

H. C. ALFORD.

SMOKE CONSUMING FURNACE.

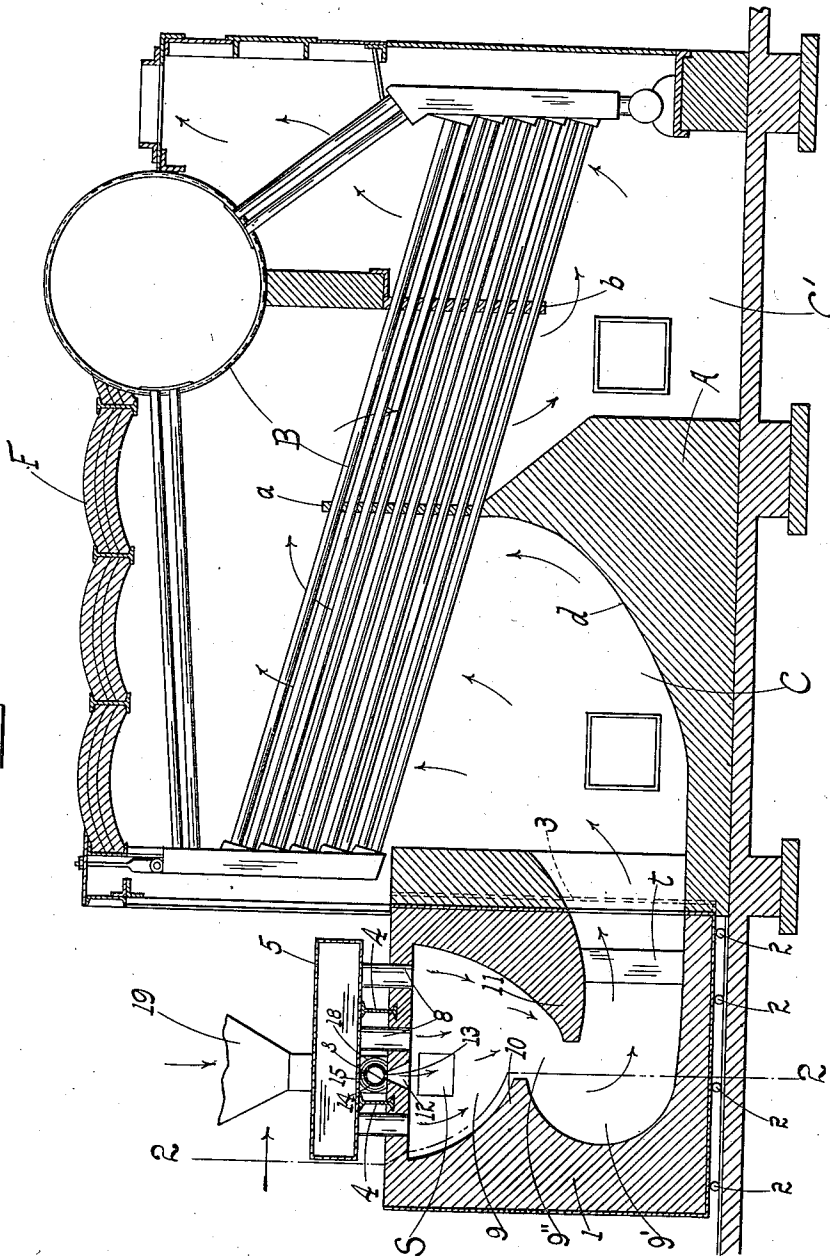
APPLICATION FILED APR. 5, 1911. RENEWED OCT. 6, 1913.

1,095,489.

Patented May 5, 1914.

3 SHEETS—SHEET 1.

FIG. 1 -



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3 SHEETS-SHEET 2.

FIG. 3.

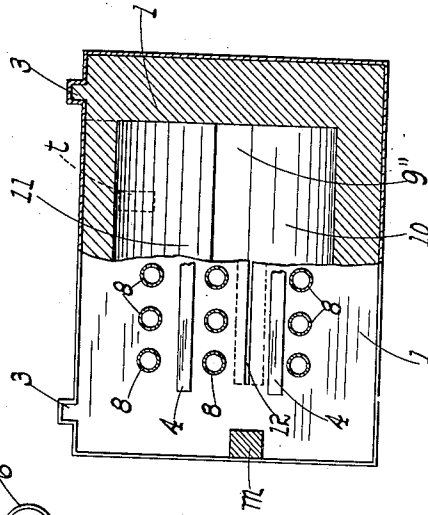
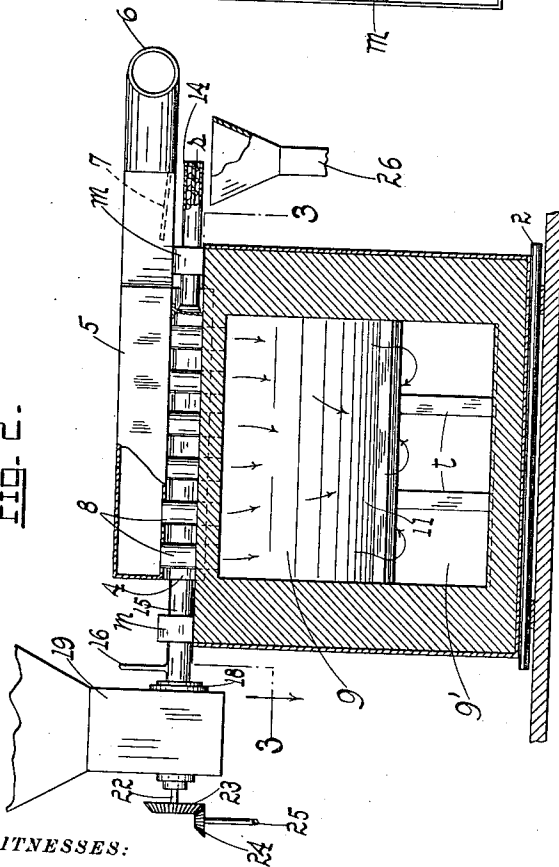


FIG. 2.



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FIG. 5.

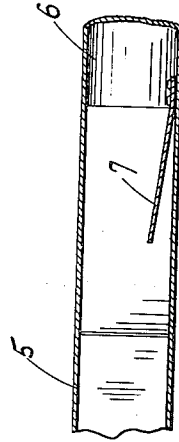
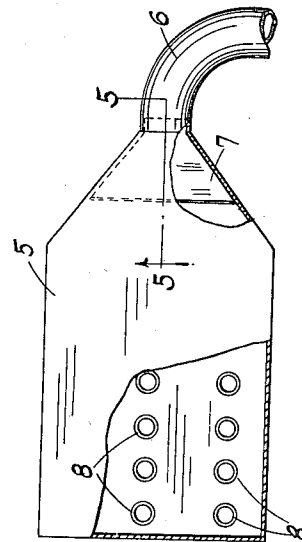


FIG. 4.



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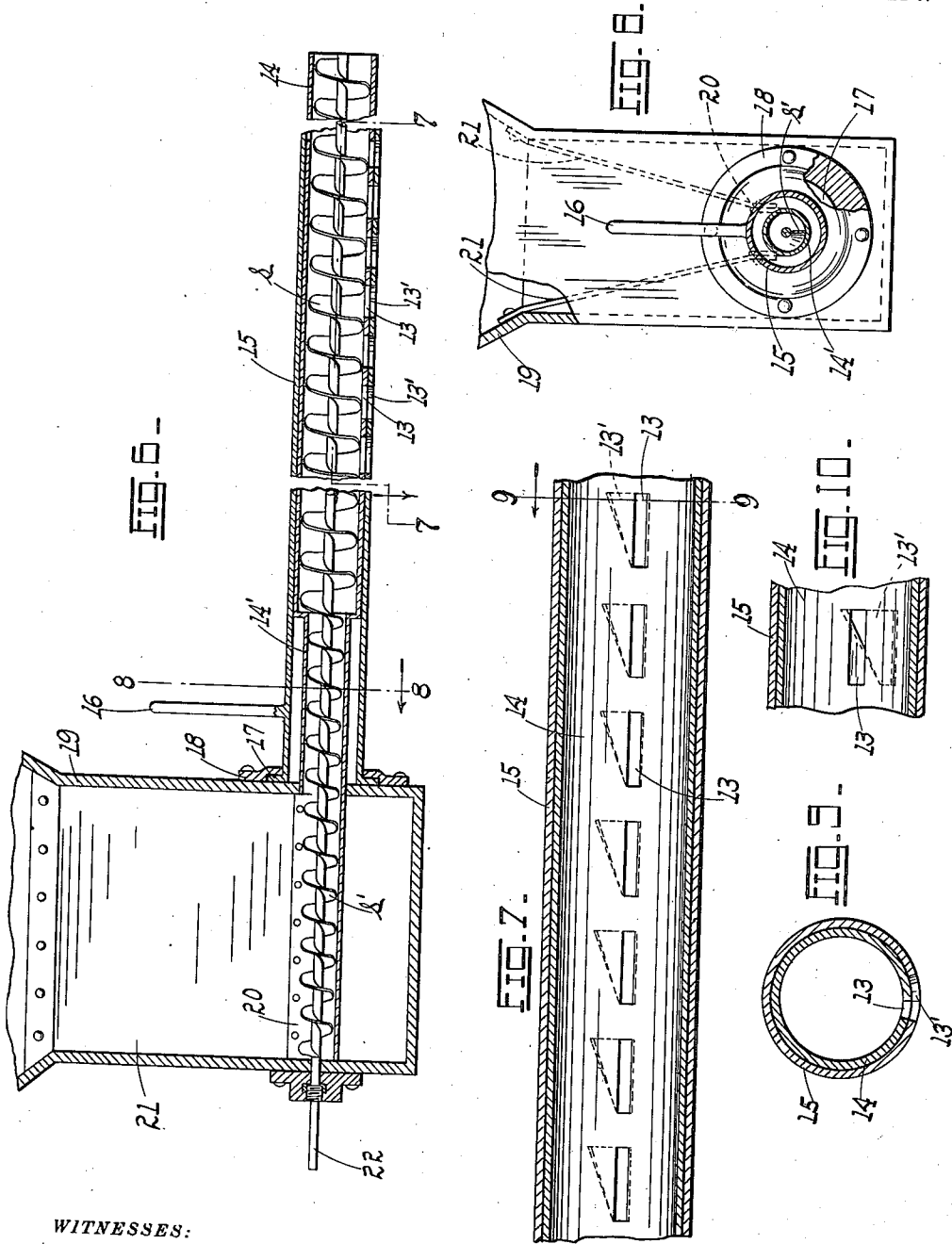
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3 SHEETS-SHEET 3.



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UNITED STATES PATENT OFFICE.

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SMOKE-CONSUMING FURNACE.

1,095,489.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HARVEY CARROLL ALFORD, citizen of the United States, residing at St. Louis, State of Missouri, have invented certain new and useful Improvements in Smoke-Consuming Furnaces, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming a part hereof.

My invention has relation to improvements in smoke-consuming furnaces; and it consists in the novel details of construction more fully set forth in the specification and pointed out in the claims.

In the drawings, Figure 1 is a middle vertical longitudinal section taken through a water-tube boiler furnace showing my invention applied thereto; Fig. 2 is a vertical cross-section on the broken line 2—2 of Fig. 1; Fig. 3 is a horizontal section on the line 3—3 of Fig. 2; Fig. 4 is a top plan of the wind-box, parts being broken away; Fig. 5 is an enlarged vertical sectional detail on the line 5—5 of Fig. 4; Fig. 6 is an enlarged vertical longitudinal section taken through the fuel-feed-hopper and tube; Fig. 7 is an enlarged horizontal sectional detail on the line 7—7 of Fig. 6; Fig. 8 is a vertical cross-section on the line 8—8 of Fig. 6; Fig. 9 is a cross-section on the line 9—9 of Fig. 7; and Fig. 10 is a sectional detail of the feed-tube showing the rotatable outer cut-off valve-cylinder partly turned.

The present improvement though specifically illustrated in connection with a water-tube boiler, contemplates a smoke consuming furnace capable of general application in the arts, particularly that portion identified with the removable fire-box section.

It has for its object to provide a furnace capable of burning liquid, gaseous, or solid fuel, the method of combustion thereof being such as to insure complete consumption of the smoke and gases not usually wholly oxidized; one in which the supply of air may be accurately proportioned to the quantity of fuel to be consumed; one by which the fuel supply can be accurately regulated in the matter of feed; one in which the maximum number of heat units from the fuel is rendered available; one which dispenses with the prevailing grate to support the fuel; one in which the fuel feed is automatic; and one possessing further and other structural fea-

tures the advantages of which will be fully apparent from a detailed description of the invention which is as follows:

Referring to the drawings, B represents a well-known type of water-tube boiler, F the furnaces as a whole, A the bridge-wall, a the deflector wall or extension thereof, b a second deflector, C the forward compartment of the combustion chamber, and C' the rear compartment thereof. These features are well understood in the art, and no claim is made therefor.

In the present embodiment of my invention, I provide a fire-brick extension 1 mounted on rollers 2 by which it may be wheeled up to the furnace F, suitable ribs or keys 3 being formed on the extension whereby it may be locked or keyed in position to the furnace wall, although any other suitable mechanical manner will answer such purpose. Mounted on I-beams 4 or equivalent structural members disposed in front of the furnace on top of the extension 1, is a wind-box 5 having a tapering intake end to which is coupled an air-feed or supply pipe 6 leading from any suitable blower or equivalent source of compressed air supply (not shown), an upwardly tending wall or deflector 7 flaring inwardly to conform to the side tapering walls of the wind-box at the intake (the deflector being thus triangular in shape), the purpose of said wall 7 being to direct the inflowing air well against the roof of the box and at an angle to such roof, this action tending to effect an even distribution of the air within the box, and thus an even pressure against the walls of the same. This even pressure of the air within the box tends to an equal and even escape thereof through the nozzles 8 leading from the bottom of the box, and discharging through the roof of the extension 1 into what may be termed the upper compartment, chamber, or section 9 of the fire-box. the lower section 9' being separated from the upper by a connecting comparatively constricted passage or neck 9". The constriction 9" results from the opposing deflector walls 10, 11, respectively, the lower edges of the deflecting faces of which terminate in superposed planes, the bottom of the deflecting face of the outer wall 10 being higher than the lower edge of the face of the wall 11. These faces slope and curve gently downward, the extension or prolongation of

the face of the wall 10 intersecting the face of the wall 11 at a point above the lower edge of the face of the latter wall (Fig. 1). These faces (and the walls) are kept comparatively cool by the impinging air escaping from the adjacent superposed nozzles 8, though the cooling may be further extended by water-cooling pipes penetrating the walls, these pipes not being shown, as that is a common expedient well understood in the art. The lower fire-box compartment or section 9' leads to the front compartment or section C of the combustion chamber, the front concave face d of the bridge-wall A curving rearwardly and gently upwardly so as to deflect the cinders and ashes (when solid fuel is used) upwardly and rearwardly over the wall or plate a , whence they will drop into the compartment C', by which time they will have cooled off to a point below the temperature of possible fusion, a temperature at which were they to lodge on the front face of the bridge wall, would cause them to cake and adhere to said face.

Formed in the roof of the compartment 9 of the fire-box (or roof of the extension 1) is a downwardly flaring fuel-feed mouth 12 (not necessarily continuous however, as shown) disposed longitudinally of the compartment 9 but transversely to the furnace F, the upper portion of said mouth or opening being substantially a slit or being comparatively constricted (Figs. 1, 3). This slit receives the powdered fuel (or liquid fuel) discharged thereinto from a series of oblong openings 13 disposed in line along the bottom of a feed-tube 14 mounted over the opening 12 between the wind-box 5 and roof of the extension 1, the available area of any opening 13 being regulated by the registering openings 13' of an outer rotatable sleeve 15 loosely embracing the tube 14, the openings 13' being in the shape of truncated triangles whose opposite ends ride over the corresponding ends of the openings 13, the triangular portion of such opening 13' gradually cutting down or shearing the area of the opening 13 as the sleeve is turned about the axis of the tube 14. The sleeve 15 thus acts as a valve-cylinder or cut-off, being manipulated by a lever arm 16 positioned along the same at any convenient point, one end of the sleeve terminating in a flange 17 operating in a bearing plate or disk 18 secured to the vertical wall of the base of the fuel-hopper 19 in which the fuel is stored and from which it is delivered. The end of the feed-tube 14 nearest the hopper 19 terminates in a cylindrical reduced portion 14' which in turn connects with the trough 20 (substantially U-shaped in cross-section, Fig. 8) at the bottom of the base of the hopper 19, the sides of the trough having secured thereto the bottoms of the converging plates 21 forming the throat or dis-

charge chute of the hopper, the upper ends of the plates being secured to the upper portions of the bottom walls of said hopper 19. Through the common center of the trough 20, neck or reduced portion 14' and tube 14 passes the shaft 22 of a screw-feed, the larger screw-section s thereof operating in the tube 14 proper, and the reduced section s' of said screw operating in the parts 20, 14' (Fig. 6), the shaft 22 passing through the wall of the hopper 19 and terminating adjacent thereto in a bevel gear-wheel 23 which meshes with a pinion 24 on a drive-shaft 25 leading from any source of power (not shown). The sleeve or cylinder-valve 15 is preferably supported in bearings m, m , on top of the fire-box extension 1 (Fig. 2). The purpose of the offset between the tube 14 proper and the reduced portion 14', whereby there is called into requisition a screw-feed having a large and small section (s, s') is for the purpose of permitting the neck 14' to remain comparatively full of fuel as against its loosely distributed state in the larger tube 14, to prevent any gases from the fire-box from backing up through the discharge ports 13 and through the tube 14 into the hopper 19, the comparatively compact and full condition of the neck 14' preventing the escape of the gases therethrough, the fuel acting as a seal against such back pressure. The "overflow" or excess of fuel, or that not dropped by the feed into the fire-box through the ports 13, 13', and opening 12, is discharged through the free end of the tube 14 into a receptacle or hopper 26 (Fig. 2) whence it is conducted or carried back to the feed-hopper 19. The baffle or deflecting wall 11 is preferably propped up by posts t, t , of fire-brick or the like, as shown, other features illustrated but not here referred to being well understood in the art and requiring no detailed description in the present description.

The operation of the furnace is substantially as follows:—Fire is started by depositing sticks of wood (through a hand-hole S, Fig. 1) across the baffle walls 10, 11, the wood being preferably moistened with kerosene or other hydrocarbon and ignited. Some coal may be deposited on the wood, and the blast started through the wind-box 5. The air currents or jets delivered through the nozzles 8 will cause rapid combustion of the material, and in a short time heat the walls of the fire-box. Thereupon the screw-feed shaft 22 is started, the hopper 19 being filled with powdered coal (or equivalent fuel), the contents of the hopper gravitating down the plates 21, 21, into the trough 20, whence the fuel is fed forward or advanced by the screw s', s , and as it advances it drops through the registering openings 13, 13' (the size of available opening being regulated by a rotation of the cyl-

inder valve 15 about the tube 14 as described) into the feed passage 12, the downwardly flaring sides of which allow the powdered fuel to spread and well fill the upper compartment 9 of the fire-box. In thus falling through the fire-box, the fuel encounters the air-jets from the nozzles 8, an intimate mixture between the fuel and air being insured by the rebound or reflection of these elements against the faces of the baffle or deflector walls 10, 11. Of course, the air flowing through the nozzles 8 at any velocity naturally expands the moment it enters the chamber 9, such expansion filling the entire chamber with air and contacting with the falling fuel, the latter burning while suspended in mid-air. The burning fuel is then constrained to pass through the comparatively narrow or constricted neck or passage 9', the velocity of the products obviously increasing by reason of the constriction, said increased velocity driving them on into the bottom chamber 9' whence at a somewhat lower velocity they follow the gentle upward curve of the front face *d* of the bridge-wall A, the curvature of the face *d* being such as to carry the products readily over the plate *a* when they descend into the compartment C' of the combustion chamber. In this way, any and all ashes and cinders are precipitated in the rear chamber C', by which time their temperature has dropped below the point of fusion. Were the cinders allowed to lodge in the compartment C against the bridge-wall, the danger of said cinders adhering to the wall as a result of fusion would be imminent, as the said cinders are highly heated, the temperature being sufficient to fuse the mass against the wall A. The hot cinders and ashes in the compartment C' by radiating heat assist in the heating of the boiler. By positioning the lower end of the deflecting face of the wall 11 below that of the wall 10, any choking of the neck 9' with fuel is avoided as quite obvious from the drawing; at the same time the rebound or reflection of the gases being in different directions, a more intimate contact between the gases, air, and fuel is obtained.

The air forced into the wind-box 5, in passing over the inclined wall or deflector 7, has an upward trend, or toward the roof of the box, and when it once fills the box, the pressure thereof is substantially uniform against the entire bottom wall of the box, so that each nozzle 8 receives the same or equal quantity of air, this resulting in an even distribution of air pressure jets over the top of the fire-box. The deflector 7 thus acts as an equalizer, since by its use the pressures over the several nozzles 8 are equal. Any gas which may tend to escape from the fire-box upwardly through the passage 12 into the flue 14, will be effectively

choked off by the fuel in the reduced neck 14' inclosing the screw-feed or conveyer *s*'. The downward flare of the passage 12 is important not only for the reason already given (that of allowing the fuel to spread) but the heat of the air and gases reflected from the faces of the walls 10, 11, are projected to the very mouth or intake slit of said passage, so that combustion of the fuel begins the moment it leaves the openings 13, 13', of the feed.

It will be observed that the inclination of the walls 10, 11 is such as to shed the fuel, so that practically no fuel can remain lodged thereon, and what may tend to adhere is swept off by the impinging air currents, the latter being reflected against the precipitating fuel and in a general direction toward the passage 12. It is intended of course that the consumption of the fuel shall take place in the main in the upper chamber of the fire-box, the constriction 9', (where solid fuel is used) allowing free precipitation of the cinders, ashes and partially consumed products into the bottom chamber. The zone of combustion may be said to extend from the lower edge of the deeper wall 11 to the roof of the upper fire-box compartment or chamber, the cinders and ashes being dropped along the axis of this zone, which axis passes substantially through the center of the constriction 9'. It will thus be seen that by reason of the precipitation of undesirable products from the upper chamber the rebounding air currents are left free to combine with the falling and spreading spray of fuel.

Having described my invention, what I claim is:—

1. In a furnace, a fire box provided with a compartment bounded on two sides by opposing walls inclined to shed solid fuel introduced into the compartment, means for feeding fuel into said compartment at points above said inclined walls, and means for projecting currents of air against the inclined walls and causing a rebound thereof, to intimately mix with the fuel.

2. In a furnace, a fire-box provided with an upper compartment bounded on two sides by inclined opposing deflecting walls, means for feeding fuel into said compartment, means for injecting air into said compartment against the faces of said walls and causing a rebound thereof toward the point of discharge of the fuel into said compartment the air so deflected commingling with the fuel, the bottoms of the deflecting walls being separated by a constricted passage allowing free precipitation therethrough of the spent or consumed products, and a bottom compartment for receiving said spent products.

3. In a furnace, a fire-box provided with an upper compartment bounded on two sides

by inclined opposing deflecting walls converging downwardly and spaced apart at their lower edges by a constricted passage, said edges being disposed in superposed planes, means for feeding fuel into the compartment through the roof thereof, means for projecting currents of air against the faces of the inclined walls and effecting a rebound of the air toward the point of discharge of the fuel into the compartment the air so deflected commingling with the fuel, and a bottom compartment communicating with the top compartment through said constricted passage.

4. In a furnace, a fire-box provided with a top and bottom compartment, an intermediate neck connecting the same and forming a constricted vertical passage for the free precipitation of the consumed products from the top to the bottom compartment, the upper compartment being bounded on two sides by opposing walls inclined to shed solid fuel introduced into the compartment, means for feeding fuel into the upper compartment at points above the inclined walls, and means for projecting currents of air against the inclined walls and causing a rebound thereof to intimately mix with the fuel.

5. In a furnace, a fire-box provided with a compartment bounded on two sides by opposing walls inclined to shed solid fuel introduced into the compartment, means for feeding fuel into said compartment at points above said inclined walls, means for projecting currents of air against the inclined walls and causing a rebound thereof, to intimately mix with the fuel, and means allowing for free precipitation of the combustion products out of said compartment.

6. In a furnace, a fire-box provided with a compartment bounded on two sides by inclined opposing deflecting walls, means for feeding fuel into said compartment, means for projecting air currents into said compartment against the faces of said deflecting walls and causing a rebound thereof against the fuel discharged into the compartment the air so deflected commingling with the fuel, and means for allowing for the escape of the products of combustion.

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

HARVEY CARROLL ALFORD.

Witnesses:

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JOS. A. MICHEL.