C. ERITH.

MECHANICAL STOKER.

APPLICATION FILED OCT. 12, 1920.

1,431,882.

Patented Oct. 10, 1922.

4 SHEETS—SHEET 1.

Fig. 1

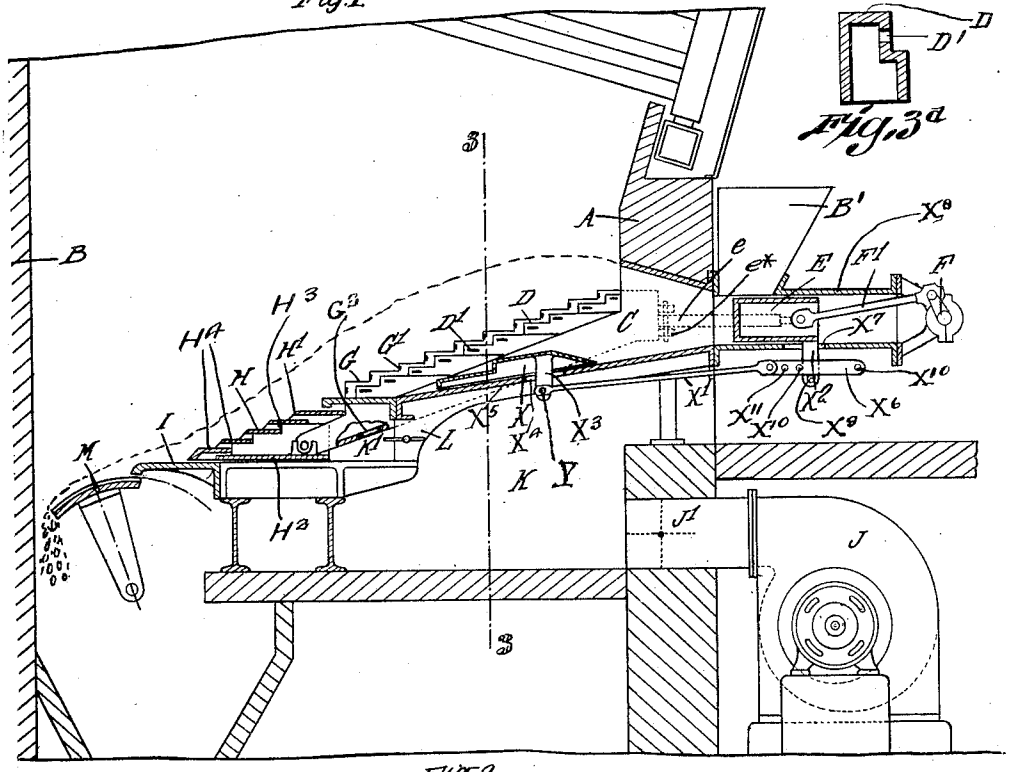
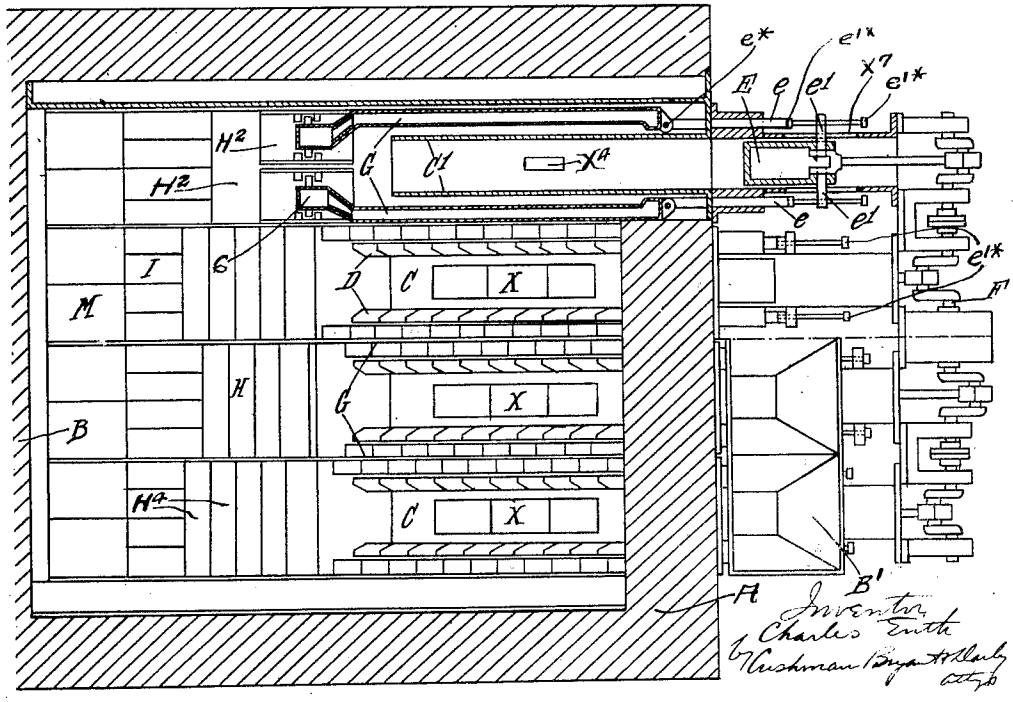


Fig. 3a

Fig. 2



Inventor
Charles Erith
by Cushman Darby & Cushman
Attys

C. ERITH.

MECHANICAL STOKER.

APPLICATION FILED OCT. 12, 1920.

1,431,882. Patented Oct. 10, 1922.

4 SHEETS—SHEET 2.

Fig. 3.

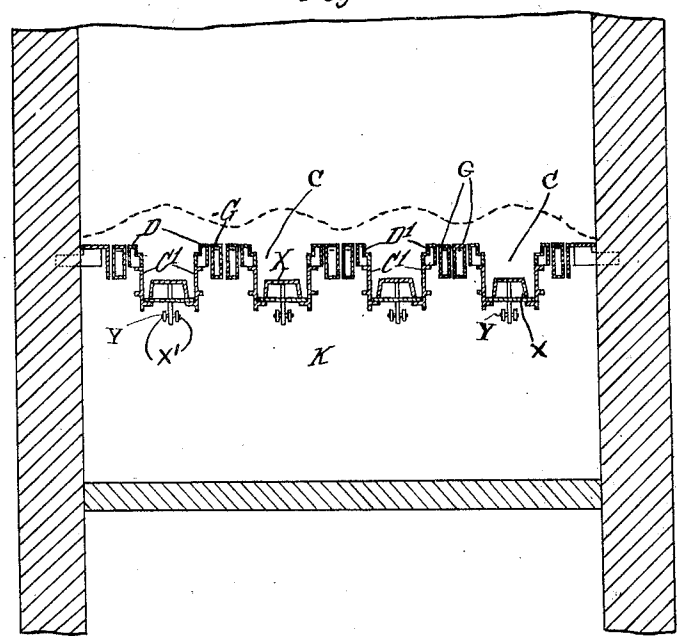


Fig. 4.

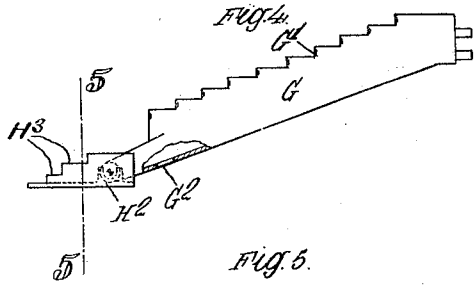
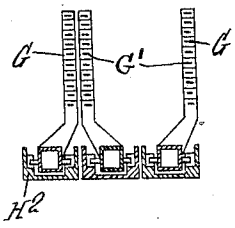


Fig. 5.



Inventor
Charles Erith
by Cushman Bryant & Hardy
attorneys

C. ERITH.

MECHANICAL STOKER.

APPLICATION FILED OCT. 12, 1920.

1,431,882. Patented Oct. 10, 1922.

4 SHEETS—SHEET 3.

Fig. 6.

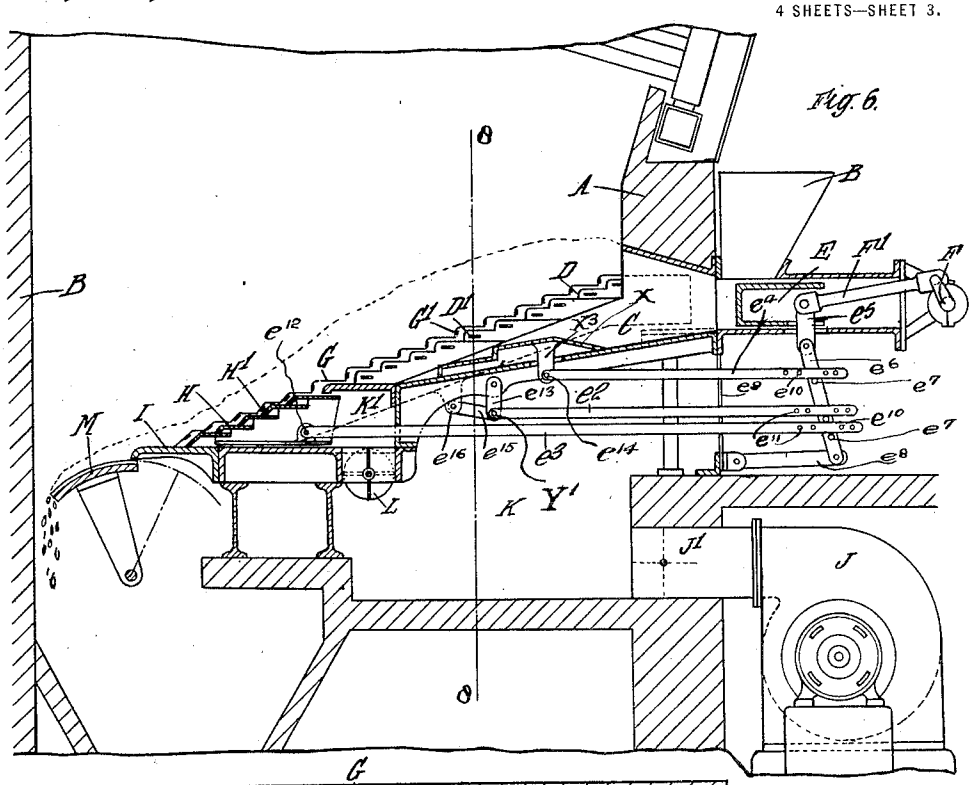
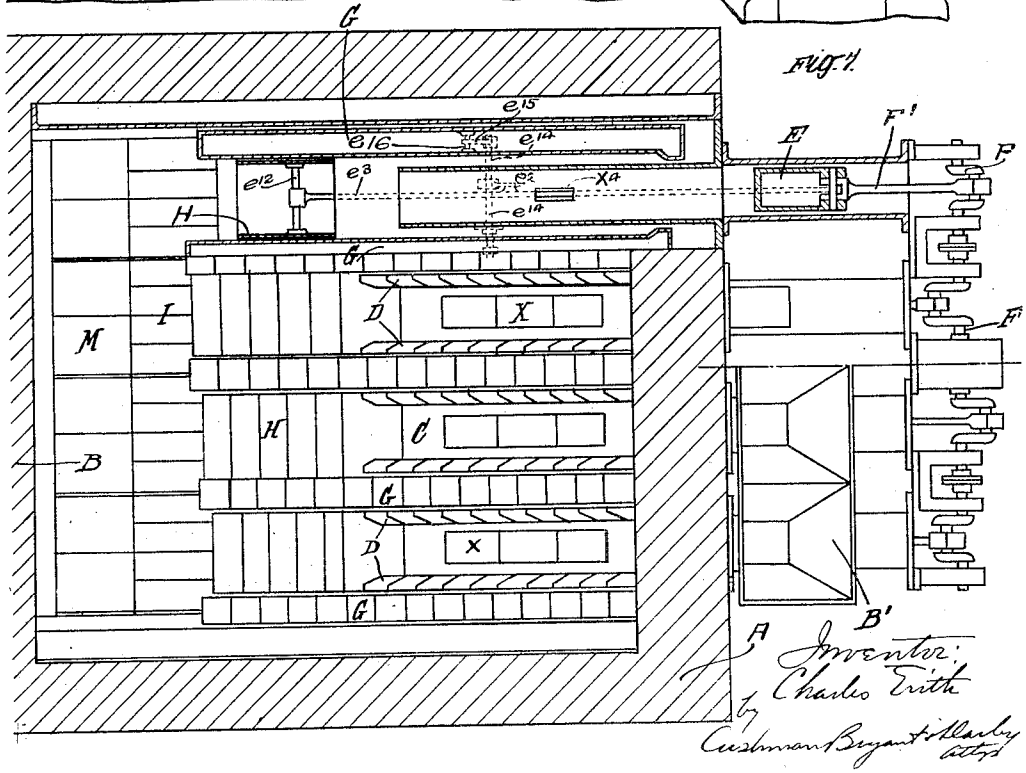


Fig. 7.



Inventor:
Charles Erith
by
Cushman Bryant & Hanby
Attys

C. ERITH.

MECHANICAL STOKER.

APPLICATION FILED OCT. 12, 1920.

1,431,882. Patented Oct. 10, 1922.

4 SHEETS—SHEET 4.

FIG. 8

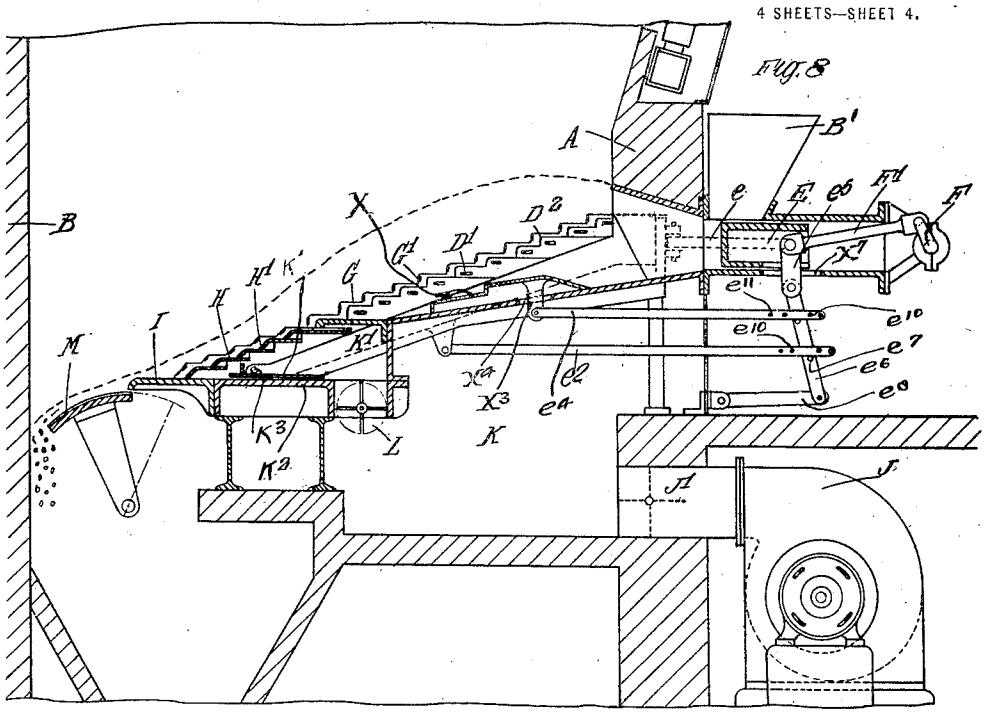
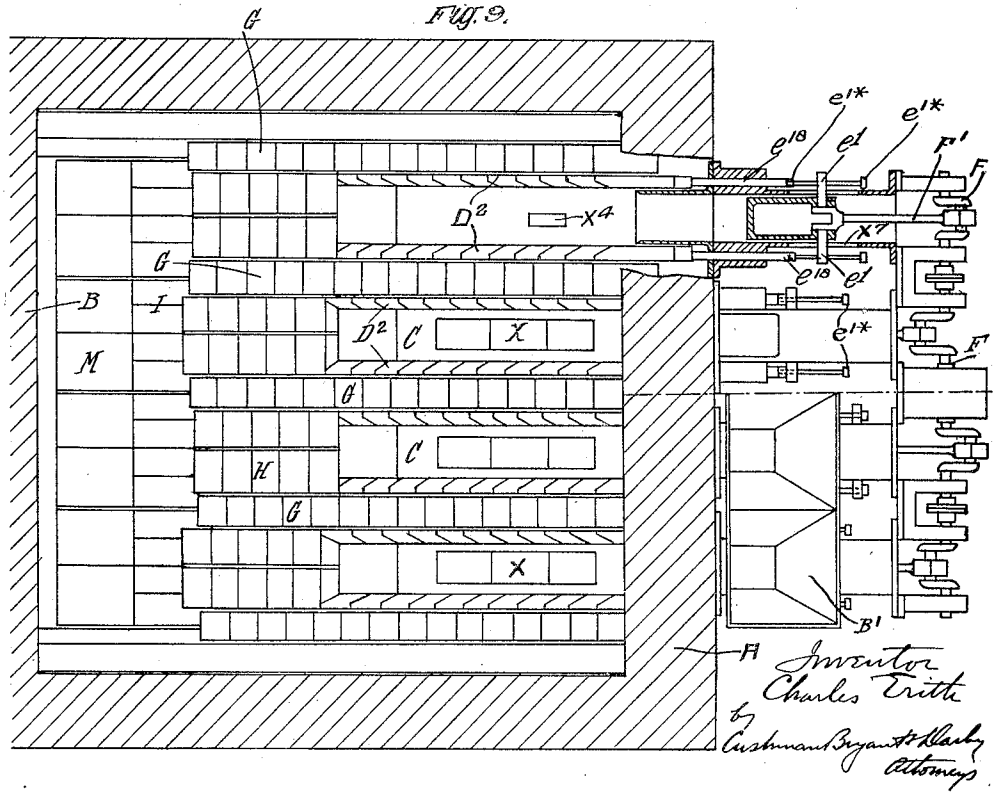


FIG. 9.



Inventor
Charles Erith
by Cushman Bryant & Clarke
Attorneys

Patented Oct. 10, 1922. 1,431,882

UNITED STATES PATENT OFFICE.

CHARLES ERITH, OF SUTTON, ENGLAND, ASSIGNOR TO ERITH'S ENGINEERING COMPANY, LIMITED, OF LONDON, ENGLAND.

MECHANICAL STOKER.

Application filed October 12, 1920. Serial No. 416,474.

To all whom it may concern:

Be it known that I, CHARLES ERITH, a subject of the King of Great Britain, residing at Winchfield, Albion Road, Sutton, in the county of Surrey, England, have invented certain new and useful Improvements in or Relating to Mechanical Stokers, of which the following is a specification.

This invention relates to underfeed mechanical stokers for boiler and other furnaces of the kind in which the fuel is fed into troughs or retorts provided with tuyères for the admission of forced draught air into the fuel as it rises from the retorts and spreads over the tops of the tuyères, and in which overfeed or extension grates (hereinafter termed extension grates) are provided at the rear ends of the retorts on which the final stages of combustion are completed.

In underfeed stokers of this kind, the fuel is usually fed by plungers or rams into the troughs or retorts, and the fuel is usually advanced by means of variable-stroke pushers within the retorts, viz, under the thickest part of the fuel bed of each retort-unit.

According to one feature of the present invention an intermediate stage is introduced into the combustion process by placing at the outer sides of the tuyères longitudinal overfeed grate bars through which a supplementary supply of air, under control and preferably at reduced pressure, is delivered into the partly-burnt fuel, so that the fuel, after rising from the underfeed retorts and becoming ignited as it spreads over the tuyères which admit full pressure air into the thick part of the fuel bed above each retort, may be supplied with additional air through the longitudinal overfeed grate bars on which the thinner parts of the fuel bed are supported, thereby burning out the combustible matter from the partly-burnt fuel to a greater degree than heretofore, before it reaches the transverse portion of the extension grates on which the final stages of combustion are completed. The said longitudinal overfeed grate bars are preferably box-shaped and stepped and may be adapted to be reciprocated so as to slice the thinner portions of the fuel bed as and when desired. The air admitted to the fuel bed through said longitudinal overfeed grate bars is preferably admitted thereto from the secondary air chamber which supplies air for supplementary combustion to the movable transverse extension grates.

A further feature of the present invention consists in imparting positive and controlled slicing actions to the various parts of the fuel bed, as well as positive rearward travel of the fuel and ash under all conditions of combustion by independent actuation and adjustable-stroke motion (1) of the pusher in each underfeed retort, (2) of the novel longitudinal overfeed grate bars, and (3) of the sectional transverse extension grates.

All three variable-stroke reciprocating motions are preferably transmitted to the parts to be actuated from the fuel-feeding-ram of each underfeed retort unit, so as to harmonize with the rate of fuel-feeding provision being made for coupling or uncoupling the actuating devices at will; for instance, the longitudinal overfeed grate bars can be so coupled as to actuate the transverse extension grate sections when desired while retaining full liberty of independent variable-stroke motions to either of these parts, as in many cases experience shows that it is desirable to have little or no regular motion on the longitudinal overfeed grate bars, owing to the fact that a shearing effect on the fuel bed is assured by the action of the pusher in each retort where the fuel bed is thickest, viz, over the retort centres, while it is often undesirable to employ a shearing effect above the tuyère centres, where the fuel bed is necessarily relatively thin, and this undesirable shearing effect on the thin parts of the fuel bed cannot be avoided in earlier forms of stokers where the transverse extension grates cannot be reciprocated independently of the tuyères; further when there is no provision for mechanically displacing clinkers which tend to form on the fixed tuyères when fires are banked, a reverberatory action of the flames under large clinkers tends to occur when active combustion is resumed, which results in a destructive effect on the tuyères.

The novel features of the present invention produce a very simple construction and arrangement of the parts of the mechanism. They add to the reliability of the stoker and eliminate manual labour; while they also reduce the cost of construction and upkeep, and make it unnecessary to employ moving

retort walls and moving tuyères, although, if desired, this latter arrangement can also be employed with the present invention, in which case the variable stroke pusher within each of the retorts may be dispensed with.

In order that the invention may be clearly understood and readily carried into effect, the same will now be described more fully with reference to the accompanying drawings which show three constructional forms of the invention and in which:—

Figure 1 is a longitudinal section of a furnace provided with an automatic stoker embodying one form of the invention.

Figure 2 is a plan view, partly in section.

Figure 3 is a cross-section of the furnace, taken on line 3—3 of Figure 1, the parts beyond the section line being omitted for the sake of clearness, and showing the fuel as it rises from the retorts and spreads over the tuyères on to the novel longitudinal overfeed grate bars.

Fig. 3ª is a detail sectional view showing the tuyère openings.

Figure 4 is a side elevation of one of the novel longitudinal overfeed grate bars and of the sliding shoe which is coupled to the sectional transverse extension grate, the lugs by which it is reciprocated being shown in sectional plan view in Figure 2 and in elevation in Figure 5.

Figure 5 is a sectional elevation on the line 5—5 of Figure 4 showing a pair of such longitudinal overfeed grate bars with sliding shoes for one unit, the shoes and lower parts of the bars being shown in section, and the upper parts of the bars in elevation; it also shows the side bar and shoe of an adjacent retort unit.

Figures 6 and 7 are corresponding views to Figures 1 and 2, showing a modified form of the invention. Figures 8 and 9 are corresponding views to Figures 1 and 2, showing a still further modified form of the invention.

In the examples illustrated in these figures, the stoker is assembled in each case from four similar units, but any desired number of units can be employed, according to the width and capacity of the furnace.

Throughout the several figures of the drawings the same reference letters are employed to denote similar or equivalent parts.

A is the front wall and B the bridge wall of the furnace, above which, as shown in Figures 1, 6 and 10, a watertube boiler is indicated, which may be of any make or size, to correspond with the stoker capacity installed.

The stokers shown each comprise a number of rearwardly inclined and stationary underfeed fuel retorts C, arranged in series above the main air chamber K, fuel being mechanically fed from the hopper B′ to each retort by a reciprocating plunger or ram E worked by a connecting rod F′, from a crank-shaft F by any suitable gearing, and the fuel being advanced by variable stroke pushers X located within the retorts, and connected to and actuated by the ram E.

C′, C′ are the side walls of each retort, and D, D, are the tuyères; the latter being preferably constituted by plates with imperforate tops, arranged in step formation as shown, and admitting air at full pressure through lateral openings D′, for primary underfeed combustion of the fuel as it rises from the retorts and spreads over the tuyères. The longitudinal grate bars G, G, in the examples shown are box-shaped and of stepped formation with air outlets G′ in the risers, and are adapted to be reciprocated longitudinally, and are supplied with air at reduced pressure which enters the grate-bars G through openings G^2 near their lower ends communicating with the secondary air chamber K′ disposed under the sectional overfeed extension grates H. The fuel is advanced by the variable-stroke pusher X in each retort, actuated in the form shown in Figure 1 by means of links X′ detachably and adjustably connected to the fuel feeding rams E. The pushers X are stepped formation as shown and are each provided with a lug X^3 which extends through an opening X^4 in the bottom plate X^5 and to which one end of the link X′ is connected by the crosspin Y. The other end of each link X′ is connected to an extension X^6 which rests on a cross pin X^9 and slides between a pair of lugs X^2 attached to the ram E, said lugs X^2 passing through a slot X^7 in the ram cylinder X^8. During the movement of the ram X the lugs X^2, X^2, alternately strike pins X^{10} projecting from the extension X^6. An additional opening X^{11} is provided in the extension X^6 so that by removing one of the pins X^{10} and inserting it in the opening X^{11} the travel of the pusher X can be decreased. The fuel on leaving the lower end of the retorts flows over the transverse portion of the extension grates whereon the final stage of combustion is completed, the ash and clinker being continuously and automatically discharged from the stationary ash-support bars, I, through an opening preferably regulated by curved plates M, M, adapted to be adjusted or actuated as and when desired.

All air required for combustion of the fuel is supplied under pressure from a fan J having a primary damper J′ into the main air chamber K located beneath the inclined underfeed retorts; the great bulk of the air is thus forced at full pressure through the lateral tuyère openings D′ across the retorts, viz., into the thickest part of the fuel bed, for primary underfeed

combustion. A proportion of the air, controlled by a secondary air damper L, is admitted as usual into the reduced-pressure air-chamber K′, from which, as aforesaid, air at reduced pressure is supplied to the overfed grates, viz, both to the longitudinal grate bars G and also to the sectional extension grates H; so that low-pressure air, suitable for the intermediate and final stages of combustion, is emitted under the relatively thin parts of the fuel bed, through the grate openings G′ and H′ respectively.

In the two embodiments of the invention shown at Figures 1 to 9 the inclined retorts C, C, are stationary and are usually composed of three plates bolted together, but they may be solid castings, thus obviating the leakage of fine unburnt coal that occurs in retorts which have moving walls, and in the examples shown at these figures the underfeed tuyères D, D, are also stationary, for a similar reason, and they are preferably bolted in stepped rows as shown to the stationary retort-walls.

In all three embodiments of the invention above described a novel method is provided of promoting an intermediate stage of combustion of partly-burnt fuel at the outer lines of the tuyères by using box-shaped overfeed grate-bars supplied with air at reduced pressure, and capable of being reciprocated. After such intermediate overfeed combustion on the longitudinal grate-bars at the outer sides of the tuyères, the fuel arrives at the transverse portion of the extension grates, in a more advanced stage of combustion than hitherto; while the final stage of combustion on the transverse portion of the extension grates is effected as usual with air at reduced pressure.

Any suitable form of ash-supporting bars or plates may be used in lieu of the ash support I or plate M and any suitable means may be employed for adjusting the width of the ash-discharge opening, while if desired an ash-crushing appliance may be employed for crushing the ash as it is discharged.

In the embodiment of the invention shown at Figures 1 to 5 both the side walls C′, C′, of each retort and also the tuyères D, D, (as aforesaid) are stationary and the grate-bars G are adapted to be reciprocated longitudinally in pairs on shoes H^2 having stepped sides H^3 on which the plates H^4 constituting the extension grates H are mounted, the requisite reciprocating movement being imparted thereto by means of push rods e, e attached at one end to lugs e^* on the grate-bars G. The ends of the links e, e are reduced in diameter and slide freely through openings in cross bars e', e' attached to the fuel feeding ram E. Mounted on the said reduced portions are nuts e'^*, e'^* adapted to be struck alternately by the cross bars e', e'. By adjusting the position of the nuts e'^*, e'^* on the cross bars e', e' the travel of the grate bars G, G can be made less by any desired amount than the travel of the ram E. In the embodiment of the invention shown at Figures 6, 7, 8 and 9, the grate-bars G, as also the extension grates H, and the pusher X are adapted to be reciprocated by means of links e^2 e^3 and e^4 adjustably and detachably connected to pivoted members e^6, which in turn are coupled to and adapted to be actuated by arms e^5 from the connecting rods F′ and operated by the crank shaft F. Pivotally connected to the arm e^5 is one end of a lever e^6 which carriers a number of pins e^7, e^7 on which the outer ends of the links e^2, e^3 and e^4 rest, the other arm of the lever e^6 being pivotally connected to a link e^8 pivotally attached to the front plate e^9 of the furnace. Each of the links e^2, e^3 and e^4 carries pins e^{10} which are adapted to be struck alternately by the lever e^6. Additional openings e^{11} are provided in the links e^2, e^3 and e^4 so that the position of the pins e^{10} can be altered and the travel of the links e^2, e^3, e^4 thereby varied. The inner end of the link e^3 is connected to a cross bar e^{12} on the extension grate H, and the inner end of the link e^4 is attached to a lug on the stepped pusher X. The inner end of the link e^2 is connected to a depending link e^{13} on the floor plate of the furnace. The links e^2, e^3, e^4 are connected to their respective supports by the cross pins Y′ e^{12} and e^{14}, respectively, as shown. Extending transversely of the furnace is a plurality of shafts e^{14} the ends of which are attached by means of links e^{15} to lugs e^{16} on the grate bars G. Owing to this arrangement and by attaching or detaching one or more links e^2 and e^3 and e^4 from the pivoted members e^6 the grate-bars G, the pusher X or the extension grates H can either be actuated in unison with, or independently of each other as desired.

In the embodiment shown at Figures 10 and 11, the side walls of the retorts as also the tuyères carried thereby are movable and are coupled with an adjustable motion to the crank-shaft F, connecting rod F′, and ram E, through the intermediary of push rods 18 coupled to cross-bars e'. The grate-bars are adapted, as in the arrangement shown in Figures 6, 7 and 8, to be actuated by the connecting rods F′ through arms e^5 and the pivoted members e^6 which are operatively associated with links e^2, e^3, e^4 and e^8. In this embodiment of the invention a variable stroke pusher X is also shown located within each retort; but this may be dispensed with if desired. The extension grates H are mounted upon a shoe k' which is adapted to slide upon a fixed plate k^2 and the side walls D^2 of the retort are connected to the sliding shoe k' by means of a pin k^3.

Owing to this arrangement the extension grates are adapted to be actuated in unison with the side walls of the retorts and with the tuyères.

By reciprocating the sectional transverse extension grates H, with or without reciprocating the longitudinal overfeed grate-bars G, the partly-burnt fuel and refuse is agitated sufficiently to break up clinkers and to separate combustible matter from the ash.

All the advantages of stationary retort-walls and stationary tuyères are thus combined with continuous but adjustable feeding motions for the fuel and ash, and for positive and controlled slicing actions for the various parts of the entire fuel bed, together with the novel provision for effecting an intermediate stage of overfeed combustion at the outer sides of the tuyères of each retort-unit.

The reciprocation of the overfeed grate bars, as well as of the fuel pushers and of the extension grates, assures shearing or slicing lines at all points where clinkers tend to form. By suitably regulating these motions, the accumulation of masses of clinker can be prevented in any part of the furnace, and thereby the destructive reverberatory action of the flames under large clinkers (such as often occurs in stokers not provided with such means for slicing action,) is prevented, and continuous mechanical operation is assured, irrespective of the size of the stoker and furnace.

What I claim and desire to secure by Letters Patent of the United States is:—

1. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts, means for admitting forced draught air into the fuel through said tuyères as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal grate bars located parallel to the retorts, means for introducing a supplementary supply of air into the partly burnt fuel through said longitudinal grate bars so that an intermediate stage is introduced into the combustion process and means for controlling the pressure of the air supplied through said longitudinal grate bars.

2. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts, means for admitting forced draught air into the fuel through said tuyères as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal grate bars located parallel to the retorts, means for introducing a supplementary supply of air into the partly burnt fuel through said longitudinal grate bars so that an intermediate stage is introduced into the combustion process, means for controlling the pressure of the air supplied through said longitudinal grate bars and means for reciprocating said longitudinal overfeed grate bars so as to slice the thinner portions of the fuel bed as and when desired.

3. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts, means for admitting forced draught air into the fuel through said tuyères as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal box shaped and stepped grate bars located parallel to the retorts, means for introducing a supplementary supply of air under control into the partly burnt fuel through said longitudinal grate bars so that an intermediate stage is introduced into the combustion process, and means for reciprocating said longitudinal grate bars so as to slice the thinner portions of the fuel bed as and when desired.

4. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts for the admission of forced draught air into the fuel as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal box-shaped and stepped grate bars located parallel to the retorts, means for introducing a supplementary supply of air into the partly burnt fuel through said longitudinal grate bars so that an intermediate stage is introduced into the combustion process and through said extension grates for final combustion of the fuel thereon, means for controlling the pressure of the air supplied through said longitudinal grate bars and through said extension grates, and means for reciprocating said extension grates.

5. An underfeed mechanical stoker comprising fixed troughs or retorts, means for feeding fuel into said troughs or retorts, fixed tuyères at the sides of said troughs or retorts for the admission of forced draught air into the fuel as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal grate bars located parallel to the retorts, means for introducing a supplementary supply of air into the partly burnt fuel through said

longitudinal grate bars so that an intermediate stage is introduced into the combustion process and through said extension grates for final combustion of the fuel thereon, means for reciprocating said longitudinal overfeed grate bars so as to slice the thinner portions of the fuel bed as and when desired, and means for reciprocating said extension grates.

6. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts for the admission of forced draught air into the fuel as it rises from the retorts and spreads over the tops of the tuyères, fuel feeding pushers within said troughs or retorts, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal overfeed grate bars located parallel to the retorts, means for introducing a supplementary supply of air into the partly burnt fuel through said longitudinal overfeed grate bars so that an intermediate stage is introduced into the combustion process and through said extension grates for final combustion of the fuel thereon, means for reciprocating said longitudinal overfeed grate bars so as to slice the thinner portions of the fuel bed as and when desired, and means for reciprocating said transverse extension grates.

7. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts for the admission of forced draught air into the fuel as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal grate bars located parallel to the retorts, means for introducing a supplementary supply of air into the partly burnt fuel through said longitudinal grate bars so that an intermediate stage is introduced into the combustion process, and through said extension grates for final combustion of the fuel thereon, means for imparting variable stroke reciprocating motions to said longitudinal overfeed grate bars, and means for imparting variable stroke reciprocating motions to said extension grates whereby a slicing action may be imparted as desired to the thin parts of the fuel bed between adjacent units of the stokers, and to the fuel bed over the extension grates.

8. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts for the admission of forced draught air into the fuel as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stages of combustion are completed, longitudinal grate bars located parallel to the retorts, means for introducing a supplementary supply of air into the partly burnt fuel through said longitudinal grate bars so that an intermediate stage is introduced into the combustion process, and through said extension grates for final combustion of the fuel thereon, fuel feeding pushers located within said retorts, means for imparting variable stroke reciprocating motions to said pushers, means for imparting variable stroke reciprocating motions to said longitudinal overfeed grate bars and means for imparting variable stroke reciprocating motions to said extension grates, whereby a slicing action may be imparted as desired to the parts of the fuel bed between adjacent units of the stokers, to the thick parts of the fuel bed over the centre of the retorts, and to the fuel bed over the extension grates.

9. An underfeed mechanical stoker comprising troughs or retorts, means for feeding fuel into said troughs or retorts, tuyères at the sides of said troughs or retorts for the admission of forced draught air into the fuel as it rises from the retorts and spreads over the tops of the tuyères, extension grates at the rear ends of the retorts on which the final stage of combustion is completed, longitudinal box shaped and stepped grate bars located parallel to the retorts, means for introducing a supplementary supply of air under control and at low pressure into the partly burnt fuel through said longitudinal grate bars so that an intermediate stage is introduced into the combustion process, and through said extension grates for final combustion of the fuel thereon, fuel feeding pushers located within said retorts, means for imparting variable stroke reciprocating motions to said pushers, means for imparting variable stroke reciprocating motions to said longitudinal grate bars and means for imparting variable stroke reciprocating motions to said extension grates, whereby a slicing action may be imparted as desired to the parts of the fuel bed between adjacent units of the stokers, to the thick parts of the fuel bed over the centre of the retorts, and to the fuel bed over the extension grates.

10. An underfeed mechanical stoker comprising underfeed longitudinal retorts, tuyères at the sides of said retorts for the admission of full pressure air, extension grates on which the final stage of combustion is effected, longitudinal overfeed grates located parallel to the retorts, a low pressure air chamber, and means for controlling the admission of air to said air chamber so as to distribute low pressure air from said air chamber to said extension grates and to said overfeed grates respectively.

CHARLES ERITH.