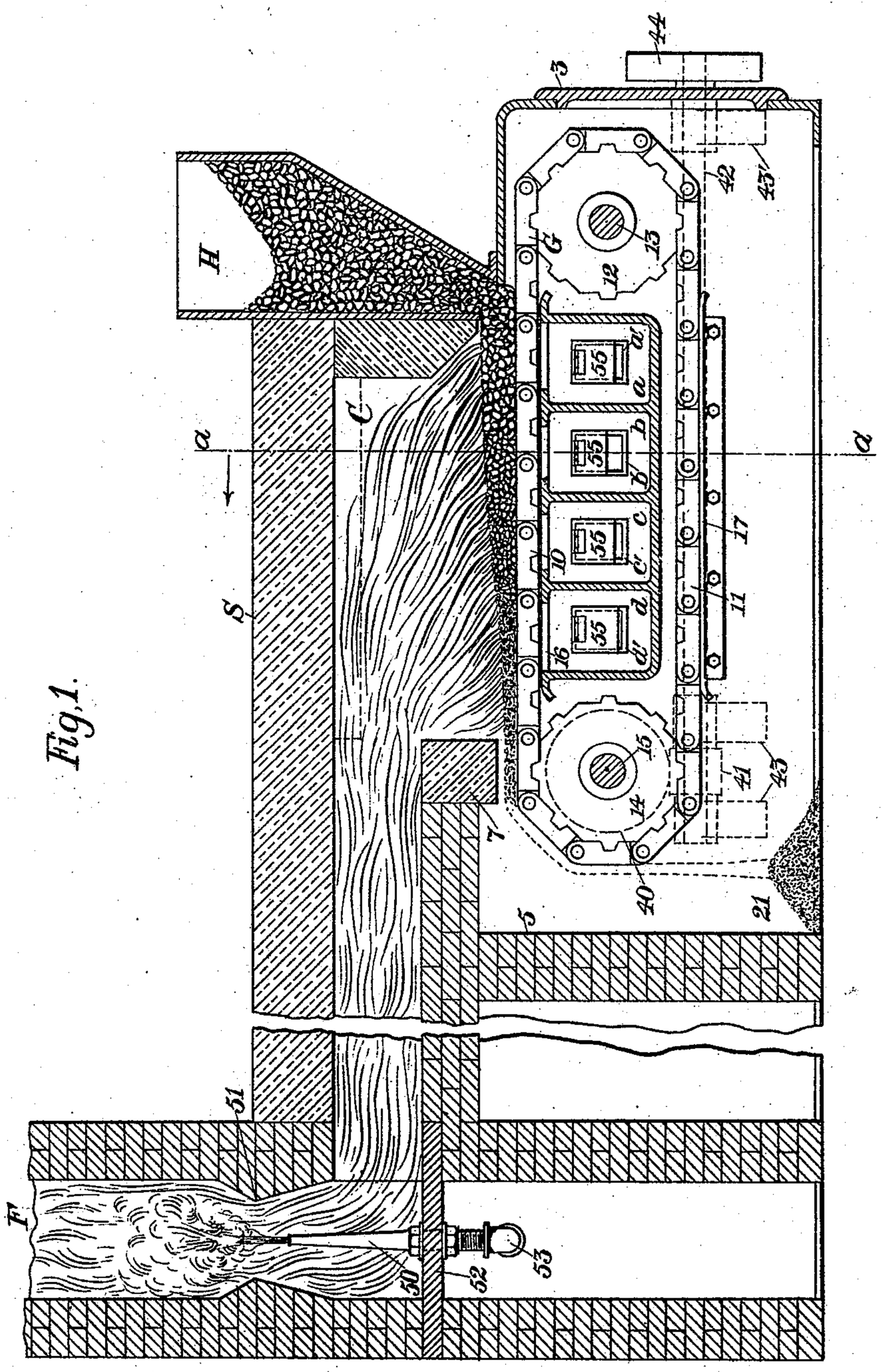

Fig. 1.

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(No Model.)

2 Sheets—Sheet 2.

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Fig. 4.

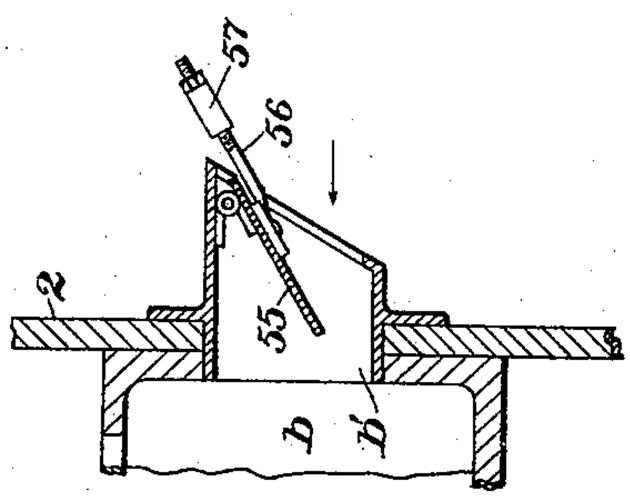


Fig. 3.

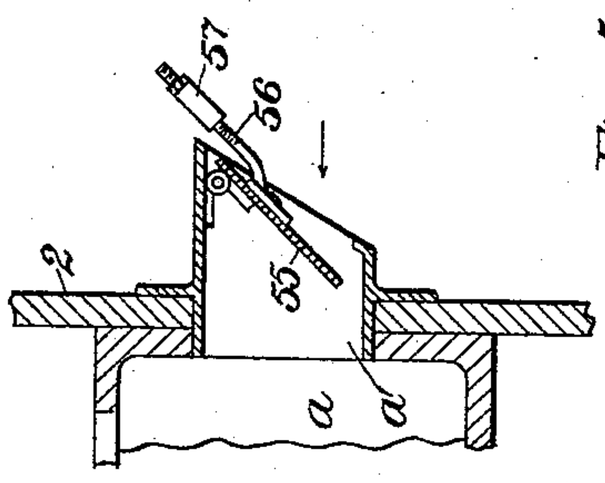


Fig. 5.

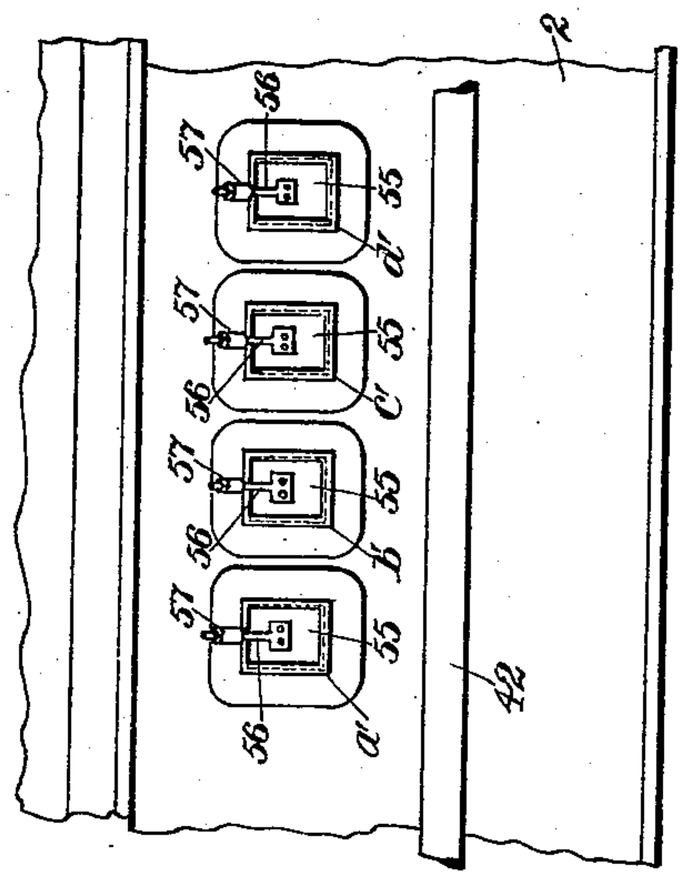
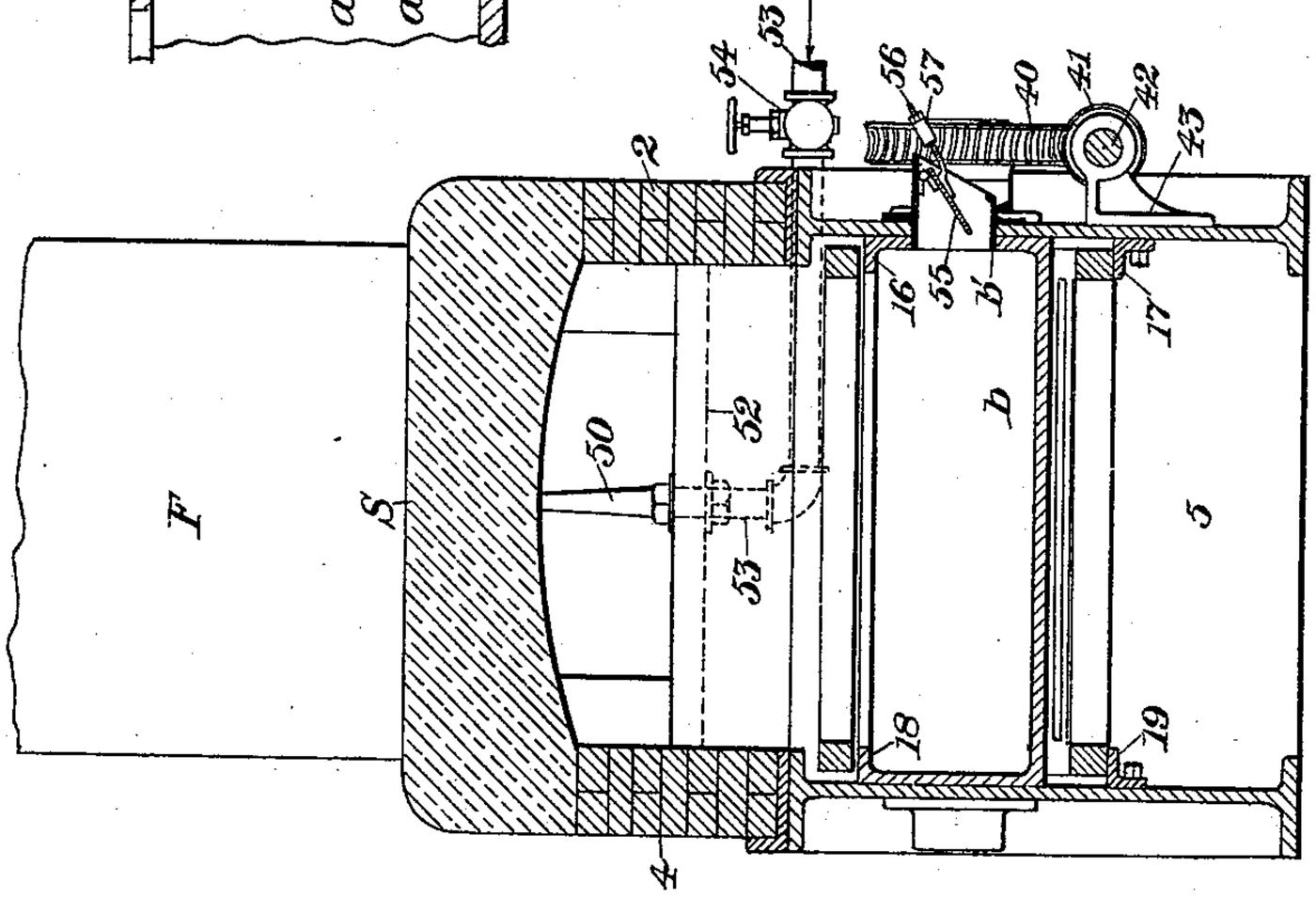


Fig. 2.



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UNITED STATES PATENT OFFICE.

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FURNACE.

SPECIFICATION forming part of Letters Patent No. 517,645, dated April 3, 1894.

Application filed February 20, 1894. Serial No. 500,825. (No model.)

To all whom it may concern:

Be it known that I, ECKLEY B. COXE, a citizen of the United States, residing at Drifton, in the county of Luzerne and State of Pennsylvania, have invented certain new and useful Improvements in Furnaces, of which the following is a specification.

This invention relates to furnaces of the class described in Letters Patent of the United States No. 499,716, granted to me June 20, 1893.

The object of my present invention is to furnish apparatus for the economical burning of the finer grades of coal after the manner described in the patent referred to; but to accomplish this end through the medium of successive "suction-blasts" of air instead of by the forced pressure-blasts described in said patent, and thereby to obviate the use of a blower and actuating mechanism therefor; and also to provide means whereby the extent or volume of the successive suction-blasts may be regulated as required.

In the drawings accompanying and forming a part of this specification, Figure 1 is a sectional side elevation of a furnace embodying my present improvement. Fig. 2 is a vertical cross-sectional view, in line *a*—*a*, Fig. 1, looking in the direction of the arrow. Fig. 3 is an enlarged sectional view similar to a portion of Fig. 2, illustrating the operation of one of the suction-blast regulators. Fig. 4 is a similar view to Fig. 3, illustrating the operation of another one of the suction-blast regulators. Fig. 5 is a partial side view of the suction-blast-regulating apparatus, as seen from the right-hand in Fig. 2.

Similar characters designate like parts in all the figures.

For the purpose of illustrating the application and mode of operation of my present improvements, I have shown the same applied to a furnace similar to the one described in said Letters Patent No. 499,716. This furnace comprises a fuel-traveling grate and means for actuating the same, and has its furnace-chamber C and also the grate-mechanism inclosed by the usual side-walls 2 and 4, and end-walls 3 and 5; said furnace also having a roof, S, a bridge-wall, 7, and a stack or flue, F, in communication with the discharge-end of the furnace-chamber. In the form herein shown, the endless grate, designated in a general way by G, comprises the upper and lower runs, 10 and 11, respectively, said upper run constituting the furnace-floor. Under this floor is located a series of vacuum-cells, or air-supply chambers, *a*, *b*, *c* and *d*, these being preferably supplied with air by induction or supply-pipes, *a'*, *b'*, *c'* and *d'*, respectively, in a manner substantially as hereinafter described. The upper and lower runs, respectively, of the endless grate are shown supported upon guides, 16 and 18, and 17 and 19, respectively. For actuating the traveling grate, this is shown carried by the chain-wheels 12 and 14, which are supported on the shafts 13 and 15, respectively; and for revolving one of the shafts and thereby actuating the grate, said shaft 15 is shown furnished with the worm-wheel 40, which meshes with a worm, 41, on a driving-shaft, 42, that is supported in bearings, 43 and 43', and that is driven by a pulley, 44, from some suitable source of power, not shown.

As a means for delivering the fuel to the grate, I have shown the furnace provided with the usual hopper, H, from which the fuel slides downward in a stream directly onto the grate, or furnace-floor, at a point adjacent to the first air-supply chamber, each section of the grate receiving the fuel at or before the time it reaches the said first air-supply chamber, being then carried along over that chamber and the succeeding chambers *b*, *c* and *d*; during this period the combustible material of the fuel is consumed, and the resultant cinder or ash is afterward carried under the bridge-wall 7, and finally delivered over the rearward end of the grate into the ash-pit 21. These several details just described relative to the furnace proper and its grate-mechanism, are substantially the same as details designated by like characters in the patent, No. 499,716, hereinbefore referred to, to which reference may be had for a more particular description than is herein contained. It is desired to state in this connection that my improvements are applicable to other types of furnaces than that shown in the drawings, and therefore I do not desire to limit myself to their use in connection with any particular form of furnace or grate-mechanism.

As a means for creating an excess of draft

or suction in the furnace-chamber over and above that naturally created by the flue-draft, and one of sufficient power to not only exhaust the heated products of combustion from the furnace-chamber, but to cause sufficient suction to draw air from below the grate through the ignited fuel, and at the same time create a vacuum in the air-supply cells to draw air thereinto, I have provided an exhaust blast-device, which, in the preferred form thereof herein shown, consists of a steam-blast nozzle, 50, preferably located within the stack or flue F at a suitable point in or beyond the outlet of the furnace-chamber. In the drawings this steam-blast nozzle is shown centrally disposed within and somewhat below the contracting ring, 51, of the flue, it being extended through, and fixed in, a transverse wall, or plate, 52, in said stack or flue. The exhaust blast nozzle is supplied through the pipe 53 in which is a valve, 54, for regulating the supply of steam to said nozzle. In practice, this valve will require regulation in connection with the regulating-valves of the air-supply pipes, as will be hereinafter fully described. Steam will be supplied to the pipe 53 from any suitable steam-supply, as, for instance, the same might be supplied from a boiler used in connection with the furnace. If desired, more than one exhaust blast device might be used in connection with the furnace-chamber; also, other kinds of exhaust-devices may be substituted for the steam-blast exhaust device herein described. In its operation, the steam-blast apparatus produces a suction in the furnace-chamber sufficient to draw air upward through the grate and fuel from the several air-cells, or chambers, *a*, *b*, *c* and *d*, located beneath the grate, and at the same time creates a vacuum in said cells sufficient to re-supply the cells with air from the outer atmosphere, said cells preferably being in direct communication with the outer atmosphere through induction-pipes, *a'*, *b'*, *c'* and *d'*, respectively.

As a means for regulating the influx of air to the several air-cells, or chambers, these cells (or the induction-pipes in communication therewith) will each, preferably, be furnished with a resistant-valve, or device, which, in the preferred form thereof herein shown, consists of a swinging valve, or gate, 55, of sufficient weight to resist the incoming air to a greater or less degree according as the same is more or less counterbalanced.

In some cases it may be desirable to dispense with the resistant-valve just described, in which case the inlets to the vacuum-cells may be made of greater or less area to regulate the in-flow of air.

As a means for counterbalancing the valves 55 to increase their resistance to the in-coming air, said valves are each shown provided with a lever, 56, having a weight, 57, adjustably secured to the free end thereof. The weights of the valves of the several air-cells may, if desired, be of different sizes, as shown in Figs. 3, 4 and 5, so that some of the valves to which they are applied will offer a greater resistance to the in-coming air than others; or, if desired, the weights may be duplicates and be adjusted upon the levers 56 toward or from the valves to increase or decrease the resistance of said valves. Fig. 3 of the drawings represents one of the valves which is the least weighted, and which, therefore, offers the most resistance to the in-flowing current of air; this figure represents the regulator apparatus of the chamber *a*. Fig. 4 similarly represents the regulator apparatus for the chamber *b*, and shows the regulator valve 55 more heavily counterbalanced so as to offer less resistance to the in-flowing current of air and thereby permit a relatively large volume of air to pass into said air-chamber *b* and so supply the fuel over said chamber with an increased air-blast.

The first one, *a*, of the series of air-chambers underneath the grate will, preferably, have its regulator valve so counterbalanced as to admit a relatively small volume of air to said chamber, as is required during the ignition of the fuel.

In practice, the described nozzle-blast in the discharge-flue will be so proportioned as to exhaust the furnace-chamber C sufficiently to draw in, by suction, a sufficient quantity of air through the several air-supply chambers to properly burn the fuel on the grate, the required variation in the successive air-supplies being obtained by increasing or decreasing the resistance of the valves 55 by counterbalancing them more or less. The maximum air-supply will, of course, have an absolute pressure slightly less than the pressure of the atmosphere; this maximum pressure (as when a pressure-blast apparatus was used as described in my prior patent referred to) will generally be in the second air-supply chamber *b*. In the succeeding chambers *c* and *d*, the air-supply will be reduced (by increasing the resistance of the valves thereof to the in-coming air) to a still lower absolute pressure; and the nozzle-blast, whether this be steam or air-blast, must be properly proportioned for producing a vacuum sufficient for obtaining the required variation in the successive air-supplies.

Having thus described my invention, I claim—

1. In a furnace, the combination with the furnace-chamber and its inclosing walls, of a grate adapted for supporting and carrying forward the fuel in a layer, a series of vacuum-chambers located below said grate and in direct communication with the outer atmosphere, and an exhaust-apparatus located at the discharge-end of the furnace-chamber and adapted for exhausting said chamber and creating a vacuum in the several vacuum-chambers, substantially as described and for the purpose set forth.

2. In a furnace having a furnace-chamber and a grate adapted for supporting and mov-

ing the fuel forward, the combination with a series of independent vacuum-cells or chambers, each having induction-passages in restricted communication with the outer atmosphere, and each having openings contiguous to the grate, of means for exhausting the furnace-chamber and creating a vacuum in said air-chambers, substantially as described and for the purpose set forth.

3. In a furnace, the combination with the furnace-chamber and its inclosing walls, of a series of successive air-chambers located below the grate and having induction-openings of varying areas for limiting the volume of in-flowing air to each successive chamber, and an exhaust apparatus adapted for exhausting the furnace-chamber and for creating a vacuum in the several air-chambers, substantially as described and for the purpose set forth.

4. In a furnace, the combination with the furnace-chamber and its inclosing walls, of a grate adapted for carrying the fuel forward in a layer, a series of successive air-chambers located underneath the fuel-layer and each having an induction-passage in direct communication with the outer atmosphere, means in connection with each induction-passage for limiting the influx of air thereto, and an exhaust apparatus for producing an increased suction in the furnace-chamber, for exhausting the same and at the same time creating a vacuum in the air-chambers sufficient to cause an influx of air thereto, substantially as described.

5. In a furnace, the combination with the furnace-chamber and its fuel-carrying grate, of a vacuum-chamber located below the ignition region of the grate and having an induction-passage of relatively small area in communication with the outer atmosphere; an adjacent vacuum-chamber having a similar induction-passage of relatively large area; a vacuum-chamber located under the region of the grate where the last stages of combustion take place and having an induction-passage of relatively small area; and a steam-blast apparatus located at the discharge-end of the combustion-chamber and adapted for exhausting said chamber and for creating a vacuum in the several vacuum-chambers to cause an influx of air thereinto, substantially as described.

6. In a furnace, the combination with the furnace-chamber and its inclosing walls, and with the discharge-flue or stack leading from the furnace, of a fuel-traveling grate, a series of vacuum-chambers located under said grate and each having an induction-passage in direct communication with the outer atmosphere, resistant valves at the inlet ends of said passages, and an exhauster in said flue or stack for drawing air upward from the said chambers through the fuel and for creating a vacuum in said chambers to continue the supply, substantially as described and for the purpose set forth.

7. In a furnace plant, the combination with the furnace-chamber and grate, and with successive air-chambers located at successive points underneath the grate, of successive induction-pipes leading from the outer atmosphere to said chambers, gravity resistant valves in said pipes adapted for regulating the influx of air to the several chambers, and an exhauster located in the flue or stack for increasing the suction in the furnace-chamber and for creating a vacuum in the air-chambers, substantially as described and for the purpose set forth.

8. In a furnace, the combination with the furnace-chamber and its inclosing walls, and with the furnace-floor adapted for carrying the fuel forward in a layer, of a series of successive air-supplies located below said floor and having their induction-passages in direct but restricted communication with the outer atmosphere, a discharge-flue or stack at the discharge-end of the furnace-chamber, a steam-blast nozzle in said flue or stack, means for supplying steam to said nozzle, and a regulator valve for controlling the steam-blast, whereby a vacuum is produced in the several air-chambers, substantially as described and for the purpose set forth.

9. In a furnace, the combination with the grate and with the furnace-chamber, of a series of successive air-chambers located below the grate and each having an induction-passage in direct communication with the outer atmosphere, a weighted gravity valve closing each passage more or less, and means for creating a vacuum in the air-chambers to overcome the resistance of their weighted valves and cause an influx of air, substantially as described and for the purpose set forth.

10. In a furnace, the combination with the furnace-chamber and its grate, of a series of air induction apparatuses comprising air-chambers located under the grate and each having an inlet and a discharge opening, the discharge opening being contiguous to the grate and the inlet opening being located outside the wall of the furnace, a weighted resistant valve contiguous to each inlet opening and adapted for regulating the influx of air, and an exhaust apparatus located at the discharge end of the furnace-chamber and adapted for creating a suction in the chambers of the induction apparatus, substantially as described and for the purpose set forth.

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Witnesses:
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