

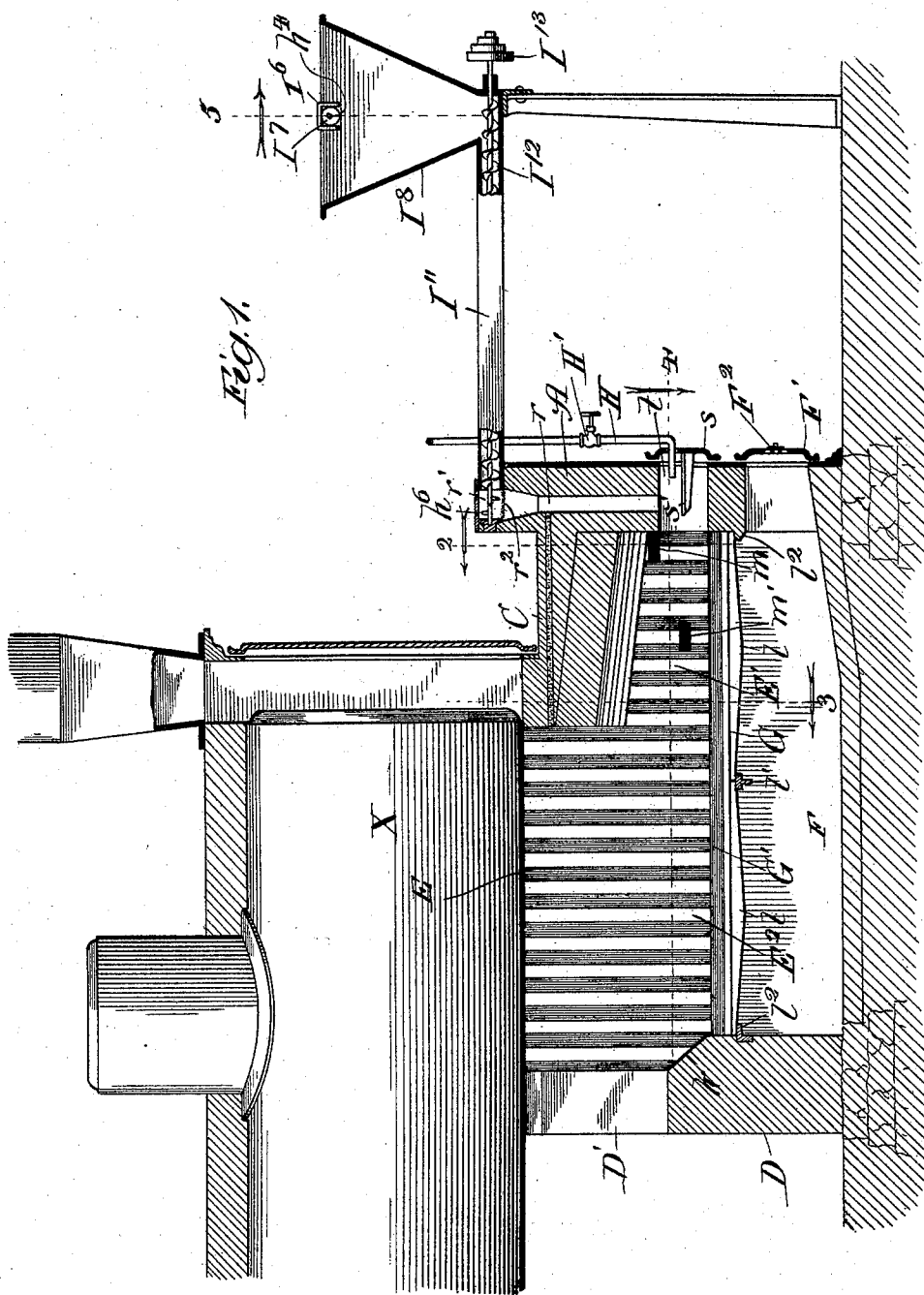
(No Model.)

3 Sheets—Sheet 1.

B. C. HEAVEY.
FURNACE.

No. 585,572.

Patented June 29, 1897.



Witnesses:
Edw. Chayford
Lito S. S. S.

Inventor:
Bernard C. Heavey.
By *Dyrenforth & Dyrenforth,*
Attys

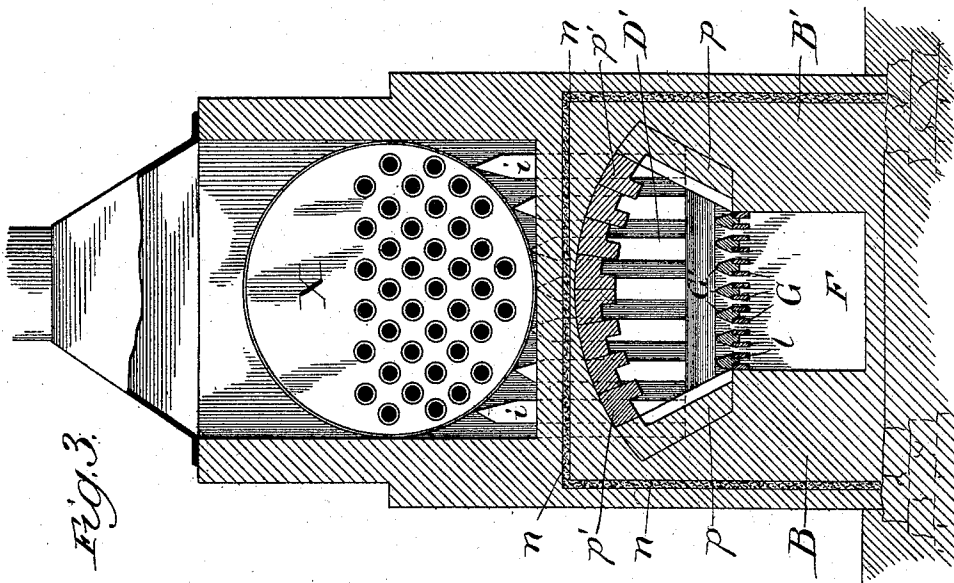
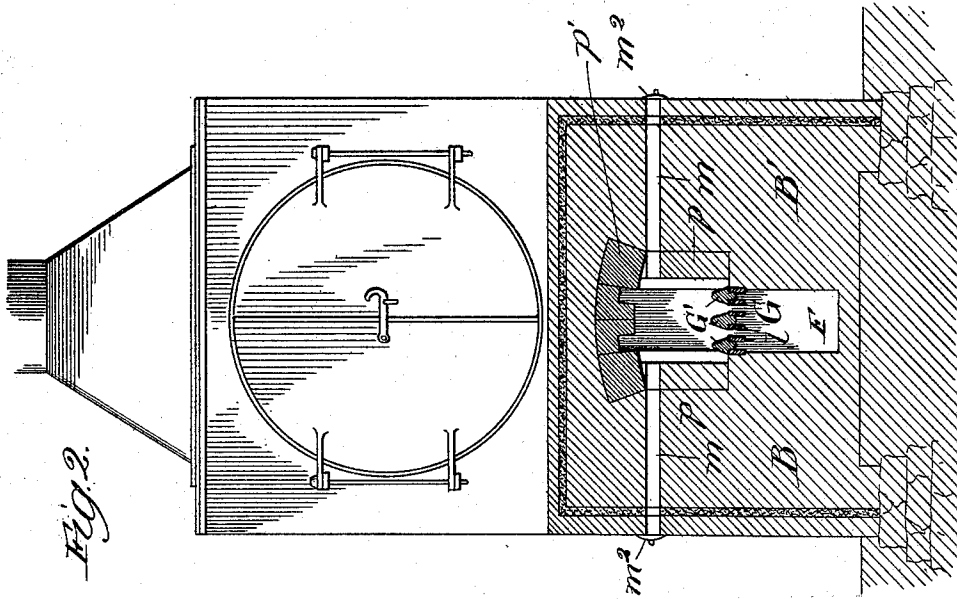
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3 Sheets—Sheet 2.

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Patented June 29, 1897.



Witnesses:
E. C. Gaylord,
L. J. Miller.

Inventor:
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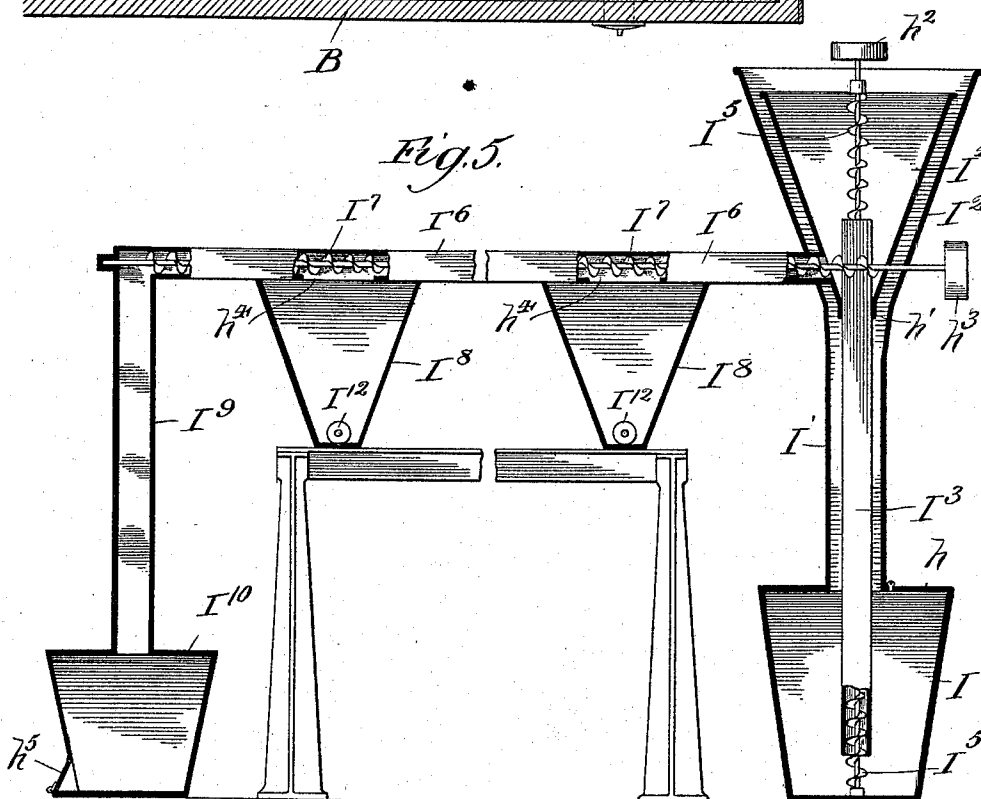
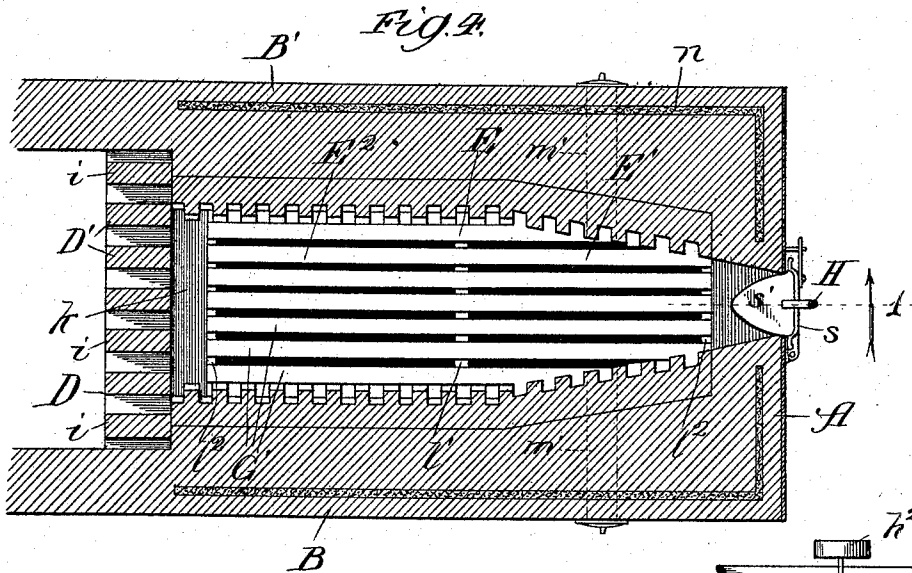
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UNITED STATES PATENT OFFICE.

BERNARD C. HEAVEY, OF CHICAGO, ILLINOIS, ASSIGNOR OF FORTY-NINE ONE-HUNDREDTHS TO SAMUEL T. WHITE AND JOHN FLAHERTY, OF SAME PLACE.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 585,572, dated June 29, 1897.

Application filed October 5, 1896. Serial No. 607,916. (No model.)

To all whom it may concern:

Be it known that I, BERNARD C. HEAVEY, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Furnaces, of which the following is a specification.

My invention relates to improvements in furnaces for use more especially in burning fuel-dust.

My objects are to provide certain improvements in the construction of the interior or fire-chamber portion of the furnace, and also improved means for automatically feeding the dust to the furnace, all to the end of economizing in the use of the fuel-dust and of producing approximately perfect combustion of the inflammable portions thereof.

In the drawings, Figure 1 is a broken vertical longitudinal section taken on line 1 of Fig. 4 and showing my improvements applied to a boiler-furnace; Figs. 2 and 3, sections taken on lines 2 and 3, respectively, of Fig. 1; Fig. 4, a broken plan section taken on line 4 of Fig. 1, and Fig. 5 a broken and sectional elevation of automatic feeding means for the fuel-dust.

A is the front wall of the furnace; B and B', the side walls; C, a forward top wall; D, the bridge-wall; E, the combustion-chamber, and F the ash-pit. Extending through the wall A, near the base of the combustion-chamber, is an opening *t*, provided with a hinged door *s*. In the wall A and extending from the top thereof to the opening *t* is a fuel-chute *r*. The forward portion of the combustion-chamber E consists of an opening or passage E' at its front end approximately of the size of and registering with the door-opening *t* and flaring thence upward and laterally, as indicated, and an enlarged chamber portion E², having inclined sides and closed at the top by the boiler X. The sides of the passage E' and chamber E² are formed of slabs or blocks *p* of fire-clay, having their inner faces formed with upward and downward extending corrugations. The top of the flaring passage E' is arched and formed of blocks *p'* of fire-clay, presenting on their inner surfaces longitudinally-extending corru-

gations. The object of the corrugations is to present an increased radiating-surface, the construction shown affording about double the surface which would be presented were the sides and top plain instead of corrugated. Beyond the fire-clay blocks or slabs *p p'* the walls are of suitable brick having an embedded surrounding casing *n* of non-heat-conducting material—such as mineral wool, asbestos, or other suitable substance. Extending through the walls B B', in the positions indicated, for example, in Fig. 1, are air-inlet passages *m m'*, which open into the passage E' at opposite sides. The passages *m m'* may be provided at their outer ends with suitable dampers *m²* for the regulation of the volume of air passing through them.

The grate G, as I prefer to provide it, consists of the closely adjacent parallel and longitudinally-extending metal bars *l*, resting at the center upon a transverse supporting-bar *l'* and at opposite ends upon sills *l²* on the furnace-walls.

G' is a series of supplemental grate-bars formed, preferably, of fire-clay or the like refractory material, tapering along their upper sides, provided on their under sides with shoulders which rest upon adjacent bars *l*, and having downwardly-extending lugs which fit between adjacent bars *l*. The supplemental grate-bars thus close every second opening between bars *l* and shield said bars from the direct action of the flames in the combustion-chamber. The bridge-wall D is provided with an inclined face *k* at the rear end of the grate G', whereby in scraping out ashes the scraper inserted through the door-opening *t* may be drawn down the surface *k* and readily engage ashes deposited at the rear end of the grate.

Formed, preferably, integral with the door *s* is a shelf *s'*, extending from the center of the door backward to a point beyond the lower end of the chute *r*.

H is a blast-pipe extending, preferably, through an opening in the door *s* in a horizontal direction above the shelf *s'*. Interposed in the pipe H is a valve H'.

My improved furnace, constructed as described, is intended more especially for use in

burning coal-dust, and particularly the dust which accumulates at the mines and has hitherto been considered worthless for fuel.

In operation the dust is fed by gravity through the chute *r* and falls toward or upon the shelf *s'*. I prefer in practice to connect the pipe *H* with a steam-supply under a pressure which will cause the dust as it falls toward the shelf to be caught by the steam-current and sprayed backward throughout the combustion-chamber. An air-blast may be employed, if desired, but, owing to the hydrogen furnished by the steam, a very intense heat is generated. Originally a lump-coal fire may be built upon the grate and when the bed is sufficiently incandescent the coal-dust may be sprayed into the combustion-chamber, as described. Part of the air to support combustion may be caused to enter through the door *F'* of the ash-pit, which door I provide with a suitable damper *F²*. This air passes from the ash-pit upward between the grate-bars. Additional air-currents to support combustion enter through the passages *m m'* at opposite sides of the passage *E'*, and these air-currents may be controlled by means of the dampers *m²*. In practice when the fire is well started the incoming coal-dust becomes ignited in the chamber or passage *E'* and under the intense heat of the burning fuel, supplemented by the combustion of the hydrogen gas from the steam, becomes practically incandescent in the chamber *E²*. From the chamber *E²* the hot products of combustion pass backward over the bridge-walls and through the boiler-flues in the usual way.

I have found it desirable in practice to in a measure retard the passage of the products of combustion from the combustion-chamber in order to confine them in the latter for a sufficient time to produce approximately absolute combustion, and as a means for accomplishing this purpose I provide upon the bridge-wall *D* vertical fingers *i*, preferably of fire-clay and set equidistant apart to afford a vertical bridge-wall grate *D'*, as shown. The fingers *i* are preferably beveled at the top at opposite sides and extend close to or contact with the under surface of the boiler *X*. I have found in practice that my improved furnace constructed as described has a very much greater steam-producing capacity than furnaces of the same size burning the same quantity of expensive lump coal and that the furnace is practically smokeless. The large radiating-surface in the combustion-chamber, effected by the corrugations and the fact of confining the heat by means of the casing *n*, contributes largely toward the effectiveness of the furnace as a steam-producer, and I have found that even after shutting off the supply of fuel toward the end of a day's work the heat stored in the walls of the combustion-chamber will continue the production of steam in the boiler *X* for several hours. While the supplemental grate-bars *G'* are

not indispensable, they in themselves form a desirable heat-storage medium, and by protecting the metal bars *l* of the grate *G* render the latter practically indestructible.

To obtain the best work from the furnace, so that it will generate the desired amount of heat, neither more nor less, and emit no smoke, it is desirable to provide mechanical means for feeding the coal-dust automatically and continuously in proper quantities. The mechanism shown in Fig. 5 is adapted for feeding two adjacent furnaces, though it may be provided for a single furnace or extended to accommodate more than two. It consists of a bin or receptacle *I*, placed, for convenience, upon the floor at one side of the furnace and provided in its top at one side with a door *h*, through which the fuel-dust may be shoveled or otherwise fed. Extending upward from the top of the bin *I* is a pipe or chute *I'*, terminating at its upper end in a hopper-shaped compartment *I²*. Centrally within the pipe *I'* is a tube *I³*, which extends upward from near the lower end of the receptacle *I* and carries at its upper end a hopper-shaped receptacle *I⁴*. In the tube *I³* is a screw-conveyer *I⁵*, which extends from the bottom of the receptacle *I* to a point above the top of the tube *I³*. The hopper *I⁴* terminates in a plane below the top of the hopper *I²*, and the parts are so constructed that a space *h'* exists all around the hopper *I⁴* and tube *I³*. At the upper end of the screw-conveyer *I⁵* is a pulley *h²*, which may be belted to a suitable drive-pulley, whereby the screw-conveyer is rotated.

Fuel-dust deposited in the receptacle *I* will be raised by the screw-conveyer through the tube *I³* and deposited in the hopper *I⁴*. In the event that the dust is carried to the hopper *I⁴* faster than it is taken away, as herein-after described, the dust will overflow and drop through the space *h'* back to the receptacle *I*. Extending from the hopper *I⁴* horizontally across the front of the furnace or furnaces is a conveyer-tube *I⁶*, containing a conveyer-screw *I⁷*, which extends from the lower end portion of the hopper practically throughout the tube *I⁶*. The screw is provided with a pulley *h³*, which may be connected by a belt to a suitable drive-pulley to turn the screw at the desired speed. In front of each furnace is a hopper or distributing-receptacle *I⁸* below an opening *h⁴* in the conveyer-tube *I⁶*. At the end of the tube *I⁶* is a chute *I⁹*, which terminates at its lower end in a close receptacle *I¹⁰*, provided at one side near the bottom with an opening having a door *h⁵*. The screw-conveyer *I⁷* carries the dust from the hopper *I⁴* to the first hopper *I⁸*, and when the latter is filled it carries the dust to the second hopper *I⁸*, and so on. When all the hoppers *I⁸* are filled, the coal-dust conveyed by the screw *I⁷* falls through the chute *I⁹* to the overflow-receptacle *I¹⁰*, whence it may be withdrawn from time to time, as desired, and shoveled or otherwise conveyed back into the

receptacle I. Extending from the lower end of the hopper I⁸ to the feed-chute τ of the furnace is a conveyer-tube I¹¹, containing a screw conveyer I¹², provided with a pulley I¹³, which may be belted to a drive-pulley. The screw I¹² terminates at a compartment τ' at the upper end of the chute τ , and between said compartment and chute is a screen τ^2 . On the shaft of the screw I¹² in the compartment τ' are agitators which may be in the form of fingers h^6 , which in the rotation of the shaft stir up the dust and clean the screen τ^2 , so that an even flow of more or less pulverulent fuel will occur through the chute τ . The pulleys I¹³ may be step-pulleys, as shown, so that the speed of the conveyer-screws I¹² may be quickly and easily regulated to supply the desired amount of fuel-dust to the chutes τ .

All the improvements shown and described contribute to the result of effecting economy in the use of the fuel and obtaining the greatest possible steam production therefrom. By regulating the speed, particularly of the conveyer-screw I¹², just the desired amount of fuel-dust will be carried to and sprayed into the furnace and the combustion-chamber will never become clogged or overfed. By regulating the supply of air which enters through the openings m m' a sufficient amount of oxygen may be provided to support combustion without producing any material cooling effect in the combustion-chamber.

The construction of the combustion-chamber gives it great capacity for heat storage and radiation, assists greatly in raising the fuel as it is sprayed into the chamber quickly to the incandescent point, and, owing to the intensity of the heat, it prevents the formation of slag on the grate-bars when the coal-dust contains impurities. The corrugated sides of the chamber aid materially in deflecting the currents which strike them, and by the stirring up of the products of combustion thus effected more perfect combustion is produced. The beveled tops of the fingers which form the grate-section D' enlarge the outlet at the top and therefore close to the surface of the boiler, besides preventing the accumulation of ashes at the tops.

In practice a much smaller combustion-chamber in comparison to the size of the boiler may be employed than is necessary where lump coal is used as the fuel, owing to the fact that the construction tends to confine and intensify the heat. In the use of coal-dust of average purity comparatively little of the solid products of combustion pass beyond the bridge-wall, so that the boiler-flues need be cleaned much less frequently than is ordinarily required and no appreciable smoke issues from the chimney. Owing to the fact that approximately all of the inflammable portion of the fuel is consumed in the combustion-chamber only a dry pulverulent ash is deposited upon the grate. This ash falls readily between the grate-bars, and as a consequence comparatively little stoking or

scrapping is required. When the fuel employed is comparatively free from refractory impurities, stoking and scrapping of the grate-bars is necessary only at long intervals, if at all. When it is desired to stoke the fuel or scrape the grate-bars, the door s , carrying the steam-pipe H, may be readily opened and the work quickly performed. It is desirable to provide belt-shipping mechanism to stop the action of the screw conveyers whenever the door s is opened. By tightly closing all doors and the dampers m^2 the stored heat may be employed for steam production after stopping the feeding of the fuel-dust and steam, and the attendant may in practice close down the furnace some time before the end of the day's work and still have an ample supply of steam to the end of the time required.

While I prefer to construct my improvements throughout as shown and described, they may be modified in the matter of details of construction without departing from the spirit of my invention as defined by the claims.

What I claim as new, and desire to secure by Letters Patent, is—

1. In a fuel-dust furnace, the combination with the combustion-chamber, and means at one side thereof for spraying the fuel-dust into the chamber comprising a fluid blast-pipe and fuel feed-chute just in advance of said pipe, of automatic supplying means for the chute comprising a storage-receptacle, a compartment at the upper end of the chute, a screen between the compartment and chute, a fuel-advancing conveyer extending from said receptacle to the compartment, and agitator mechanism in the compartment, substantially as and for the purpose set forth.

2. In a fuel-dust furnace, the combination of a combustion-chamber comprising a gradually-enlarging passage E' and enlarged chamber portion E² having corrugated side walls of fire-clay and an outlet, a grate below the chamber, an air-inlet at the said passage, additional air-inlets at opposite sides of the chamber, a fuel feed-chute toward the outer end of the passage, and a fluid blast-pipe opening into the outer end of the passage just beyond the feed-chute, all constructed and arranged to operate substantially as and for the purpose set forth.

3. In a fuel-dust furnace, a combustion-chamber comprising a passage E' having side walls provided with up-and-down corrugations, and an arched top provided with longitudinal corrugations, and an enlarged chamber portion E² having vertically-corrugated side walls, in combination with a fuel feed-chute toward the outer end of said passage and a fluid blast-pipe opening into the outer end of said passage just beyond the feed-chute, substantially as and for the purpose set forth.

4. In a fuel-dust boiler-furnace, the combination of a combustion-chamber, a bridge-wall at the rear end of said chamber, a ver-

5 tically-disposed grate upon the bridge-wall comprising parallel vertically-disposed fin-
 10 gers beveled at their upper ends, a fuel feed-chute at the forward end portion of the cham-
 15 ber and a fluid blast-pipe opening into the chamber just beyond the said chute, all constructed and arranged to operate substan-
 20 tially as and for the purpose set forth.

5. In a fuel-dust boiler-furnace, a combustion-chamber provided with side walls having
 10 up-and-down corrugations and comprising an enlarged chamber portion E^2 and reduced
 and arched passage portion E' , a grate G comprising parallel longitudinally-extending
 15 metal bars l , a supplemental grate G' comprising fire-clay bars resting upon and shielding
 the bars l , in combination with a fuel feed-chute toward the outer end of said passage
 20 end of said passage just beyond the feed-chute, substantially as and for the purpose
 set forth.

6. In a fuel-dust furnace, the combination
 of a combustion-chamber comprising the en-

25 larged chamber portion E^2 and reduced pas-
 sage portion E' provided with a door-opening
 30 t , a door s at said opening, a shelf s' on the door, a fluid blast-pipe H extending through
 said door above the said shelf, a fuel feed-
 chute in the front wall of the furnace termi-
 35 nating above the shelf and back of the said
 pipe, and fuel-dust-supplying means for said
 feed-chute, substantially as and for the pur-
 pose set forth.

7. A fuel-dust feeder for furnaces, compris-
 35 ing, in combination, a supply-bin for the dust,
 an overflow-receptacle, a dust-conveyer ex-
 tending from said bin to the overflow-recep-
 40 tacle, a distributing-receptacle in the line of
 said conveyer, and a dust-conveyer extend-
 ing from the distributing-receptacle to the
 furnace, substantially as and for the purpose
 set forth.

BERNARD C. HEAVEY.

In presence of—

J. H. LEE,

M. J. FROST.