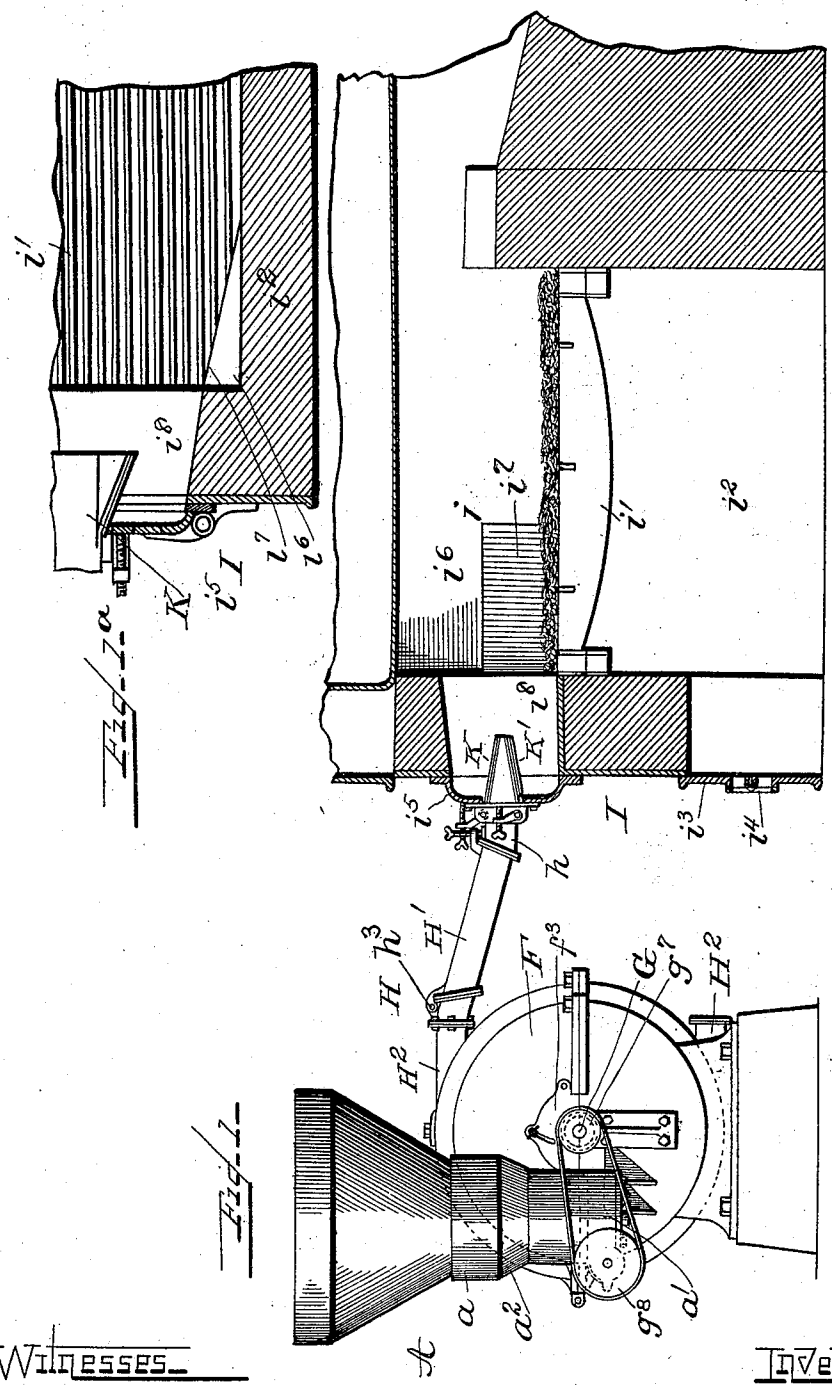
No. 617,522. Patented Jan. 10, 1899.

C. M. DAY.

APPARATUS FOR PREPARING AND FEEDING FUEL TO FURNACES.

(Application filed June 9, 1898.)

(No Model.) 3 Sheets—Sheet 1.



Witnesses—

G. A. Taubenschmitt,

L. D. Knigobery

Inventor—

Charles M. Day

By Whitaker & Prost

Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

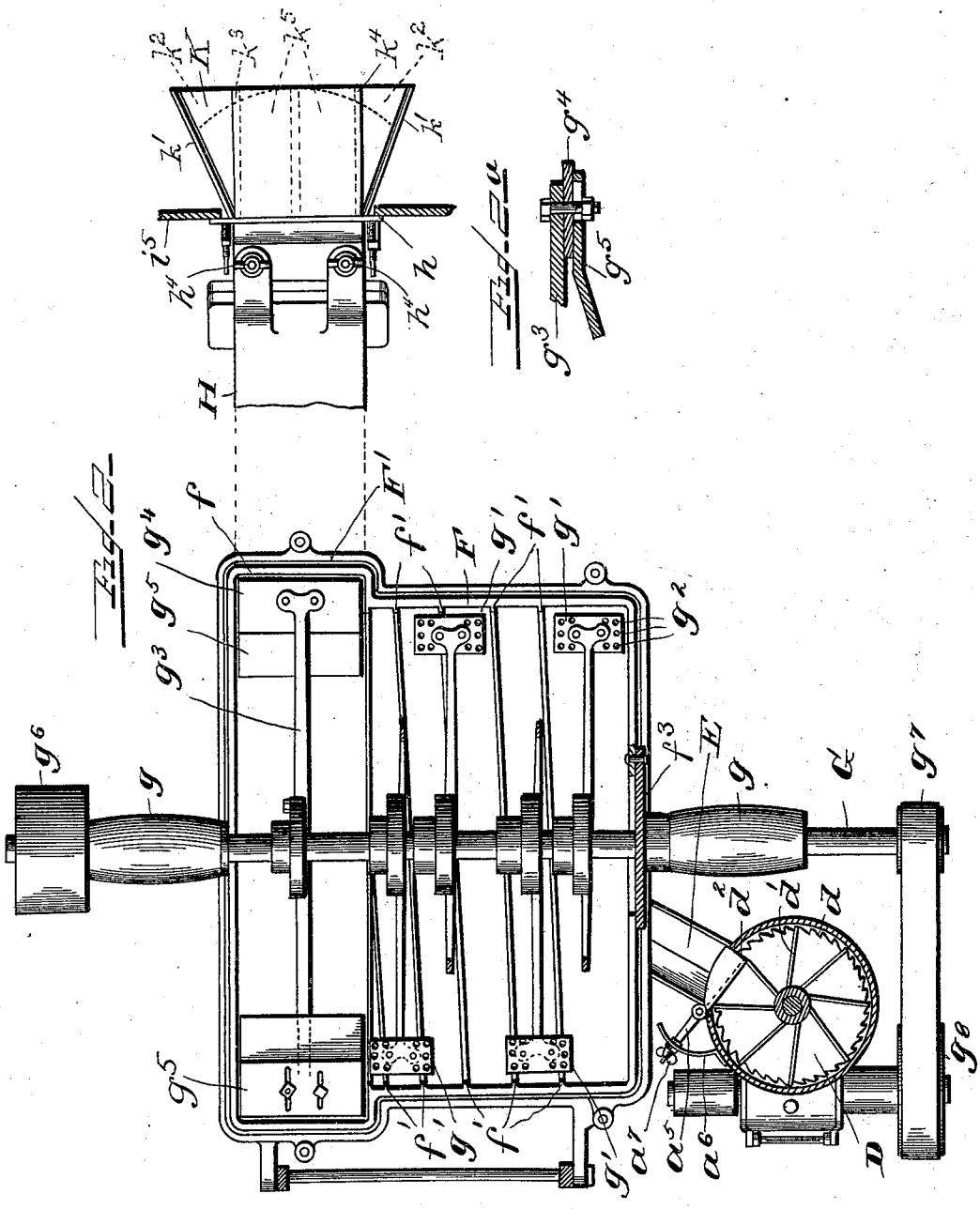
No. 617,522. Patented Jan. 10, 1899.

C. M. DAY.

APPARATUS FOR PREPARING AND FEEDING FUEL TO FURNACES.

(Application filed June 9, 1898.)

(No Model.) 3 Sheets—Sheet 2.



Witnesses—

G. A. Taubenschmitt,
J. D. Montgomery

Inventor—

Charles M. Day
By Whitaker & Prevost
Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 617,522. Patented Jan. 10, 1899.

C. M. DAY.

APPARATUS FOR PREPARING AND FEEDING FUEL TO FURNACES.

(Application filed June 9, 1898.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

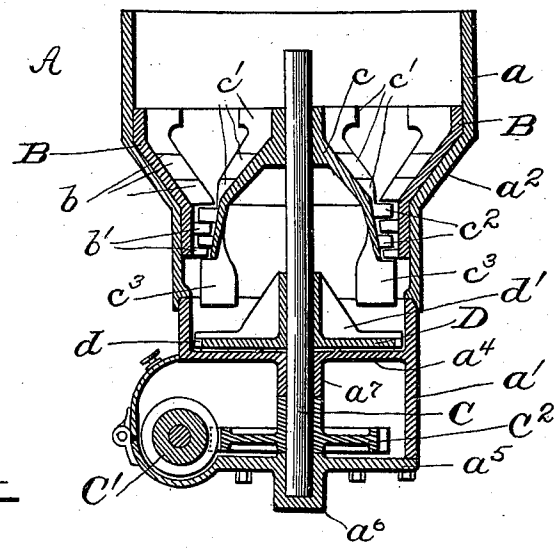


Fig. 5.

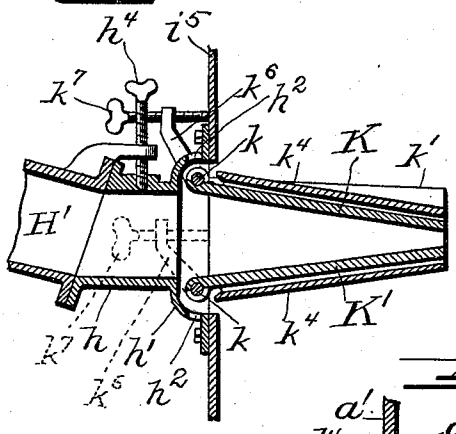


Fig. 6.

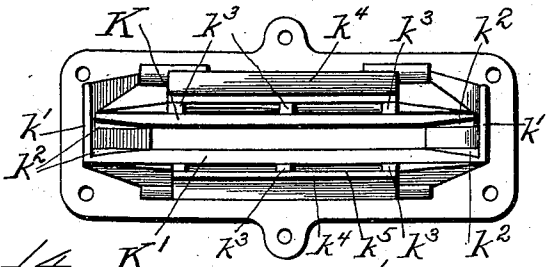


Fig. 4.

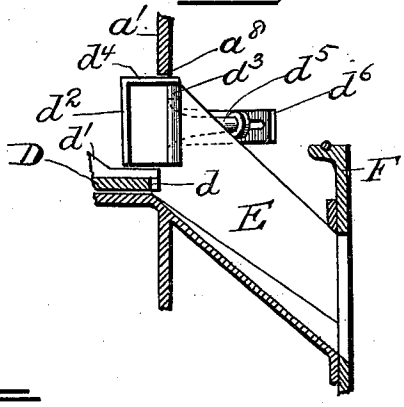
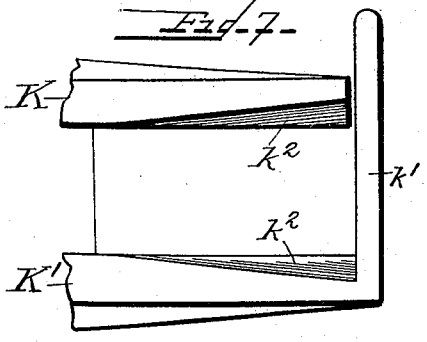


Fig. 7.



Witnesses.

G. A. Pauberschmidt.

J. D. Rungsberg.

Inventor.

Charles M. Day

By Whitaker & Prevost

Attys.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES M. DAY, OF NEW YORK, N. Y., ASSIGNOR TO ALBERT A. DAY, OF SAME PLACE.

APPARATUS FOR PREPARING AND FEEDING FUEL TO FURNACES.

SPECIFICATION forming part of Letters Patent No. 617,522, dated January 10, 1899.

Application filed June 9, 1898. Serial No. 683,009. (No model.)

To all whom it may concern:

Be it known that I, CHARLES M. DAY, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Apparatus for Preparing and Feeding Fuel in a Finely-Divided Condition to 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 is an improvement in apparatus for preparing and feeding and burning coal in finely-divided particles; and it consists in the novel features hereinafter described, reference being had to the accompanying drawings, which illustrate one form in which I have contemplated embodying my invention, and said invention is fully disclosed in the following description and claims.

Referring to the said drawings, Figure 1 represents a sectional view of a portion of a boiler-furnace, showing my improved apparatus in elevation applied thereto. Fig. 1^a is a horizontal sectional view of a portion of a furnace for the consumption of the finely-divided fuel. Fig. 2 is a horizontal sectional view of my apparatus. Fig. 2^a is a detail view of the ejector-blades. Fig. 3 is an enlarged vertical sectional view of the breaking and feeding mechanism forming part of my apparatus. Fig. 4 is an enlarged detail sectional view of the discharge-chute of the breaking and feeding mechanism and the adjacent parts. Fig. 5 is an enlarged vertical sectional view of the discharge-nozzle. Fig. 6 is a front elevation of the same. Fig. 7 is a still further enlarged front elevation of a portion of the nozzle at one side of the same.

A represents the casing of my breaking and feeding apparatus, which is supported upon the frame of the apparatus and comprises in this instance the upper portion or hopper a and the lower portion or receptacle a', connected in any desired manner. The upper portion is preferably provided with an inclined inwardly-tapering portion a^2. The lower cylindrical portion a' is provided with a horizontal bottom plate a^4, below which and parallel therewith is the bearing-plate a^5, provided with a central step-bearing a^6.

B B represent the breaker-plates, which are arranged in the form of a cylinder and are supported by the walls of the casing. The breaker-plates are provided with suitable breaking webs or projections b and lugs b', as shown.

C represents a vertical shaft mounted in the step-bearing a^6 at its lower end and passing upwardly through a sleeve or bearing a^7 formed integrally with or attached to the bottom plate a^4. To the upper end of the shaft C is secured the breaking-cone c, the upper portion of which is provided with suitable breaking webs or projections c', while the lower portion is provided with breaking-lugs c^2, alternating with the lugs b of the breaking-plates B B. The material passing between the cone c and the breaking-plates B B will be broken and reduced to the desired degree. The cone c is also provided with downwardly-extending agitating-fingers c^3, extending into the receptacle a'.

D represents a horizontal revolving plate or disk secured to the shaft C just above the bottom plate a^4 and provided with a toothed or serrated periphery d, as shown in Fig. 2. The upper face of this plate is provided with ribs or webs d', preferably of greater height adjacent to the center of the plate, said ribs being so disposed on said plate as to force the material thereon toward the periphery.

A discharge-orifice is formed in the casing at a^8, the lower edge of said orifice being below the plate or disk D, and said orifice is controlled by a swinging gate d^2, pivoted to the receptacle a' at d^3 and provided at its upper edge with a horizontally-disposed portion or guard d^4. This gate d^2 is provided with an operating-arm d^5, extending outwardly from the casing A and provided with an adjusting device consisting in this instance of a stationary curved arm or plate d^6, secured to the casing A and provided with a slot through which the arm d^5 passes, said arm being threaded, as shown, (see Fig. 4,) and provided with a clamping-nut d^7. The gate d^2 can thus be set at any desired angle, so as to vary the discharge of the crushed or

ground material from the casing A. The lower edge of the gate d^2 is so located as to clear the ribs d' of the plate D. E represents a delivery-chute extending from the aperture a^8 to the casing F.

The shaft C is preferably driven by means of a horizontal worm C', the shaft of which is mounted in suitable bearings in the frame of the machine, said worm engaging a worm-wheel C^2 on the shaft C, located beneath the bottom plate a^4.

F represents (Fig. 2) a cylindrical casing preferably formed of two halves or sections hinged at one side and secured together when in use, provided at one end with an enlarged annular portion F', forming within the same an annular recess or trough f, as shown in Fig. 2. The inner face of the casing F is provided with a spiral or helical rib f', having its pitch toward the inlet end of the cylinder. A shaft G is mounted in suitable bearings g, supported by the frame of the apparatus, and extends centrally through the casing F. Within the main portion of the casing this shaft is provided with radial arms carrying blades g', the outer edges of which travel very close to the spiral rib f'. These blades are provided with apertures g^2 therein to permit the pulverized material to pass through the blades as they rotate. The shaft G is also provided with a series of radial arms g^3, carrying ejector-blades, which are adapted to travel in the annular recess or trough f of the casing F. I prefer to form the ejector-blades as shown in Fig. 2^a, in which g^4 represents the blade proper, which is also a pulverizing-blade, secured to one of the arms g^3, and g^5 represents an adjustable plate secured to the arm g^3 and blade g^4 by bolts and nuts or set-screws passing through a slot in said adjustable plate. By adjusting the plate g^5 with respect to the main portion g^4 of the blade the area of the complete blade can be increased or diminished to vary the ejecting force of said blades.

It will be noted that the outer edges of the blades g^4 are at a greater distance from the shaft G than the outer edges of blades g'. Hence the blades g^4 will travel in a circle of larger diameter than the blades g' and will move at a relatively greater speed. Thus by making the casing with the annular trough or recess f I am enabled to drive the ejector-blades which travel in said trough at greater speed than the other blades without increasing the speed of the shaft G.

I term the main portion of the casing F the "pulverizing-chamber" and the blades located therein the "pulverizing-blades," and the annular trough, with its blades, I term the "ejector." The casing F is preferably provided at the end adjacent to the breaking and feeding mechanism with an opening f^2 for the admission of air, said opening being controlled by a movable closing-plate f^3, pivoted at one end to the casing, in this instance, and provided with a curved slot engaging a thumb-screw or other device for securing it in any position to which it may be adjusted.

A conducting-tube H is connected to the exterior of the annular trough f and communicates with a suitable delivery therein for delivering the pulverized material to a discharge-nozzle, by means of which it is discharged into the furnace in which it is to be consumed. The delivery-tube H connects tangentially with the ejector, as shown, by means of a hood H^2. (See Fig. 1, in which I have shown such a hood at the top and also at the bottom of the ejector.) I prefer to connect the tube at the top, as in Fig. 1, in which case the other hood, if the machine is constructed with two, will be closed in any desired manner; but in some cases I may desire to discharge the material from the bottom. In either case the blades of the ejector will of course be given the necessary direction of rotation to discharge the material into and through the delivery-tube.

I represents the furnace, provided with the fire-box or combustion-chamber i, grate i', and ash-pit i^2. The ash-pit is provided with a door i^3, having a suitable air-inlet, which is controlled by a damper i^4 of any preferred construction.

i^5 represents the furnace-door, which is provided with an aperture for the passage of the nozzle therethrough. To the exterior of the door i^5 is bolted or otherwise secured the front end h of the delivery-tube, the upper and lower sides of which are slightly adjacent to the door, as shown at h' h'. Within these enlarged portions are mounted the ends of the upper and lower nozzle-plates K K', which form my discharge-nozzle, each of said plates being secured to a horizontal shaft k in any desired way and the shafts mounted in suitable bearings in the end of the tube, so that the plates can be raised or lowered by rotating said shafts. One of said plates (in this instance the lower plate K') is provided with lateral vertically-disposed flanges k' k', between which the other plate moves. The plates K and K' spread out laterally from the portions adjacent to their supporting-shafts, as shown in Fig. 2, so that they are much wider adjacent to their discharge ends than at the opposite end, thereby enabling them to spread the material discharged between the said plates very widely in a horizontal plane. I desire to have the discharge greater at the outer sides of the nozzle than in the center, and to secure this result the outer corner portions of the upper and lower plates are slightly beveled on their horizontal inner sides or faces, as shown at k^2 in Figs. 6 and 7, or made convex to slightly increase the delivery-orifice formed between said plates at their outer edges. I also provide one or both of the plates K K' (both plates as shown) with external air-passages, as indicated in Figs. 2, 5, 6, and 7. To this end each plate is provided on its exterior with two or more ribs k^3, to which is secured an outer plate k^4,

which may be of the full width of the nozzle-plate or may extend over the central portion only, as shown in the drawings. Air-passages k^5 k^5 are thus formed between the nozzle-plate and the plate k^4, extending the whole length of the plates, and said passages will receive air from slots or apertures h^2 in the enlarged end of the delivery-tube h, as shown in Fig. 5. The air in passing through the air-passages k^5 will have a tendency to keep the nozzle-plates cool by taking up heat therefrom and will be delivered in a heated condition within the furnace adjacent to the discharge-orifice of the nozzle. Each of the shafts k k is provided with an external adjusting-arm k^6, having an adjusting-screw k^7 operatively connected therewith, by means of which the plates K and K′ can be adjusted with respect to each other to vary the discharge-opening formed between their edges and by means of which the plates can be elevated or depressed to discharge the material passing between them horizontally or upwardly or downwardly, as desired. This nozzle is formed entirely by the two plates K and K′ and can be cheaply made and easily controlled and operated. Moreover, by this construction the clogging of the plates which is experienced where they are confined within a shell or casing is entirely avoided. Where the nozzle-plates are inclosed in a casing, particles of the fuel are constantly getting into the spaces between the plates and the walls of the casing, where they are coked by the high heat to which the nozzle is subjected and interfere seriously with the movements of the plates in adjusting the nozzle.

The delivery-tube H is provided with a removable section H′, which is preferably hinged at h^3 to the part attached to the ejector and has its forward end provided with an inclined face adapted to engage a parallel face on the end of the portion h which is secured to the furnace-door. The parts H′ and h are secured together by any suitable means, clamping-screws h^4 being shown for the purpose. (See Figs. 1 and 5.) It will be thus seen that by releasing the screws h^4 and throwing the movable section H′ out of operative relation with the part h the furnace-door carrying the nozzle may be swung open to give access to the furnace.

The operation of the device in preparing and feeding fuel to the furnace is as follows: The fuel is deposited in the upper part of the breaking and feeding device, where it is crushed or broken between the breaking-plates and cone to the desired condition, after which it passes through the chute E into the pulverizing-chamber, the gate d^2 regulating the feed of the material to said chamber. In the pulverizing-chamber the material is forced to the walls by the centrifugal action of the pulverizing-blades, and portions of the material will be maintained in contact with said walls between the coils of the spiral rib f'. Other portions of the material will be forced around by the blades, thus setting up a rubbing or pulverizing action between the material on the inside of the walls and that which is being moved or rolled around by the blades. The heavier particles of the material will also tend to fall from the top of the casing to the bottom, where they will be taken up by other blades and again carried upward. Any large particles of greater diameter than the height of the rib f' will be forced along the pitch side of the rib toward the inlet end of the pulverizing-chamber, thus subjecting them to a shearing action and propelling them toward the inlet to be again acted upon by the blades. The lighter portions of the material will be caught up by the current of air admitted through the aperture f^2 and pass longitudinally through the casing along the blades and will be carried toward the ejector. In the ejector the material will also be given a further pulverization by the blades g^4, and the material will be discharged with great force by the ejector-blades through the delivery-tube H, which is tangential to the annular trough, as before described, the material being spread out and sprayed into the furnace by the discharge-nozzle. The material in passing through the delivery tube and nozzle is accompanied by and suspended in a current of air and remains suspended in the air until it is consumed.

In using this apparatus in connection with a boiler-furnace I first detach the removable section H′ of the delivery-tube to permit the furnace-door to be opened and build an initial fire upon the grate, which is fired by hand in the ordinary manner. The draft-damper below the grate is then closed, the section H′ of the tube H is placed in operative position, and my apparatus is started. As the material is fed into the furnace and discharged from the nozzle a certain regulated amount of air is supplied with the fuel, and the finer particles of the latter are instantly ignited by the flame from the initial fire and are consumed while in a state of suspension between the grate and the boiler, producing an intensely-hot flame without smoke. Any heavier particles of the fuel will fall upon the coals already burning on the grate, but which are merely smoldering, as the air-supply below the grate is cut off. These heavier particles will thus form a covering for the fire upon the grate, tending to still further check its combustion, but adding almost imperceptibly sufficient fuel to maintain a low fire.

If now for any cause it becomes necessary to stop my apparatus, as by the breaking of a part or derangement of the apparatus, the movable section H′ of the delivery-tube is thrown back, the draft-damper below the grate is opened, and the furnace-door can be at once opened to enable the fire already burning upon the grate to be fed by hand, thus obviating any delay in changing from the use of my apparatus to hand-firing, and vice

versa. Furthermore, the presence of the fire continually above the grate during the use of my apparatus will prevent the grate from being destroyed or injured by the intense heat of the flame above it, which would result if the grate were directly exposed.

The shaft G of the apparatus will be driven from a suitable source of power, preferably by means of a driving-pulley g^6, and motion is communicated to the breaking mechanism from a pulley g^7 on shaft G to a suitable pulley g^8 on the shaft of the worm C'.

The side walls of the furnace I are provided adjacent their front ends with cheeks i^6, (see Figs. 1 and 1^a,) extending a short distance above the grate i' and having inclined inner faces i^2, which taper from the side walls to the aperture i^8, through which the fuel is introduced and which is closed by the furnace-door i^5. These inclined faces are so disposed that the lateral portions of the fuel discharged by the nozzle will travel parallel and adjacent thereto, and as said walls become intensely hot while the furnace is in use they will impart a great amount of heat to the adjacent portions of the fuel, thus assisting in the combustion of the same. As the cheeks i^6 do not extend to the bottom of the boiler, they do not intervene between the boiler and the products of combustion, and such heated portions of the fuel as lodge upon their upper faces will impart their heat to the boiler.

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

1. In an apparatus for preparing and feeding fuel, the combination with mechanism for reducing the fuel to a finely-divided condition, of an ejector comprising a cylindrical casing, having a tangential delivery-tube communicating therewith, and a series of revolving blades of substantially the width of said casing, substantially as described.

2. In an apparatus for preparing and feeding fuel, the combination with mechanism for reducing the fuel to a finely-divided condition, of an ejector comprising a cylindrical casing having a tangential delivery-tube communicating therewith, and a series of revolving blades of substantially the width of said casing, said blades having adjustable portions for varying the area of the blades, substantially as described.

3. In an apparatus for preparing and feeding fuel, the combination with mechanism for reducing the fuel to a finely-divided condition, comprising a pulverizing-chamber and a revoluble shaft within said chamber provided with pulverizing-blades, of an ejector comprising a cylindrical casing of greater diameter than the pulverizing-chamber and communicating therewith, a series of ejector-blades mounted upon said shaft and having their outer edges at a greater distance from the same than the outer edges of the pulverizing-blades, whereby the ejector-blades will travel at a greater speed than the pulverizing-blades, substantially as described.

4. In an apparatus for preparing and feeding fuel, the combination with mechanism for reducing the fuel to a finely-divided condition comprising a pulverizing-chamber and a revolving shaft within said chamber provided with pulverizing-blades, of an ejector comprising a cylindrical casing of greater diameter than the pulverizing-chamber, communicating therewith and forming an annular groove or recess, a series of ejector-blades mounted upon said shaft, adapted to travel in said annular groove or recess and of substantially the width of the same, the outer edges of said blades being at a greater distance from the shaft than the outer edges of the pulverizing-blades whereby said ejector-blades will travel at a greater speed than the pulverizing-blades, substantially as described.

5. In an apparatus for preparing and feeding fuel, the combination with mechanism for reducing the fuel to a finely-divided condition including a cylindrical pulverizing-chamber provided on its interior with a spiral rib having its working face extending from the delivery end of said chamber toward the end at which the fuel is admitted, a revoluble shaft in said chamber provided with a series of blades extending into close proximity to said rib, of an ejector comprising a cylindrical casing of greater diameter than the pulverizing-chamber, and communicating with the latter, said casing forming within the same an annular groove or recess, and a series of ejector-blades mounted on said shaft, adapted to travel in said annular groove or recess, and of substantially the width of the same, the outer edges of said blades being at a greater distance from the shaft than the outer edges of the pulverizing-blades whereby said ejector-blades will travel at greater speed than the pulverizing-blades, substantially as described.

6. In apparatus for preparing and feeding fuel, the combination with mechanism for reducing the fuel to a finely-divided condition, of an ejector consisting of a cylindrical casing, and a series of revolving ejector-blades in said casing, a discharge-nozzle secured to the furnace-door, and a delivery-tube connecting the ejector-casing and the nozzle and provided adjacent to the nozzle with a removable section to permit the furnace-door to be opened, substantially as described.

7. In apparatus for feeding fuel, the discharge-nozzle comprising two horizontally-disposed pivoted plates, one of said plates being provided with lateral perpendicular flanges between which the other plate is fitted and independent adjusting mechanism for each plate, substantially as described.

8. In apparatus for feeding fuel, the discharge-nozzle comprising two horizontally-disposed pivoted plates, one of said plates being provided with lateral perpendicular flanges between which the other plate is fitted, and independent adjusting means for each of

said plates, said plates having straight delivery ends, the inner horizontal faces of which are separated a greater distance adjacent to the sides of the nozzle than at the center, substantially as described.

9. In apparatus for feeding fuel, the discharge-nozzle consisting of a pair of horizontally-disposed pivoted plates, one of said plates having lateral perpendicular flanges within which the other plate is fitted, one of said plates being provided with a longitudinal air-passage communicating with the air outside of the furnace, substantially as described.

10. In apparatus for feeding fuel, the discharge-nozzle consisting of two horizontally-disposed pivoted plates, one of said plates being provided with lateral perpendicular flanges between which the other plate is fitted, independent adjusting mechanism for each of said plates, one of said plates being provided with longitudinally-disposed ribs, and an auxiliary plate secured thereto and engaging said ribs to form a longitudinal air passage or passages, substantially as described.

11. In apparatus for feeding fuel, the discharge-nozzle consisting of two horizontally-disposed pivoted plates, one of said plates being provided with lateral perpendicular flanges between which the other plate is fitted, an adjusting-arm for each plate, and an adjusting-screw operatively connected with each adjusting-arm, whereby said plates may be independently adjusted, substantially as described.

12. In apparatus for preparing and feeding fuel, the combination with a pulverizing-chamber, provided with revoluble pulverizing-blades, an ejector comprising a cylindrical casing communicating with said pulverizing-chamber and provided with revolving ejector-blades and a discharge-nozzle connected with said ejector, of a breaking and feeding mechanism comprising a cylindrical casing, having a discharge-aperture communicating with the pulverizing-chamber, revoluble breaking mechanism within said casing, and an adjustable swinging gate adjacent to said discharge-aperture for regulating the amount of fuel delivered to the pulverizing-chamber, substantially as described.

13. In apparatus for preparing and feeding fuel, the combination with a furnace provided with a grate, a draft-damper below the grate for controlling the air-supply beneath the same, a discharge-nozzle secured to the furnace-door, mechanism for reducing the fuel to a finely-divided condition and a delivery-tube connected with the nozzle for delivering the finely-divided fuel thereto, said delivery-tube being provided adjacent to the furnace-door with a removable section, whereby said section may be removed, to allow the furnace-door to be opened for the purpose of hand-firing when desired, substantially as described.

14. The combination with a furnace having its combustion-chamber provided with cheeks extending a distance above the grate, having forwardly-converging vertical faces, of a nozzle for introducing finely-divided fuel into the combustion-chamber, and means for supplying finely-divided fuel to said nozzle, substantially as described.

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

CHARLES M. DAY.

Witnesses:
L. P. WHITAKER,
J. D. KINGSBERY.