

Sept. 1, 1931.

D. E. LAIN

1,820,916

FUEL BURNER

Filed June 17, 1929

4 Sheets-Sheet 1

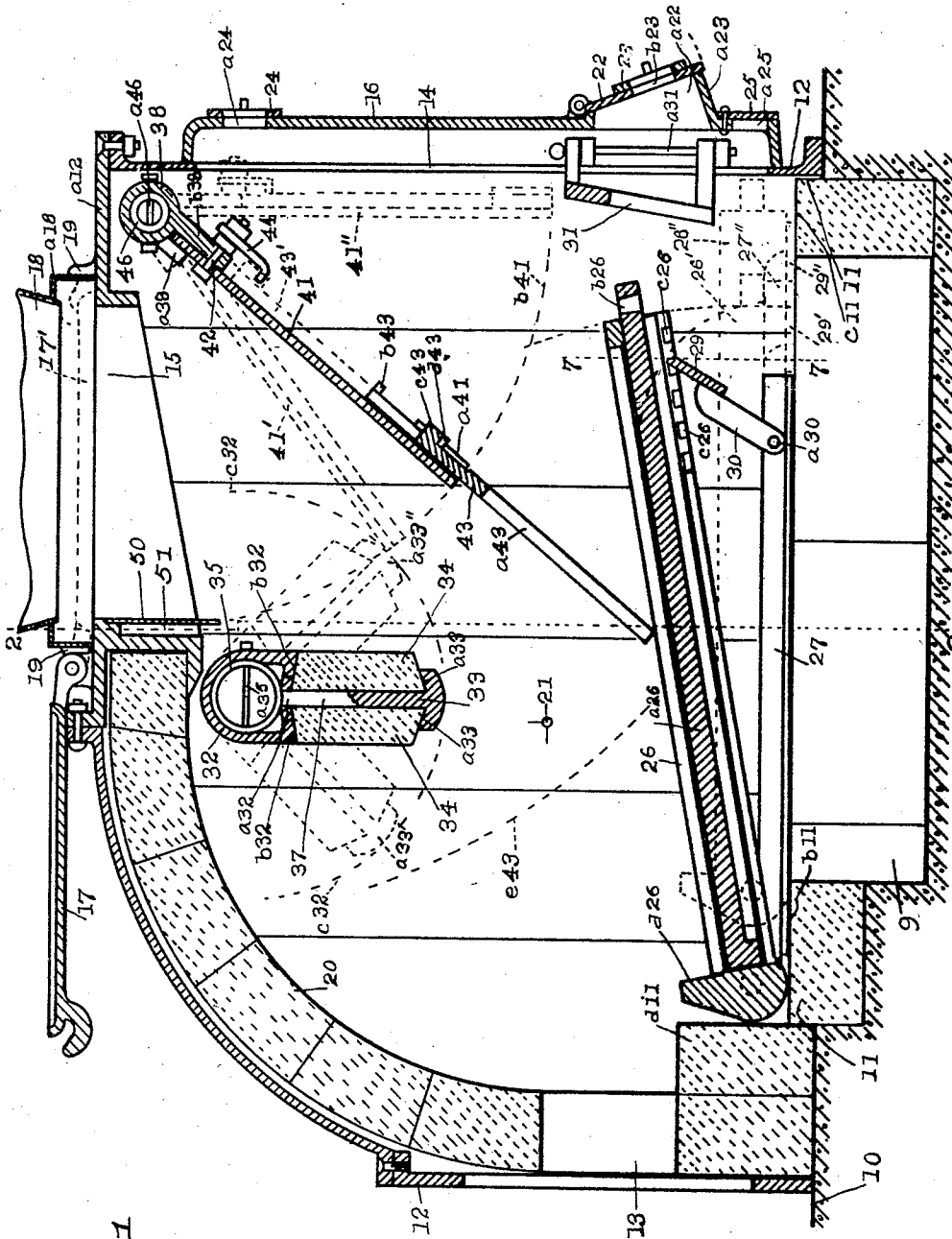


Fig. 1

INVENTOR,

David E. Lain.

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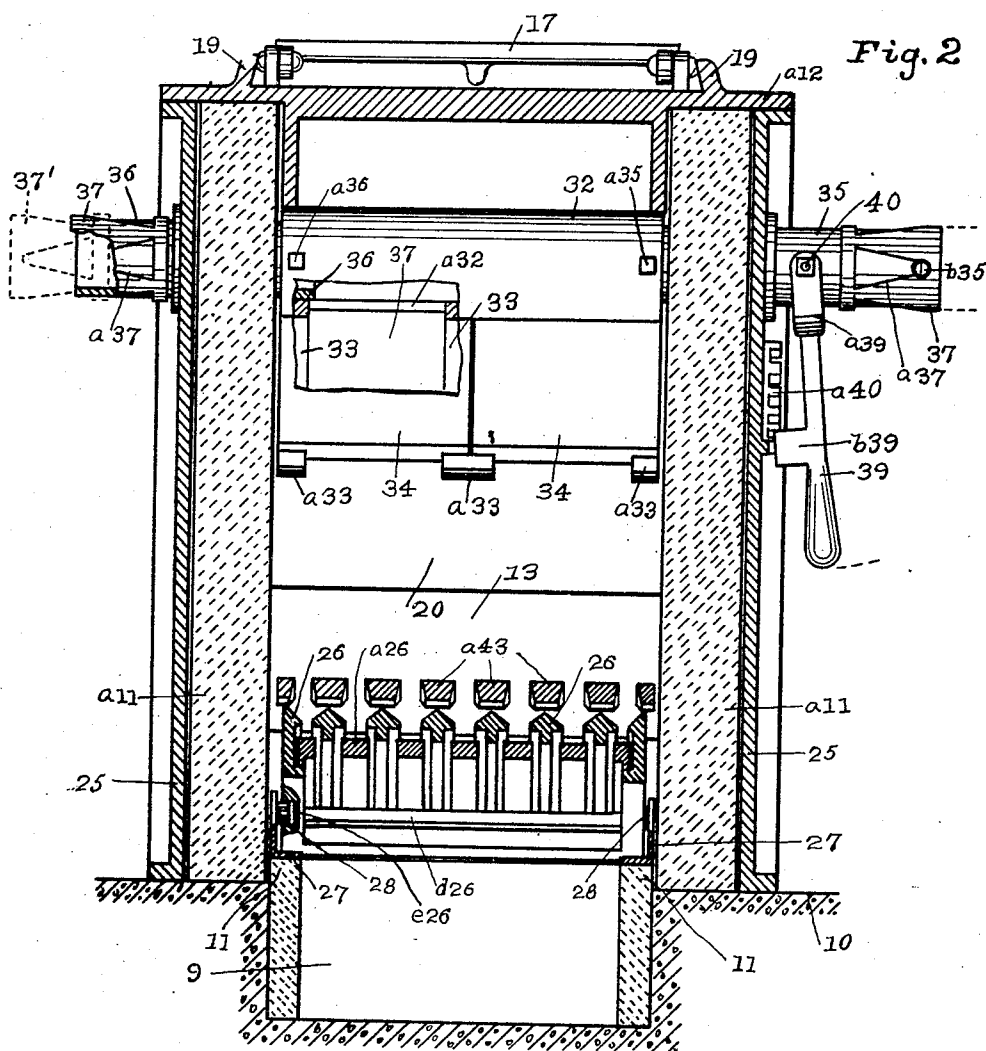


Fig. 2

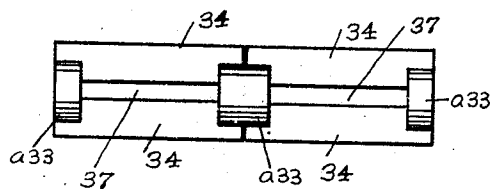


Fig. 3

INVENTOR,

David E. Lain.

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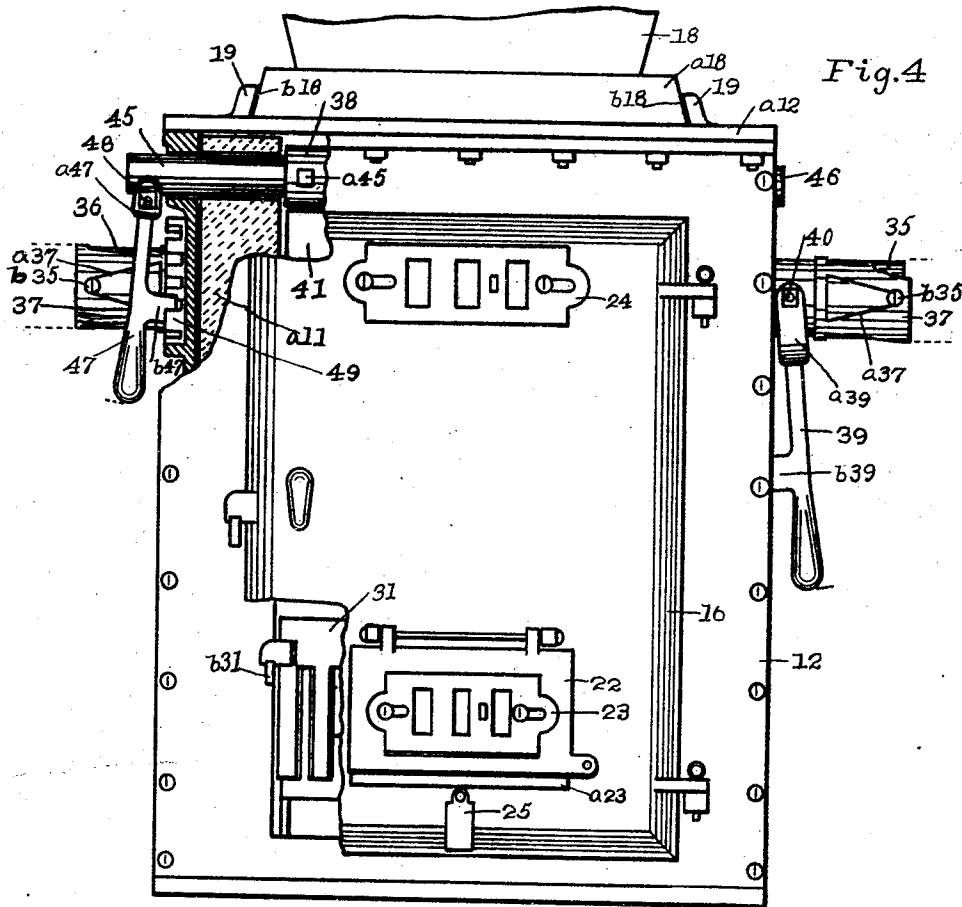
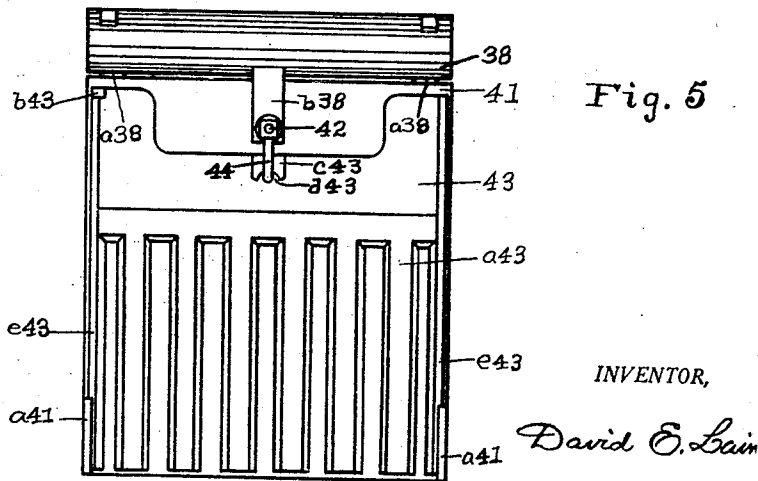
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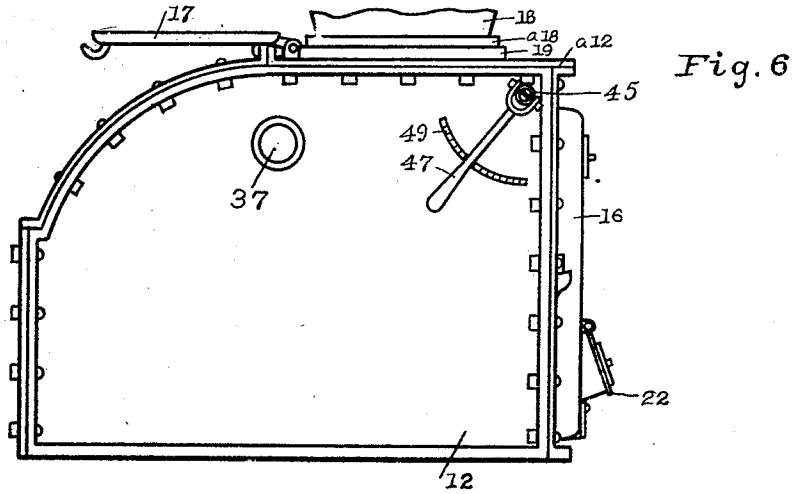
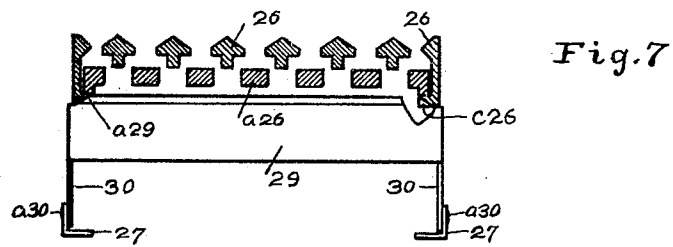
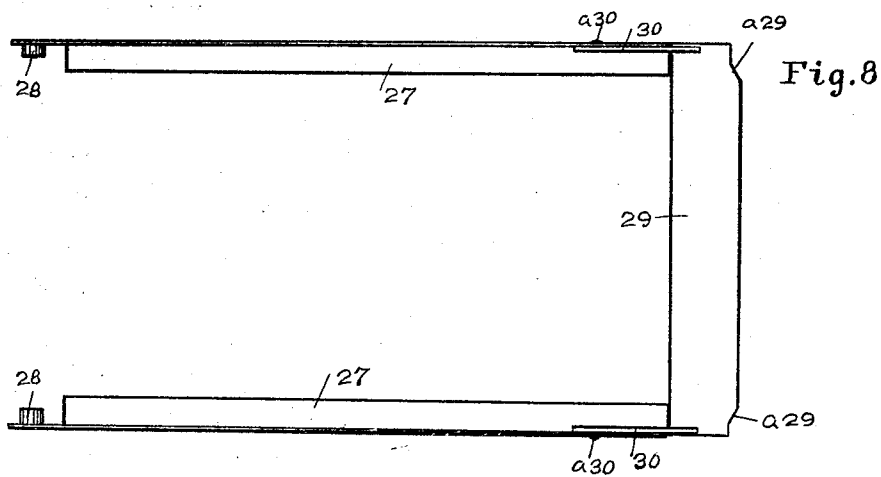
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4 Sheets-Sheet 4



INVENTOR,

David E. Lain,

UNITED STATES PATENT OFFICE

DAVID E. LAIN, OF BELLINGHAM, WASHINGTON

FUEL BURNER

Application filed June 17, 1929. Serial No. 371,545.

My invention relates to improvements in fuel burners, especially those in which combustion occurs apart from radiating areas and it is adapted for the burning of any desired solid fuel both pulverous and coarse and while it is more particularly disclosed as a sawdust burner it is also well suited for other solid fuels after making some simple adjustments hereinafter described, and has for an object to provide a burner in which a vaulted wall, lower controllable draught inlets and upper controllable draught inlets cooperate to provide for complete fuel combustion.

Another object of my improvement is to provide a burner in which a vaulted wall, controllable lower draught inlets, controllable top draught inlets and controllable automatic fuel feed cooperate to secure complete fuel combustion.

Another object of my improvement is to provide a grate oscillative on a transverse axis and reciprocative longitudinally with means to retain it in desired operative positions.

Another object of my improvement is to provide an oscillative fuel-chute baffle operable and retainable by external means to cooperate with said grate to support the flow of fuel into the burner.

Another object of my improvement is to provide said baffle with a grate extension retainable in a withdrawn position.

Another object of my improvement is to provide an oscillative fuel-chute valve controllable by external means.

Another object of my improvement is to provide an oscillative fuel-chute valve the most exposed parts of which may be of refractory materials disposable to supply reverberative areas relative to the mass of burning fuel within the burner.

Another object of my improvement is to provide a combined hollow oscillative fuel-chute valve and air nozzle having a conduit for the delivery of top-draught air into the combustion chamber through a lateral outlet setable in desired positions in oscillation by external means.

Another object of my improvement is to

provide for conducting the top-draught air through the nozzle and thus avoid raising the fuel adjacent thereto to a destructive temperature and also protect the valve from disintegrating temperatures.

Another object of my improvement is to provide adjustments for said grate, fuel-chute baffle and combined fuel-chute valve and top draught air nozzle suited to the combustion of hand-stoked fuels.

Another object of my improvement is to provide a burner in which the transverse axis of the vaulted reverberative wall and the transverse outlet of the top-air conduit and the burning fuel within the furnace may be proximate.

Other objects of my improvement will appear as the description proceeds.

I attain these and other objects of my invention with the mechanism illustrated in the four sheets of accompanying drawings, which form a part of this specification, in which Figure 1 is a side elevation of my burner in section on a medial longitudinal plane, Fig. 2 is a transverse section of my burner on a plane through vertical line 2—2 in Fig. 1; Fig. 3 is a bottom plan view of the combined fuel-chute valve and air nozzle, Fig. 4 is a front end elevation of the burner, Fig. 5 is a front elevation of the fuel-chute baffle with its extension grate in place thereon held in a withdrawn position, Fig. 6 is a front side elevation of the burner drawn on a smaller scale, Fig. 7 is a transverse cross section of the grate on the vertical line 7—7 of Fig. 1 in which the drawing of the grate is limited to the plane section, and Fig. 8 is a plan view of the grate carriage showing the grate support in a folded-down, non-operable position.

Similar characters of reference indicate similar parts throughout. Certain parts are broken away to show other parts hidden thereby.

With more particular reference to the designated parts: The burner as illustrated is designed to be set up on a concrete floor 10 in which is provided cavity 9 for an ash pit lined with brick wall 11 the top of which projects above the floor level and provides a

toe wall for the lining brick walls *a11* of the burner. The rear wall *b11* of the ash pit provides a platform for the rear end of the grate to bear on and reciprocate to a limited distance while maintaining a draught closure between said rear end of the grate and the ash pit, and the top *c11* of the front of the ash pit wall provides a bearing for the front end of the grate when in its most forward position.

The exterior metal wall of the burner is indicated in general by the numeral 12. The flue outlet 13 is at the rear and preferably proximate to the floor of the burner. Front door opening 14 is preferably the full width of the combustion chamber and extends from near the floor of the burner to near the top thereof. The top wall *a12* of the burner covers the forward end thereof and contains fuel opening 15. Front door 16 covers front opening 14 and preferably is hinged to the front wall and offset forward to provide space for front grating 31. Lid 17 closes top opening 15 and preferably is hinged to top wall plate *a12*. It is shown in its open position in full lines and in its closed position in dotted lines at 17'. Fuel hopper 18 is mounted over top burner opening 15 and has base *a18* with beveled side walls to engage with and slide between parallel inclined guide ribs 19, 19, preferably integral with top *a12*. In this manner the hopper is removably engaged in operative position on top of the burner. For lack of space the whole upper part of the hopper is broken away.

The rear upper and end walls of the burner from the rear of fuel inlet opening 15 to the top of flue outlet 13 preferably are vaulted in shape about a transverse axis through 21 which preferably is located centrally longitudinally in the main fuel combustion area. Arch fire bricks 20 provide suitable refractory lining for the semi-vaulted ceiling.

Front draft door 22 is preferably horizontally hinged to front door 16 to cover front draught opening *a22* in inclined draught conduit *a23*. Through door 22 are draught openings *b23* coverable by slide 23 thereon. Upper draught openings *a24* near the top of door 16 are coverable by slide 24 mounted for reciprocation thereon.

Near the bottom of door 16 is opening *a25* covered by pivoted door 25. Through this opening a shaker may be extended to engage with and operate the lower grate when in its horizontal position.

The grate consists of an upper main grate frame having parallel bars 26, and a lower grate frame slidable in guides on the upper frame having parallel bars *a26* beneath the upper bar spaces. In the front end of the slidable grate frame is opening *b26* for the engagement of a shaker therewith. At the rear end of the main grate frame is bridge *d26*. In the bottom edge on the inside thereof of

the front end of each of the side rails of the main grate frame are notches *c26* to engage grate-support bar 29. And in the sides at the rear end of the main frame are bearing recesses *e26* to engage grate carriage gudgeons 28.

The grate carriage consists of angle bars 27, 27 mounted for reciprocation on the top of the side walls 11, 11 of the ash pit. At the rear ends of these angle bars are fastened oppositely disposed gudgeons 28, 28 to engage in bearing recesses *e26*, as stated, to mount the main frame of the grate for oscillation thereon. On the front ends of angle bars 27 are pivoted arms 30, 30 at *a30*, *a30*. Said arms are fastened to the ends of grate-supporting bar 29 to mount said bar on said pivots for oscillation. The construction provides for the oscillation of the entire grate on said carriage, the retention thereof in desired operative positions in elevation on bar 29 engaged in an opposite pair of notches *c26*, the turning down of bar 29 to its dotted-line position at 29' with its ends bearing on the side walls of the ash pit in front of the forward ends of carriage bars 27, the turning down of the entire grate to a horizontal position shown in dotted lines at 26' with its rear end proximate to ashpit wall *b11* its side rails bearing on carriage bars 27 and its front rail on turned-down bar 29, and the moving forward of the carriage and grate while the latter is in its horizontal position to its dotted position at 26'' with bar 29 at 29'' between the end of the grate and the top of the front end wall of the ashpit. With the grate at 26' draught air may not pass beneath the rear nor side rails of the grate but may pass into the ashpit and beneath the grate between the front end thereof and the front wall of the ashpit thus promoting combustion in the bottom strata of the burning fuel. However, with the grate in its position at 26'', made possible by moving the grate carriage to 27'', bar 29 is at 29'' between the front end rail of the main grate frame and the top of the front wall of the ashpit preventing the passage of draught air into the ashpit past the front end of the grate, and, since the other parts of the lower edge of the main grate frame also makes a closure with the rear ashpit wall and the grate carriage, no draft air may pass into the ashpit and combustion is not promoted by the movement of air through the grate. This later grate position is operatively useful in some cases as will be explained later in the description.

With the grate in its full-line position in elevation, or at any other desired angle of inclination, the carriage may be moved forward with it to the limit of its movement in reciprocation. Thus providing for other useful operative positions of the grate not illustrated. Door opening 14 is the full width of the combustion chamber and grate

26 with carriage 27 may be easily removed from its operative position in the burner through the front door.

Front grate 31 is preferably mounted for oscillation in the horizontal on ears on the front wall by hinge pin *a31* and retainable in operative position by a latch thereon engaged in catch *b31* on said wall. In operation grate 31 preferably is disposed across the bottom part of door opening 14 with the lower end of its fingers above and proximate to the front end of grate 26 when the latter is in its position at 26". It is also useful when carriage 27 and grate 26 are removed from the burner while wood is used for fuel as will be noted later. But when operating the burner with the grate in an elevated position, as shown in full lines, front grate 31 is not needed and, if so desired, it may be removed by withdrawing hinge pin *a31*.

Combined fuel-chute valve and air nozzle 32 is transversely disposed within the burner at the upper part thereof and is nearly the width of the combustion chamber. Its hollow hub has hollow shafts 35 and 36 fastened in the ends thereof by bolts *a35* and *a36* therethrough and said shafts are extended through bearings in the side walls of the burner to mount the valve in the combustion chamber for oscillation. The valve hub has parallel arms 33, 33, 33 radiating therefrom and each arm terminates in a T lug inclined at *a33*, *a33* toward the hub on both sides of the arm. The hub wall is inclined on both sides of said arms at *b32*, *b32* toward said lugs and with them provides slideways on each side of the arms to retain beveled valve-wall bricks 34. Slots *a32*, *a32* through the hub wall between said arms join with spaces 37 between said bricks to provide a draught air conduit from the hollow hub into the combustion chamber. Dotted arc *c32*—*c32* indicates the path of the lower end of the air nozzle in oscillation.

Over the outer ends of hollow shafts 35 and 36 are mounted draught caps 37, 37 which have triangular slots *a37* through their walls. The caps are retained in operative position on the shaft ends by stop screws *b35* extended through said slots and engaged in the shafts. When said caps are in their closed position, shown in full lines in Figs. 2 and 4, no draft air may pass through said shafts but when they are extended, as shown in dotted lines at 37' in Fig. 2, top draught air may enter said shafts and pass into the air nozzle and thence from the end thereof into the combustion chamber.

Draught caps 37 are fully open when in the position indicated at 37' and the effective draught openings through them gradually diminish as they are returned to their fully closed position. These caps control the quantity of draught air which may be discharged from the inner edge of the fuel-chute valve

into the combustion chamber. Handle 39 has yoke *a39* at the end of its shank which embraces shaft 35 and is pivotally fastened thereto by bolt 40 through said shaft and yoke. Said handle is provided with blade *b39* which is engageable in any one of the notches in segmental rack *a40* disposed on the side wall of the burner for this object concentric with the axis of shaft 35. Preferably the position of bolt 40 is closer to the burner wall than the center of gravity of the handle may approach, thus causing the blade to remain in engagement till purposely removed. The handle may be swung outward on bolt 40 to pass the teeth of rack *a40* when desiring a new engagement. The position of the handle in oscillation on the axis of the valve hub 32 determines the position of said valve.

Fuel-chute baffle 41 is engaged between arms *a38*, *a38* and *b38* on hub 38 and bolted to said middle arm *b38* by bolt 42 extended through registering holes in said plate and middle arm. Hub 38 is fastened to shafts 45 and 46 which are extended in the ends thereof and fastened thereto by bolts *a45* and *a46* extended through registering holes in said hub and shafts. Said shafts are mounted in bearings in the side walls of the burner to dispose said hub within the same close to the front wall and the top thereof. On the lower end of baffle 41 at the edges thereof are slideways *a41*, *a41* in which is engaged for reciprocation baffle grate 43 having fingers *a43* and a lug on its upper end on one corner at *b43* to bear against the upper end of one of slideways *a41* and prevent the dismounting of said grate from the baffle plate. Said baffle grate may be extended to dotted arc *e43*, to its full-line position or fully withdrawn to its dotted-line position at 43', with notch *d43* in lug *c43* on the upper edge of the grate engaged by eye hook 44 which is engaged on the extended end of bolt 42. Dotted arc *b41* indicates the path of the lower end of baffle 41 in oscillation.

Handle 47 has yoke *a47* on the end of its shank to embrace the outer end of shaft 45 to which it is pivoted by bolt 48 extended through registering holes in said shaft and yoke. Handle 47 has blade *b47* to engage any one of the notches in arcuate rack 49 which is disposed on one of the side walls of the burner for that purpose concentric with the axis of shaft 45. Preferably bolt 48 is closer to the burner wall than is the center of gravity of the handle and said blade will remain in engagement in the rack till purposely removed therefrom. Handle 47 may be swung on bolt 48 to disengage it from the rack for reengagement at another notch. The position in oscillation of handle 47 on shaft 45 determines the position in oscillation of baffle plate 41 and baffle grate 43 on the axis of hub 38.

Baffle plate 50 is fastened on the rear of

fuel opening 15 spaced apart from the lower part of the casing of said opening at 51 to protect fuel passing through said opening from the high temperature to which the

5 lower part of said casing may attain.

In operation: It is assumed that hopper 18 contains sawdust, or more coarsely comminuted fuel, which occupies the space within the combustion chamber between air nozzle 32 and baffle and grate 41, 43 and on top of grate 26 with its top surface inclined downward from the edge of the valve to grate bridge *d*26. It is preferred that the slope from the air nozzle to the bridge be maintained nearly to the top of the bridge and adjustments in grate, baffle and nozzle are made with this in view. Combustion is started in the fuel and continues on the surface of said slope fed by bottom air through grates 26 and 43 and top air through nozzle 32. The volume of bottom air is controlled by draft door 22, slide 23 thereon and slide 24 above. The volume of top air entering through the nozzle is controlled by draught caps 37. These controls are adjusted to promote or diminish the combustion as desired. It is desirable to maintain the rear end of the grate near bridge *d*26 covered with fuel and the rate of fuel flow into the burner is controlled with this in view. All of the fuel now passes between the nozzle and the baffle and these are adjusted by moving handles 39 and 47 to provide the required space between these controls bearing in mind that the rate of inflow of draught air also must be controlled in conjunction with the control of the flow of the fuel to secure the desired amount of heat and maintain grate 26, to the rear of grate 43, covered with fuel. Combustion due to the passage of bottom air through the fuel may be much augmented by the flow of top air from the lower edge of the valve, and the distribution of this top air fully across the fire box promotes evenly distributed burning. The area of conflagration is beneath semivault 20 and proximate to the axis thereof and the heat from the burning is caught up by the vault and reflected back to the burning area to increase the intensity of the burning till the reverberatory effect products temperatures sufficient to burn the primary gases of combustion thus attaining complete combustion of the fuel. Thus, more than sufficient draught air for the primary combustion is required in the combustion chamber and this had better be delivered directly from the exterior into the combustion chamber proper, that is, that part of the firepot between the burning area and the vault. I supply as much air as is needed for primary combustion, in addition to that which passes through the fuel, through nozzle conduits 37 and also through these conduits is supplied top air for the secondary combustion occurring in

the combustion chamber proper. An uncovered area of grate 26 would permit bottom draught air free access into the combustion chamber proper and carry with it carbonized particles of fuel into the flue thus making complete combustion of the fuel impossible to that extent. 70

During operation ashes may be shaken from grate 26 by inserting a poker in hole *b*26 and reciprocating lower grate *a*26. The poker may be extended between fingers *a*43 of baffle grate 43 and the top of the grate raked therewith. Also, valve 32, *a*33 may be retained in its position at *a*33" and baffle 41 retained in its position at 41', thus closing the fuel chute outlet, when grates 26, *a*26 may be lowered for more complete cleaning; or, if desired, be removed from the firebox through door opening 14. Ashes may be removed from ashpit 9 with a shovel inserted between the elevated end of grate 26, *a*26 and the front end of the ashpit, when door 16 and front grate 31 stand open. 75 80 85

For operating by hand stoking grate 26, *a*26 is lowered to its horizontal position and baffle 41 is placed in its position at 41" with grate 43 fully withdrawn and engaged by hook 44. Hopper 18 is removed and door 17 placed in its position at 17' thus closing fuel opening 15. The fuel may be passed in by using a shovel through opening 15 in which case baffle 41 may be used under control of handle 47 to aid in placing the fuel evenly on the rear end of the grate. When stoking by hand through open door 16 baffle 41 had again better be used under handle control to prevent smoke from the firebox passing out through the upper part of door opening 14. 90 95 100

When using a slow-burning fuel on the horizontal grate it had better be placed in its position at 26' which allows draught air to enter the ashpit through the opening between the front end of the grate and the front end of the ashpit. Combustion then may proceed aided by air passing upward through the grate and also over the top of the fuel which is admitted through draught openings in door 16, and also by air through air nozzle 32, *a*33 admitted through slots *a*37 in caps 37. 105 110 115

When using a free-burning fuel grates 26, *a*26 had better be at 26", closing the ashpit to draught air, and promoting combustion by bottom air passing over the top of the fuel from the front of the firebox aided by top air from air nozzle 32, *a*33. In practice it has been found that, when hand stoking is used, the position of the air nozzle at 32, *a*33' is very useful for the top air is introduced directly into the hottest part of the combustion chamber and also the valve serves the further purpose of a baffle to reflect heat down on the burning fuel. In practice, with 120 125 129

the grates at 26" very fine coal dust has been completely consumed with efficiency.

This burner is well adapted for burning wood with the grates at 26". But it is even better suited for wood burning with grates 26, a26 removed from the firebox and the pit filled with ashes to the level of the ash-pit wall.

Having thus disclosed my invention, what I claim as new therein and desire to secure by Letters Patent is,—

1. In a fuel burner in combination, a firebox having a fuel-chute opening therein, a baffle plate mounted for oscillation on one side of said fuel opening in said firebox, means external to said firebox connected with said baffle plate to control the movements thereof, a fuel-chute valve mounted within said firebox for oscillation on the other side of said fuel opening, and means external to said firebox connected with said valve to control the movements thereof.

2. In a fuel burner in combination, a firebox having a fuel opening therein, a baffle plate mounted for oscillation in said firebox on one side of said fuel opening, a baffle grate mounted on said baffle plate for longitudinal reciprocation as an extension thereof, means external to said firebox connected with said baffle plate to control the movements thereof, a fuel-chute valve mounted within said firebox for oscillation on the other side of said fuel opening, and means external to said firebox connected with said valve to control the movements thereof.

3. In a fuel burner in combination, a firebox having a fuel opening therein, a hollow fuel valve mounted for oscillation within said firebox on one side of said fuel opening, controllable draught-air conduits external to said firebox connected to said hollow valve to supply draught air therethrough into said firebox, and means external to said firebox connected with said valve to control the movements thereof.

4. In a fuel burner in combination, a firebox having a fuel opening therein, a vaulted ceiling in said firebox, a hollow gate valve mounted for oscillation in said firebox between said fuel opening and said vault, draught-air conduits external to said firebox connected with said hollow valve to conduct draught air into said firebox and deliver the same beneath said vault, and means external to said firebox connected with said valve to control the movements thereof.

5. In a fuel burner in combination, a firebox having a fuel opening and also having an outlet flue opening through the walls thereof, a grate mounted for reciprocation and oscillation in said firebox, a baffle plate mounted for oscillation in said firebox on one side of said fuel opening, and a baffle grate mounted for reciprocation on said baf-

fle plate as an extension thereof to contact with said grate when extended.

6. In a fuel burner in combination, a firebox having a fuel opening also having an outlet flue opening through the walls thereof, a grate mounted for reciprocation and oscillation in said firebox beneath said fuel opening and proximate to said outlet flue opening, a baffle plate mounted for oscillation in said firebox on one side of said fuel opening, a baffle grate mounted for reciprocation on said baffle plate to contact with said grate when extended, and a fuel-chute valve mounted for oscillation on the other side of said fuel opening adapted to contact with said baffle plate in oscillation.

7. In a fuel burner in combination, a firebox having a top fuel opening at the front thereof and a gas flue opening at the rear thereof, a grate in the firebox, means to mount the grate on a rear horizontal transverse axis for oscillation and for longitudinal reciprocation between said openings, a fuel baffle mounted for oscillation on a transverse axis in front of the fuel opening to contact with the front end of the grate, a combined draught-air nozzle and fuel valve mounted for oscillation on a transverse axis adjacent and at the rear of the fuel opening to cooperate with the fuel baffle in fuel-feed control and conduct draught air into the firebox, conduit means to connect the nozzle with the external air, externally controllable means to oscillate the combined draught-air nozzle and fuel valve, and externally controllable means to oscillate the fuel baffle.

DAVID E. LAIN.

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