Jan. 13, 1931. W. C. DRAKE ET AL 1,789,223

STOKER FURNACE

Filed Sept. 26, 1921 4 Sheets-Sheet 1

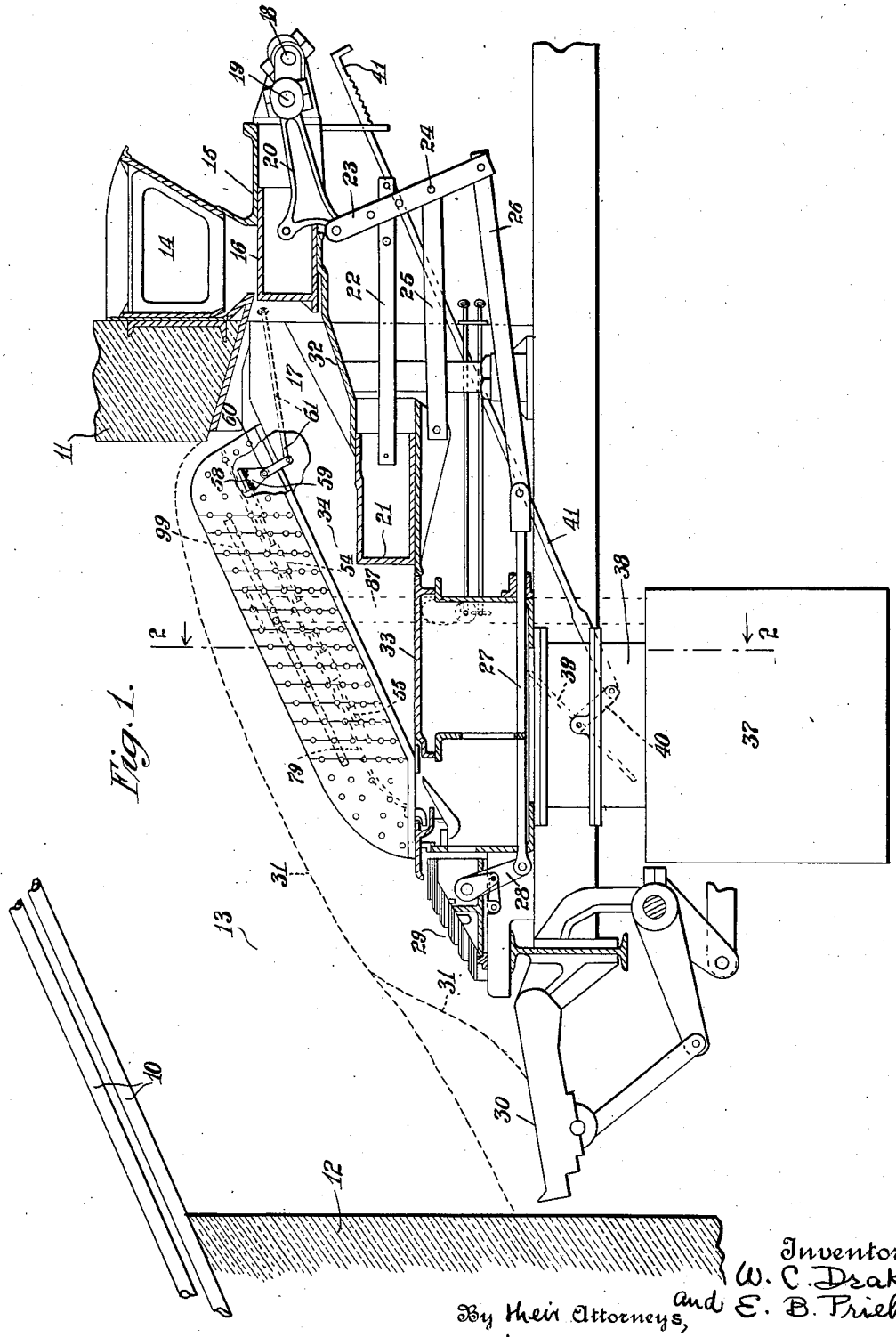


Fig. 1.

Inventors:
W. C. Drake,
and E. B. Priebe,
By their Attorneys,
Rogers, Kennedy & Campbell.

Jan. 13, 1931. W. C. DRAKE ET AL 1,789,223

STOKER FURNACE

Filed Sept. 26, 1921 4 Sheets-Sheet 2

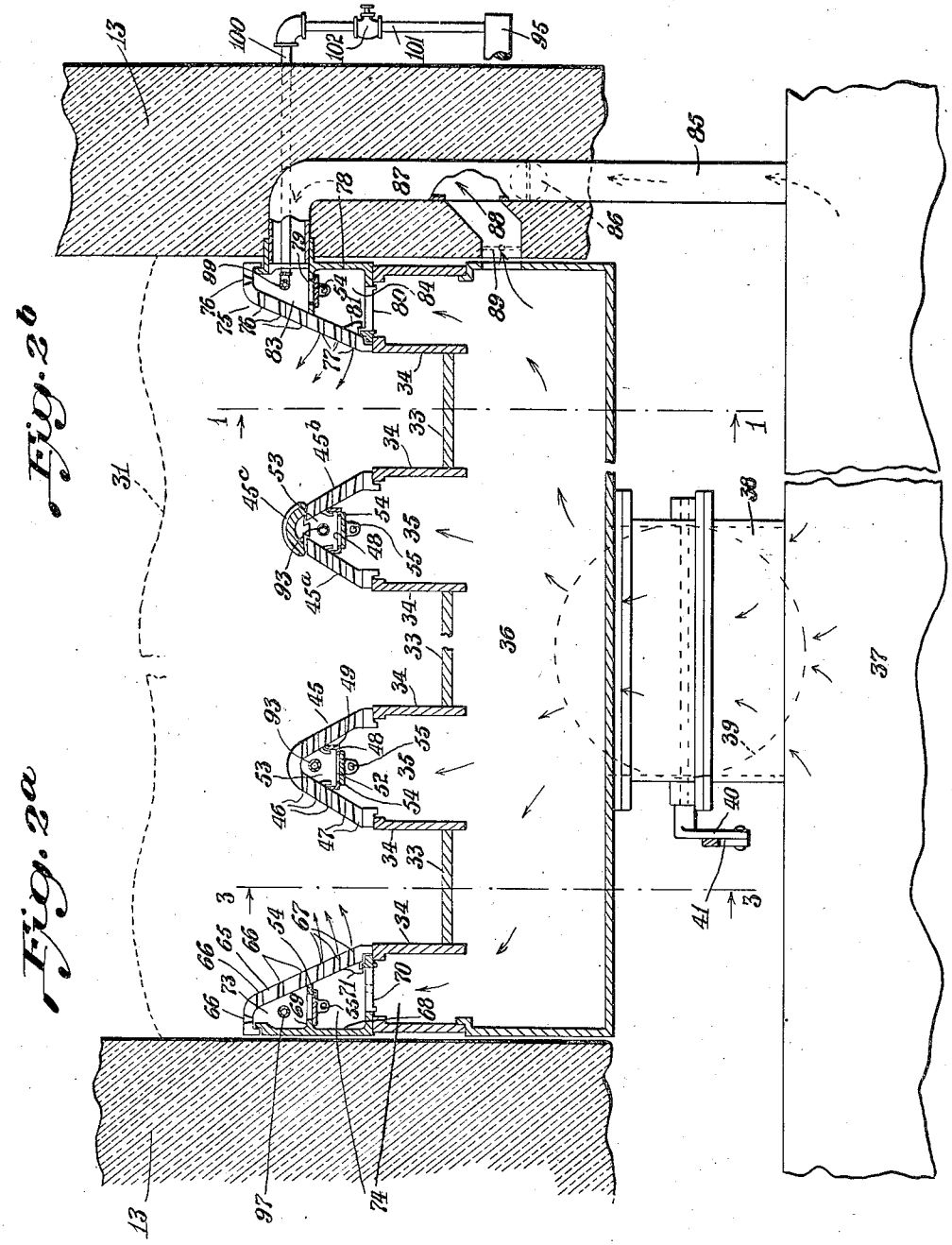


Fig. 2a

Fig. 2b

Inventors:
W. C. Drake and E. B. Priebe,
By their Attorneys,
Rogers, Kennedy & Campbell.

Jan. 13, 1931. W. C. DRAKE ET AL 1,789,223

STOKER FURNACE

Filed Sept. 26, 1921 4 Sheets-Sheet 3

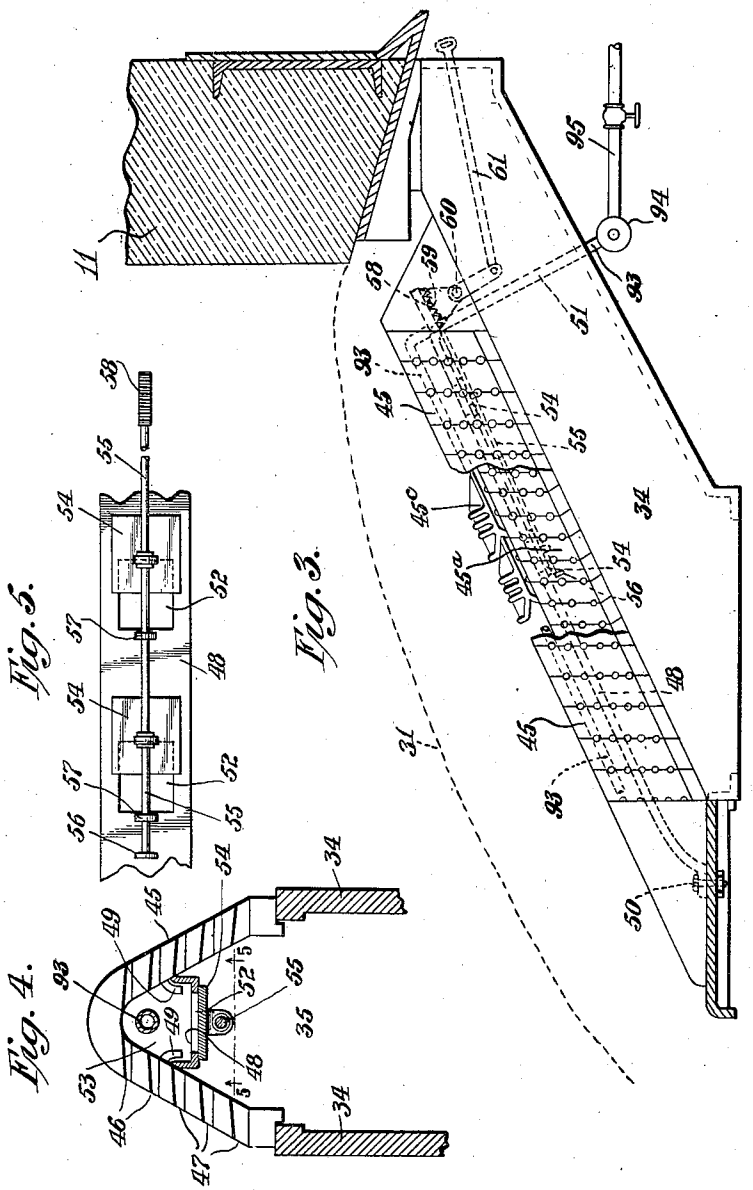


Fig. 3.

Fig. 5.

Fig. 4.

Inventors:
W. C. Drake, and E. B. Priebe,
By their Attorneys,
Rogers, Kennedy & Campbell.

Jan. 13, 1931. W. C. DRAKE ET AL 1,789,223

STOKER FURNACE

Filed Sept. 26, 1921 4 Sheets-Sheet 4

Fig. 6.

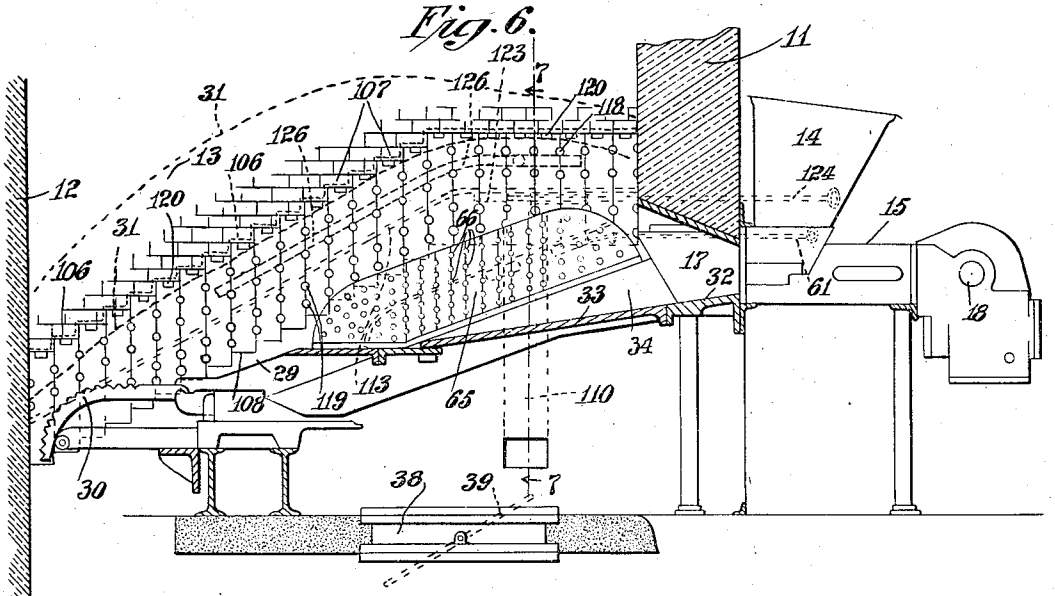


Fig. 7.

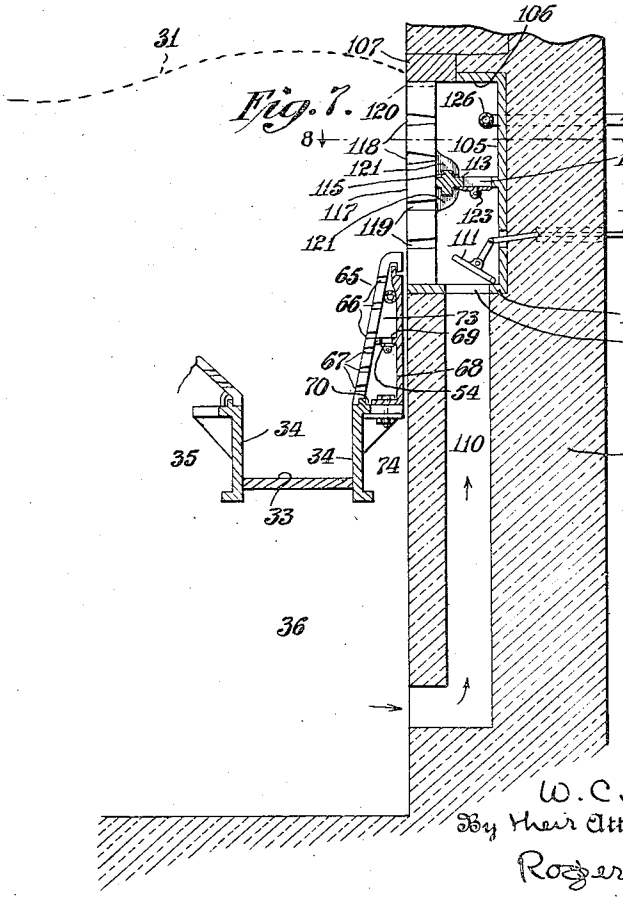
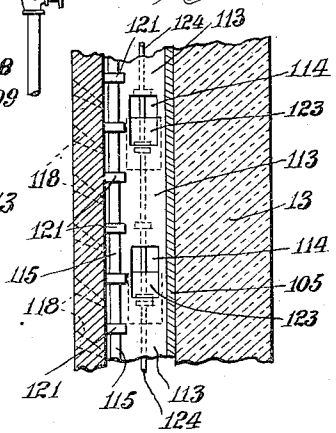


Fig. 8.



Inventors:
W. C. Drake, and E. B. Priebe,
By their Attorneys.
Rogers, Kennedy & Campbell.

Patented Jan. 13, 1931 1,789,223

UNITED STATES PATENT OFFICE

WARREN C. DRAKE AND ERNEST B. PRIEBE, OF INWOOD, NEW YORK, ASSIGNORS TO FURNACE ENGINEERING COMPANY, INC., OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

STOKER FURNACE

Application filed September 26, 1921. Serial No. 503,334.

This invention is an improved fuel burning furnace and relates to furnaces of various types, more especially to the modern coal burning, forced draft, progressive feed furnace, such for example as a boiler furnace supplied with fuel by an automatic stoking mechanism of the retort type, although the several features of invention herein can in many cases be employed in other types and kinds of furnaces.

The main object of the present invention is the general improvement in efficiency, ease of operation and durability in furnaces. A particular object is the minimizing of a certain prevalent difficulty, namely, the deposition of ferrous oxide, and formation of slag therefrom, on various parts of the furnace or boiler including the tubes of a tubular boiler. Another object is to secure the better distribution through the fuel bed of the fluid of combustion, air or steam, by an improved twyer system and control. Another object is to enable the direct introduction of steam into the body of the fuel bed for the improvement, in various respects, of the operation of the furnace; or a combination of steam and air. Another object is to afford differential control in the admission of fluid of combustion, air or steam or both, at various particular parts of the fuel bed. Another object is to minimize or prevent the formation of clinkers at the walls of the furnace. Other objects and advantages of the present invention will appear in the hereinafter following description of one or more embodiments thereof or will be apparent to those skilled in the art.

To the attainment of the above mentioned objects and advantages the present invention consists in the various novel features of, apparatus, mechanism, combination, arrangement or detail herein described or illustrated.

Fig. 1 is an interior side elevation of a furnace and stoker mechanism embodying the present invention, taken partly in section on the plane 1—1 of Fig. 2; the invention being shown applied to a furnace having a stoker of the retort type, with stationary retorts, and pushers working on the retort bottoms, such for example as the well known Taylor stoker, or the similar Westinghouse stoker.

Figs. 2ª and 2ᵇ are transverse sections looking rearwardly, taken on the plane 2—2 of Fig. 1, and together showing three retorts between four twyer boxes, although the number could be changed; the two figures showing different embodiments.

Fig. 3 is a partial side elevation and section, similar to Fig. 1, but taken on the plane 3—3 of Fig. 2ª, and partly broken away to show parts beyond.

Fig. 4 is an enlarged sectional view of one of the twyer constructions, shown in the same view as in Fig. 2ª.

Fig. 5 is a bottom view of certain parts in Fig. 4.

Certain features of the present improvement may be embodied in other types of furnace and stoker, for example in a furnace having the well known Riley type of stoker in which the retorts have stationary bottom walls, but side walls which are reciprocated bodily with the twyer boxes.

Fig. 6 is a view similar to Fig. 1 but showing features of the present invention embodied in the Riley type of stoker.

Fig. 7 is a transverse section taken on the plane 7—7 of Fig. 6.

Fig. 8 is a horizontal section on the plane 8—8 of Fig. 7.

As will be seen, certain of the features of the present invention, especially pertaining to features of method and to the structure of the furnace side walls, or the twyers adjacent thereto, may be used on other types of progressive-feed furnace, for example a furnace with a traveling or chain grate, or a combination of underfeed stoker with chain grate.

Describing first the details of structure of the illustrated embodiments of this invention, the furnace is shown as a boiler furnace, boiler tubes 10 being indicated, and the combustion chamber being shown bounded between front wall 11, bridge wall 12 and opposite side walls 13. The usual fuel hopper 14 is shown at the front, and delivers coal into a ram casing 15, in which a ram 16 is reciprocated to force the fuel through the throat 17 into the retorts of the furnace. There may be

several throats and rams, the rams all being operated by a common crank shaft 18. For each ram there is a crank or pin 19 connected by a pitman 20 with the ram. At a point further down and inward is shown a secondary ram 21 operated by a connecting rod 22 which is moved backwardly and forwardly from a lever 23 fulcrumed at 24 and oscillated by the connecting rod 20. The fulcrum 24 is at the forward end of a bar 25 to give a floating action. From the lower end of the lever 23 extends a connecting rod 26, which in turn reciprocates a slide rod 27, which actuates a rock lever 28 in a usual manner, to reciprocate a so-called extension grate 29 located at the rear of the main grate and retorts, and between them and the usual dumping grate 30.

In all the figures the outline of the fuel bed is indicated by the broken line 31, this in some cases indicating two positions where the bed materially varies during operations.

The fuel forced into the furnace by the ram passes first over the bottom plate 32 of the throat, and thence over the secondary ram 21, and thence over the bottom plate 33 of the retort, and thence out of the retort upon the extension grate 29 and to the dumping grate 30.

Each retort is formed by its bottom wall 33 and its opposite side walls 34. On top of each adjacent pair of side walls is a twyer construction which will be later described. This, with the side walls beneath it form what may be termed a twyer box 35, it being hollow and serving to conduct air to the twyer openings. The several twyer boxes communicate directly with the wind box 36 which extends entirely across the width of the furnace. Beneath the wind box is a large air duct 37 from which the various parts of the stoker obtain their air supply. Thus from the main air duct 37 is shown a large upward pipe 38 leading to the wind box and containing a damper 39 which may be turned to different positions to control the air flow. The damper has an operating arm 40 outside the pipe, and as shown in Fig. 1 a handle rod 41 at the front is accessible for regulating the same.

Four species of twyer construction are shown. The twyers 65 and 75 adjacent to the side walls are of greater height than the others and serve additional functions, taking part in the effective prevention of clinker formation and attachment at the side walls. These would be useful in any progressive-feed type of furnace, and other types. The intermediate twyers 45 and 45a are useful especially for the retort type of underfeed furnace, but the principles could be adapted to other uses.

Referring first to the twyer 45, this is shown as comprising a generally A-shaped structure, being built up of a number of castings of this shape, set upright and placed in face contact, as indicated in Fig. 3. Air apertures into the fuel bed are provided along the height of each twyer member. For reasons that will appear these apertures may be grouped into upper apertures 46 and lower apertures 47. They may be formed by means of registering grooves at the contacting vertical faces of the adjacent twyer members or bars, as shown.

It should be explained that the A-type of twyer member is shown in prior patent of E. B. Priebe, No. 1,360,250 of November 23, 1920. For this reason it is not necessary to explain in complete detail all the minor features of structure herein. Various features shown in the prior patent may be considered as available with the present invention. For example as appears in the prior patent the air orifices may be directed into the fuel in the retorts at an angle slanting rearwardly in the direction of fuel travel, and the apertures may be tapered and graduated in size. These remarks apply not only to the twyer 45 hereof but also the other forms of twyer.

An important feature of this invention is a novel air distribution and regulation, with differential pressures, as will be described. This is controllable, preferably at will, according to conditions in the furnace. Air is introduced into the fuel bed from the twyers at different heights or depths. My method is normally to provide greater pressure at the greater depth of fuel so as to give more complete air distribution and more perfect combustion. In some instances, however, an excess depth of fuel may form, perceived by the attendant, and my invention enables this to be eliminated by causing the burning down of the excess fuel by reversing the differential pressures, introducing air at greater pressure at the upper part of the twyers.

For the purpose of carrying out this method and structure each twyer is shown as having its interior space divided into upper and lower chambers or divisions, separately controllable. Thus the twyer 45 is shown as having a division plate 48 extending interiorly across its width and longitudinally throughout its length. This division plate or partition is shown in the form of a channel with its side flanges extending upwardly. Each of the opposite inclined sides of the twyer member has interior fingers 49 extending downwardly to hook over the channel 48 and give additional support to the twyer. The channel or division plate 48 is of course inclined rearwardly, as are the retort and twyer box, and its lower and upper ends may be secured by bolts 50 and 51.

This division wall 48 separates off the upper part of the twyer box 35, forming an upper chamber 53. It will be noticed that the upper series of apertures 46 emerge from the upper chamber while the lower series 47

give exit of air from the lower or main chamber 35.

To admit air to the upper chamber the division plate 48 is provided with a series of passages 52, and to regulate the flow a sliding damper 54 is provided at the under side of the plate. In this way the flow of air to the upper twyer apertures 46 may be relatively decreased so that the lower apertures will receive the greater pressure. This conduces to the efficiency of the furnace since the lower apertures, being at the greatest depth of fuel, require the greater pressure to force the air into the fuel. Therefore, a much more thorough and uniform distribution is secured. Air at a lower pressure will pass from the upper apertures into the fuel with comparative readiness. This differentiation of pressure according to position or depth of the apertures is an important feature of the present invention; also the damper control giving relative regulation is important, owing to the constantly changing conditions within the furnace.

The damper 54 is shown as consisting of a series of short damper members connected together by a rod 55. The rod has lugs 56 formed on it, affording stops to limit its movements in opposite directions. The underside of the division plate 48 has also a series of lugs 57. These extend downwardly and are perforated to receive the rod 55. The rod thereby slides through the lugs 57 and these lugs cooperate with the stop lugs 56. At its upper or forward end the damper 54 is shown provided with an operating rack 58, as seen in Fig. 3, engaged by a toothed segment 59 pivoted at 60 and operated by a handle rod 61 accessible from the exterior to shift the damper and thus control the relative air pressure and flow in the upper and lower chambers respectively of the twyer box.

This described differential regulation of pressure according to depth involves a greater pressure at the greater depth, but later will be described how a greater pressure at a greater height will be obtained at a given part of the furnace for breaking down a temporary excessive depth of fuel.

The second of the intermediate twyers as seen in Fig. 2^b is substantially the same as the twyers 45 excepting that the two sloping side portions are shown as separate castings 45^a and 45^b, with an interlocking cap plate 45^c, or rather a series of them, as shown in the middle part of Fig. 3, and generally like those shown in said prior Patent No. 1,360,250.

At the two side walls are shown special twyer constructions, with air directed inwardly and upwardly into the fuel bed, and interior division into upper and lower chambers. These constructions not only give the advantages already mentioned, but give substantial improvement in minimizing clinker formation at the side walls. The admission of air or steam at the side walls not merely improves combustion so as to minimize clinkers, but gives ample air flow along the side walls, protecting them from the tendency to fuse and unite with clinkers. For such purposes the construction herein shown is decidedly superior to that shown in the prior patent.

Two forms of side wall twyers are shown in Fig. 2, and that at the right is also seen in Fig. 1. Each of the side wall twyers is shown as of considerably greater height than the intermediate twyers. They may be formed of cast iron, as are the others, and may be set directly alongside the refractory wall 13 or in some cases may be partly or wholly inset or built into the wall. The cast iron is amply protected by the flow of air, and as stated the result of the action is the protection of the refractory walls at points above the twyer upward to the top level of the fuel bed.

The side wall twyer 65 at the left is shown as having upper groups of apertures 66 and lower groups 67 directed effectively into the fuel bed. With its inclined shape and integral top portion the twyer 65 may be described as similar to one half of the twyer 45. The twyer 65 is shown as resting upon an L-shaped casting 68 which in turn rests upon the vertical walls 34 beneath. At an intermediate point is a horizontal partition or division wall or flange 69 extending from the casting 68. The lower flange or bottom part 70 of the casting is of open construction so that the space directly above it freely communicates with and forms part of the space below. The twyer member has hooks or fingers 71 engaging in the openings of the lower flange 70 so as to properly position the parts.

The division wall 69 divides the interior space of twyer 65 into an upper chamber 73 and a lower chamber 74, which latter includes the space above the open flange or wall 70. Associated with the partition wall 69 is a damper 54 for regulating the pressure and relative flow of air in the upper and lower chambers. This for convenience is shown as the same in structure and operation as the damper 54 already described in connection with the twyer 45.

The side wall twyer 75 shown at the right side of Fig. 2^b is in some respects similar to the twyer 65 at the left. It shows the similar series of upper apertures 76 and lower apertures 77. The twyer member also rests upon an L-shaped casting 78. This casting has a horizontal flange 79 which may serve as a partition wall, and a lower flange 80 of open construction, engaged by fingers 81 formed on the twyer member. By this construction the interior space is divided into an upper

chamber 83 and a lower chamber 84. In this embodiment is shown a separate means of conducting air from a point below the lower chamber to the upper chamber, and therefore it would be unnecessary to provide openings and a damper 54 at the division wall 79; but as in some cases this may be of additional advantage we have shown such a damper 54, together with the elements 55 to 61 for operating it, similar to the connection for operating the dampers 54.

There will now be described the preferred means of producing an excess of air pressure and flow at the upper part of the twyers. This additional air of combustion introduced at the proper point will tend to burn down any excess depth of fuel, as explained. This condition is met herein by closing the twyer division wall and providing air of greater pressure in the upper twyer chamber than at the lower chamber.

Thus for the twyer 75 at the right of Fig. 2^b is shown an air passage 85, of ample dimension, leading from the main air duct 37 directly through the furnace side wall and into the upper twyer chamber 83. As this, however, may be of only temporary service we have shown a damper 86 in the passage 85. The passage above the damper is indicated by the numeral 87. Ordinarily it may be sufficient to pass air from the wind box 36 through a short passage 88 directly into the passage 87 and thereby to the upper twyer chamber. A damper 89 is shown in the passage 88 for cutting off this passage when the air at greater pressure is introduced directly from the air duct 37.

A similar provision of high pressure air to the various other twyer members may be made, so that the entire area of the fuel bed is thus controllable. The pipes 93 and 97 hereafter mentioned may be used for this purpose.

Another part of this invention is the direct introduction of steam into the bed of burning fuel. A proper quantity of steam so introduced assists the combustion, but moreover tends to decompose certain products which otherwise are carried with the furnace gases and deposit themselves on walls, boiler tubes, etc. The introduction of the steam eliminates the deposits or renders them friable and easily or automatically removable. Ferrous oxide is believed to be one of the worst sources of trouble, especially in its forming of a slag upon the boiler tubes, to the great detriment of efficiency; and this invention breaks down this substance by the decomposing action of the steam introduced into the burning fuel.

According to this invention the steam in vaporous condition is introduced into the twyer boxes, preferably by steam conduits leading directly into the interiors of the upper twyer chambers 53, 73 and 83, from which it permeates into the burning fuel. This is done without discontinuing the usual supply of air of combustion; the steam being supplemental to the air, yet independent of the air as to pressure, and separately controllable.

Thus, in the two intermediate twyer members shown in Figs. 2^a and 2^b are indicated steam pipes 93 within the upper chambers 53. Each pipe may have a number of distributing apertures to pass the steam into the chamber along its length. Each steam pipe may be bent downwardly at its upper end as indicated in Fig. 3, so that this element may be utilized as the upper holding bolt 51. The extremity of this pipe may be connected by a header 94 with a main steam feed pipe 95. The steam and air supply therefore are independent, but each of course is fully regulable by means of the usual steam valves and air dampers.

In the side wall twyer box 73 is shown a similar steam pipe 97. The steam admitted at this point serves not merely for the purpose mentioned but also to promote combustion adjacent to the side wall, thus tending to minimize clinker difficulties.

With the other illustrated side wall twyer 83 the steam pipe 99 is shown as supplied by horizontal pipe 100 and a vertical extension 101 controlled by a valve 102, these supplied from the main steam feed pipe 95.

A moderate quantity and pressure of steam will serve the purposes hereof, and practice will determine the best regulation for any given conditions.

In Figs. 6, 7 and 8 are shown features of the present invention applied to the Riley type of stoker. The underfeed mechanism may be similar to the other figures. The retort bottom plate 33, however, is stationary in the Riley stoker while the retort side walls 34 reciprocate, and the extension grate 29 is connected to reciprocate with the retort walls and the twyer constructions overlying the same. The space 35 beneath the twyers is directly connected with the wind box 36 as before and the latter is supplied through an upward pipe 38 controlled by damper 39.

The side wall twyer 65 is similar to that at the left of Fig. 2^a having the upper and lower series of apertures and the upper chamber 53 formed by the division wall 69 and the lower chamber 74 connected with the wind box. Also associated with the partition wall is the sliding damper 54 operable by the exterior handle rod 61 to control the relative air pressures within the upper and lower chambers.

For use in connection with any of the described side wall twyers, or in some cases in lieu of them, we have provided air supplying structures or twyer boxes embodied or inset directly in the side walls. For example, in Figs. 6 and 7 we have shown the side wall 13 provided with an air supplying

structure at a height slightly above that of the side wall twyer 65. This might be constructed of refractory material but is herein shown as formed of cast iron. It serves to admit air or steam or a combination of air and steam directly into the fuel at the side wall for promoting combustion and minimizing clinker difficulties, and as stated it may be used in conjunction with a twyer located within the furnace directly adjacent to the side wall, as shown in Figs. 6 and 7. It is believed to be new to use in combination a twyer construction alongside a wall and another within or forming part of the wall.

This part of the invention may be embodied in the side wall by means of an elongated inclined cast iron air box 105 which in cross section is shown as somewhat of the shape of the letter E. The upper flange 106 is of stepped formation, having alternate short horizontal and vertical portions as seen in Fig. 6, so as conveniently to combine with the refractory bricks or tiles of which the wall is composed. This top flange 106 is shown as not quite reaching the face of the wall, and it is shielded from the fuel bed by a series of protecting tiles or refractory bricks 107. The bottom flange 108 of the wall box may be of stepped form similarly to the top flange and at one or more points it has a large aperture 109 to receive air under pressure through a wall passage 110 controlled by damper 111 regulated by an exterior handle 112.

The middle flange 113 is not stepped but extends first horizontally and then downwardly at a slant and it has a series of openings 114 so as to admit air from the lower chamber to the upper chamber of the box. The inner extremity of the flange 113 is enlarged at 115 for the purpose of positioning and locking the upright twyer bars 117. These bars are stacked in face contact, and form the effective air supplying face of the furnace wall. Each of them is provided with an upper series of side grooves 118 and a lower series 119 affording tapered passages from the upper and lower chambers respectively, directly into the fuel bed. Also each bar may have a small groove 120 at its top. Each bar has a pair of interior fingers or hooks 121 engaging the enlargement 115 for the purpose of positioning and holding the twyer bars in position. The bars may be strung onto the middle flange 113 at its upper end and slid into position.

The side wall box 105 is of such shape as substantially to correspond with the fuel bed line 31 so that the air or steam or both are effectively introduced into the fuel at all points along the side walls from the front to the rear of the furnace.

In order to regulate the relative air pressure in the upper and lower chambers, a damper 123 is shown beneath the perforated flange 113, and this may be regulated by a handle 124.

It is practically of value, especially for the reasons already mentioned, to introduce steam into the fuel bed and for this purpose a longitudinal steam pipe 126 is shown within the side wall box, the same supplied by a pipe 127 leading through the wall and a vertical pipe 128 controlled by a valve 129.

It will thus be seen that a fuel burning apparatus has been described embodying the principles and attaining the objects of the present invention. Since many matters of construction, combination, arrangement, operation and detail may be modified without departing from the principles involved it is not intended to limit the invention to such features except so far as specified in the appended claims.

What is claimed is:

1. In a forced draft furnace having spaced apart twyer structures supporting the fuel bed, twyer apertures at different altitudes in a twyer structure, and means to cause a difference in pressure of air supplied to the apertures of greater and lesser altitude respectively.

2. In a forced draft furnace having spaced apart twyer structures supporting the fuel bed, the same having upper and lower apertures, and means to supply air to said apertures with the greater air pressure to the lower apertures.

3. A furnace as in claim 1 and wherein means are provided to relatively regulate the pressures during combustion.

4. In a multiple retort furnace having means for underfeeding coal into the retorts, and means for maintaining travel of the fuel bed, a series of twyer boxes forming retorts between them, each twyer box being divided into separate chambers, air supply means for one chamber in each twyer box and separate connections for supplying steam to another chamber in each twyer box, for injection into the fuel bed at distributed points throughout its width.

5. In a furnace the combination of the furnace wall, a twyer structure extending between the fuel bed and wall and admitting air to the fuel bed and an air injecting structure in the wall above the level of said twyer structure, with apertures leading directly into the fuel bed.

6. In a retort furnace a series of twyer boxes forming retorts between them, a division wall within a twyer box dividing it into upper and lower chambers, means to supply forced draft to the lower chamber, and a draft regulator between the chambers.

7. In a retort furnace a series of twyer boxes forming retorts between them, a division wall within a twyer box dividing it into upper and lower chambers, means to supply forced draft to the lower chamber,

and a separate means to supply fluid to the upper chamber.

8. In a furnace having twyer structures forming a retort between them, an air box supplying air to the structures, a partition separating a structure into upper and lower chambers, with twyer apertures both above and below the partition, at different depths beneath the fuel bed and an air passage to the upper chamber.

9. Furnace as in claim 8 and wherein are means for regulating at will the relative pressures of air to the upper and lower chambers.

10. In a retort furnace a series of twyer boxes forming retorts between them, a division wall within a twyer box dividing it into upper and lower chambers, means to supply forced draft to the lower chamber, and a separate means to supply steam to the upper chamber.

11. In a furnace having twyer boxes forming retorts between them, an arrangement with the extreme boxes closely adjacent the side walls and substantially higher than the intermediate boxes but not as high as the fuel bed top level, such side wall boxes having division walls separating their interiors into upper and lower chambers.

12. In a furnace having twyer boxes forming retorts between them, an arrangement with the extreme boxes closely adjacent the side walls and substantially higher than the intermediate boxes but not as high as the fuel bed top level, such side wall boxes having division walls separating their interiors into upper and lower chambers, and connections for supplying fluid at different pressures into the two chambers.

13. In a furnace having twyer boxes forming retorts between them, an arrangement with the extreme boxes closely adjacent the side walls and substantially higher than the intermediate boxes but not as high as the fuel bed top level, such side wall boxes having division walls separating their interiors into upper and lower chambers, and separate fluid connections to the two chambers.

14. In a furnace having twyer boxes forming retorts between them, an arrangement with the extreme boxes closely adjacent the side walls and substantially higher than the intermediate boxes but not as high as the fuel bed top level, such side wall boxes having division walls separating their interiors into upper and lower chambers, an air connection to the lower chamber, and a steam connection to the upper chamber.

15. In a forced draft furnace, the furnace side walls, and the grate between them, having parallel retorts, separated by twyer structures, and comprising a twyer structure extending upwardly and outwardly substantially to the wall, substantially higher than the other twyers, and a hollow metallic box in the side wall immediately above such twyer structure with apertures directed into the fuel bed, and means conducting fluid under pressure thereto, said side wall box having a fuel contacting face composed of a series of separate, narrow, upstanding metal bars assembled in mutual face contact, the said bars having transverse grooves at their contacting faces forming apertures directed into the fuel bed.

16. In a forced draft furnace, the furnace side walls, and the grate between them, comprising a twyer structure extending upwardly and outwardly substantially to the wall, and a hollow structure in the side wall above such twyer structure with apertures directed into the fuel bed, and means conducting fluid under pressure thereto; the twyer structure being an iron structure extending at a slant upwardly to a point substantially higher than the normal height of the grate and perforated to admit air to the fuel supported by it, and the hollow wall structure being an iron box set in the side wall between the twyer structure and the fuel bed top level.

17. In a forced draft furnace, the furnace side walls, and the grate between them, comprising a twyer structure extending upwardly and outwardly substantially to the wall, and a hollow structure in the side wall above such twyer structure with apertures directed into the fuel bed, and means conducting fluid under pressure thereto; the hollow side wall structure being built up of numerous upstanding bars assembled in face contact and secured together.

18. In a forced draft retort furnace, the furnace side walls, and the retort grate between them, the grate comprising a perforated twyer structure extending upwardly and outwardly from a retort substantially to a side wall, and said side wall embodying a hollow wall portion immediately above such twyer structure, the same composed of an assembled series of wall members and formed with numerous perforations for delivering fluid jets directed into the fuel bed, and means conducting fluid under pressure thereto and to such twyer structure.

19. In a stoker furnace, the furnace side walls, and the grate between them inclined toward the discharge, comprising a reciprocable twyer structure extending upwardly and outwardly to the side wall, and entering the clinkering zone, and the side wall embodying a hollow portion above such twyer structure built of a system of wall members assembled in mutual contact and with apertures directed into the fuel bed, and means conducting fluid under pressure thereto.

20. In a forced draft multiple retort progressive feed furnace having lateral walls, longitudinal twyers between the retorts, and means underfeeding coal into the front end of each retort, the combination of an extreme

twyer structure, the same extending slantingly from the adjacent retort upward to the side wall but terminating substantially below the top of the cool bed, and the side wall, the same formed with a wall section extending between the top of the extreme twyer structure and the top of the coal bed having air circulation passages to constitute it an air cooled wall section, for the prevention of clinkers on said wall, and means supplying air to said twyer structure and to said air cooled wall section.

21. In a forced draft furnace, the furnace side walls, and the grate between them, comprising a twyer structure extending upwardly and outwardly substantially to the wall, and a hollow structure in the side wall above such twyer structure with apertures directed into the fuel bed, and means conducting fluid under pressure thereto; the hollow side wall structure being built up of numerous upstanding bars assembled in face contact and secured together, said bars having face grooves forming the apertures into the fuel bed.

22. In a forced draft furnace, the furnace side walls, and the grate between them, comprising a twyer structure extending upwardly and outwardly substantially to the wall, and a hollow structure in side wall above such twyer structure with apertures directed into the fuel bed, means dividing the hollow structure into compartments, means conducting fluid under pressure to said hollow structure, and means affording different pressures in such compartments thereof.

23. In a forced draft furnace, the furnace side walls, and the grate between them, comprising a twyer structure extending upwardly and outwardly substantially to the wall, and a hollow structure in the side wall above such twyer structure with apertures directed into the fuel bed, means dividing the hollow structure into compartments and means conducting air to one compartment and steam to another.

24. In a multiple retort progressive feed furnace having means for underfeeding coal into the retorts, a plurality of spaced apart twyer structures between the retorts and supporting the fuel bed, said twyer structures each having interior air passages and a set of air apertures therefrom delivering air into the advancing fuel bed and having separate interior steam passages and a set of steam apertures therefrom for delivering steam into the advancing fuel bed, and separate regulable connections for supplying air and steam respectively to said passages to be delivered directly into the advancing fuel through such respective sets of twyer apertures at distributed points throughout the width of the fuel bed.

25. In a multiple retort furnace a system of twyer structures with fuel retorts between them, and air boxes beneath the twyer structures formed by the retort sides, there being an air box formed between the extreme retort and the furnace side wall, and the extreme twyer structure adjacent the side wall consisting of an integral L-shape frame member with its horizontal arm apertured and spanning and resting on the sides of the extreme air box, and its vertical arm arranged adjacent the side wall, separate twyer members extending upwardly and outwardly from the lower-inner to the upper-outer portion of such L-shape member and engaged over such upper-outer portion thereof, and enclosing an air space, a wall dividing such air space into upper and lower compartments, and damper means in such dividing wall for varying the air pressure in the upper compartment of such air space.

26. A progressive feed stoker furnace having in combination with its enclosing walls, a system of air boxes and twyer members forming retorts inclined downwardly from the front toward the rear, means for feeding coal at the front into the retorts and for maintaining progressive travel of the coal bed toward the rear, an air box between each extreme retort and the adjacent side wall and a twyer structure extending upwardly from such retort to such wall, the same slanted downwardly toward the furnace rear, all said twyer members and air boxes being located a substantial distance below the coal bed line; and each side wall embodying a hollow fluid-cooled clinker-preventing metallic wall structure built up of a system of wall members assembled in mutual contact, and said structure extending substantially from the top of the side wall twyer to the top of the coal bed and stepped downwardly to the rear with a trend substantially parallel to the slant of the retorts, and the stepped upper side of such structure having substantially horizontal supporting surfaces giving support to the side wall elements or bricks thereabove; and means for supplying cooling fluid for circulation through such hollow structure.

In testimony whereof, we have affixed our signatures hereto.

WARREN C. DRAKE,
ERNEST B. PRIEBE.