Dec. 20, 1932. A. L. GALUSHA 1,891,809

SELF CLEARING GRATE

Filed July 20, 1928 3 Sheets-Sheet 1

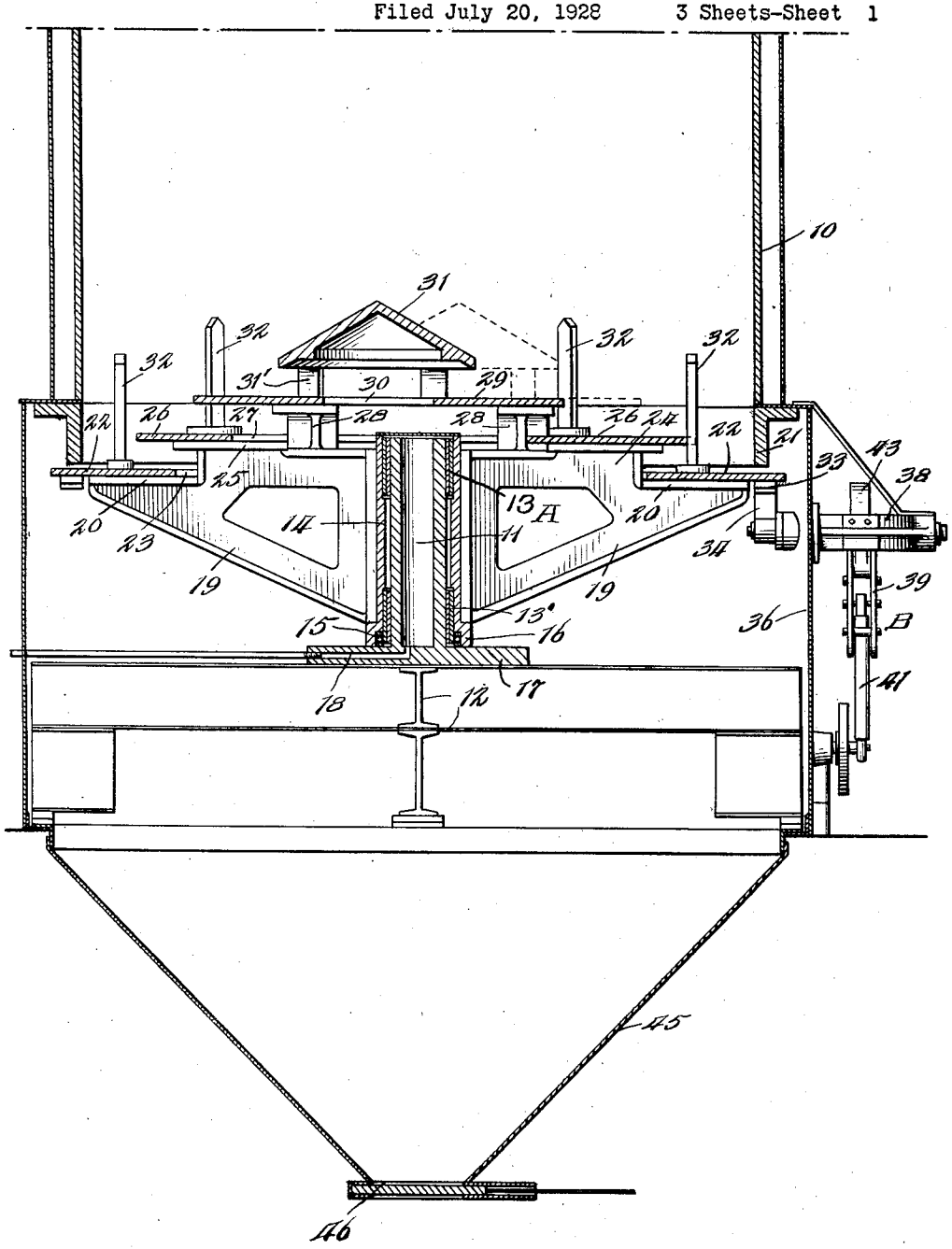


Fig. 1.

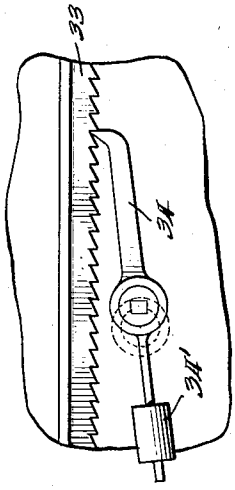
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Fig. 5.



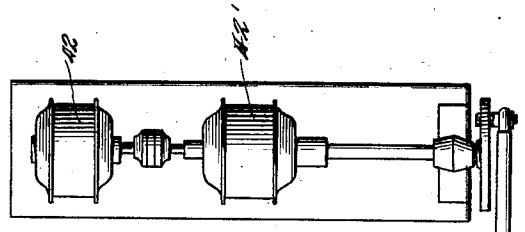
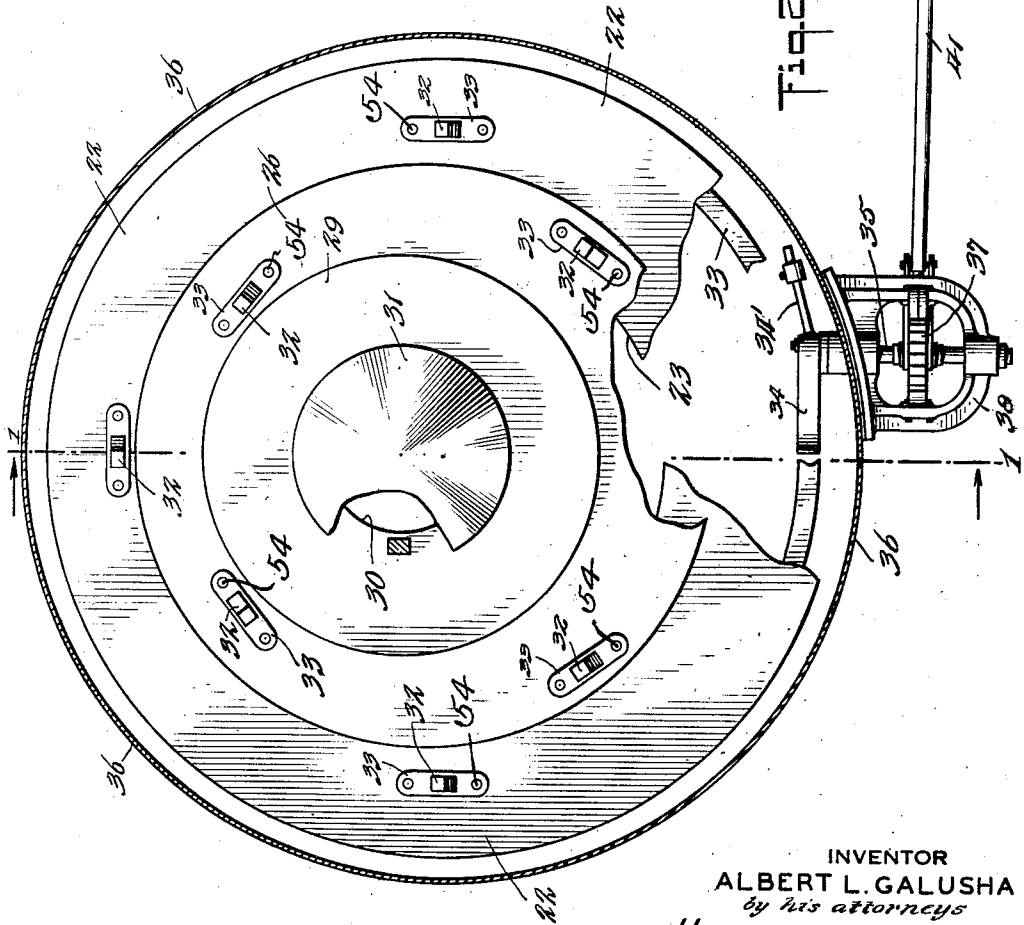


Fig. 2.



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Fig. 5.

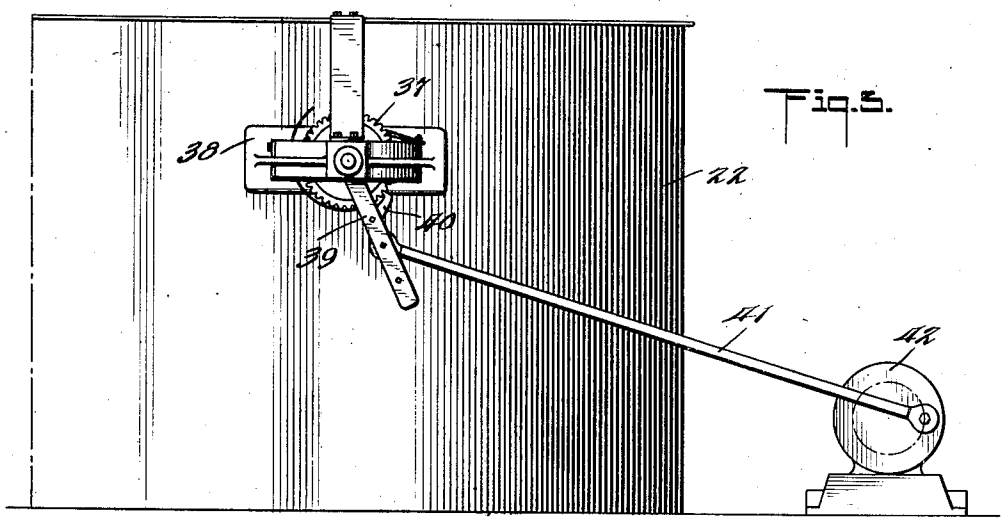
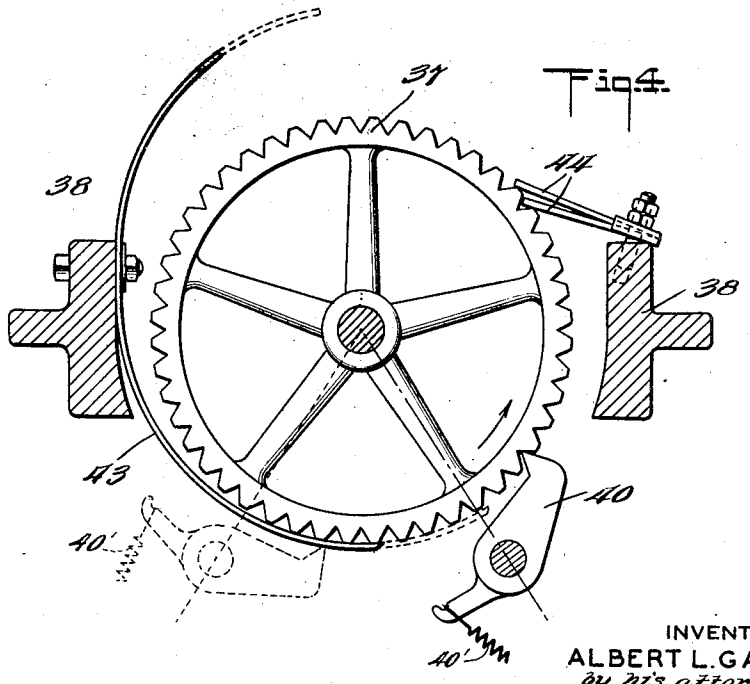


Fig. 4.



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UNITED STATES PATENT OFFICE

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SELF-CLEARING GRATE

Application filed July 20, 1928. Serial No. 294,132.

This invention relates generally to grates and particularly to a rotary stepped grate for use in a gas producer.

The objects of this invention are (1) to provide a grate which will maintain an even fire over the whole area of the grate; (2) to provide a grate which will make possible the economical use of inexpensive small size fuel; (3) to enable the removal of ash from a fire-bed centrally while maintaining uniformity of burning over the furnace area; (4) to make possible the maintenance of a deep ash bed and the delivery of high pressure gas; (5) to provide a grate which will be self clearing in that it will be capable of reducing clinkers to a size that may be discharged through the grate opening and at the same time, will discharge the ashes uniformly from a number of points over the whole grate area; and (6) it is an object to improve various details of construction in the grate drive mechanism, in the cooling and lubricating and in the mounting of the grate members.

A preferred embodiment of the invention is described specifically hereinafter and is illustrated in the accompanying drawings.

In the drawings—

Figure 1 is a view on a central vertical section on line 1—1 of Fig. 2 through the lower part of a gas producer furnace showing the grate and its drive mechanism;

Figure 2 is a top plan view of the grate and its drive mechanism with certain parts of the grate shown as being broken away;

Figure 3 is a view in elevation of the lower part of the furnace showing the drive mechanism for the grate;

Figure 4 is a detail of a portion of the grate drive mechanism;

Figure 5 is a detail view in elevation of the grate driving pawl and of a part of the rack on the grate.

The preferred embodiment of the invention is shown here in a circular gas producer having furnace walls 10 forming the fire box. The superstructure is not shown as it is not a part of the present invention. It may be of any suitable construction.

The grate, generally denoted as A, is mounted below the fire box on a hollow vertical post 11 which is supported on transverse steel beams 12 forming the sub-structure of the gas producer. The post is provided with upper and lower bushings, 13 and 13′ respectively, which afford a bearing for a cylindrical sleeve or hub 14 to which the grate members are attached. A thrust bearing 15 at the lower end supports the hub 14 and is shielded by the flanged end 16 of the hub which has a running clearance from the base flange 17 of the post 11. The base flange is drilled at 18 to permit introduction of lubricant or of cooling water. At the top, a cap or shield is secured to the sleeve 14 to prevent the entry of ashes into the interior of post 11 and into the bearings 13, 13′, 15.

The grate itself consists of radially extending brackets 19 secured to the rotatable hub 14 and grate members secured on the brackets. The hub preferably is hexagonal in exterior shape so that six brackets may be used. These brackets 19 carry a series of vertically spaced annular plates and a cap member which afford a base for the fire bed. Each bracket is stepped to provide at its periphery a horizontal ledge 20 at a level slightly lower than the bosh 21 which forms the lower rim of the fire-box wall.

The first plate 22 of the grate rests on the tier of horizontal ledges 20. This plate 22 is circular and of an over-all diameter slightly greater than that of the fire-box so that its periphery lies under and close to the bosh 21. The plate 22 is flat and has a circular central opening 23 eccentric of its periphery.

The riser portion 24 of the step on each bracket extends through the opening 23 and, somewhat above the level of plate 22, has a horizontal ledge 25 which extends radially beyond the riser portion 24. The second plate 26 of the grate rests on the several flats 25 which form a second tier spaced radially and axially from the tier of ledges 20. This plate is circular and the diameter of its periphery is such that it overlies the first plate 22. Its center is directly above the center of the circular opening 23 in the first plate 22 thus making the overlap the same at all points. This plate, like plate 22, has its in-

ner margin, which is also the margin of the central opening 27, eccentric of its periphery.

On each bracket, radially inward from the flat 25, is an upstanding spacer 28 having a flat upper surface. The several surfaces, so provided by the brackets, make up a third tier and support a third circular plate 29 whose periphery is concentric with the opening 27 in the plate 26 below it. This plate 29 is of such size as to overlap plate 26. It has a central opening 30 concentric with its periphery, this opening being capped by a cone 31 having a larger overall diameter than the opening 30 to provide a lap over the plate 29. Cone 31 is supported from plate 29 by lugs 31. The apex of the cone is directly above the center of plate 29 and opening 30. It is to be noted that although the central opening 30 is concentric of the periphery of the plate, it is eccentric of the grate axis and of the furnace wall.

It will be clear that the central aperture 30 of the third plate 29 could be eccentric of the periphery of that plate. In such case, the cone 31 would be eccentric of plate 29 since it should be concentric with the opening 30 to give a uniform overlap. The apex of cone 31 could be eccentric of its periphery or, if desired, other than a cone shaped cap member could be used. Some convex shape is to be preferred however as the convexity prevents the collection of ashes on its top surface. It is not necessary to provide the further eccentricity that would be created by the suggested change in the construction of plate 29. The construction as shown is preferred for furnaces of usual size, say in the neighborhood of six or eight feet in diameter.

It is likewise clear that plate 29 could be concentric with plate 26 and, if so, opening 30 would be concentric with the periphery of plate 29. This is possible since plate 29, even if concentric with plate 26, is eccentric of the furnace wall and so has a sliding movement with respect to the fire bed when the grate is rotated. Many other variations in the relations of the grate members are possible, all embodying the characteristic features of novelty disclosed in this specification. There is no intent to exclude others by mentioning some.

An important factor insuring uniform ash discharge and preventing loss of unburned fuel is the uniform lap of any one plate over the plate directly beneath it, this being attained by the concentricity of the periphery of each plate above the lowest with the opening in the plate next below. The eccentricity of all of the plate openings with respect to the furnace wall causes lateral movement of the ash discharge ports with respect to the bed of ashes, thus giving the effect of a horizontal oscillation of a grate member. The eccentricity of certain of the plate peripheries with respect to the furnace wall gives the effect of lateral movement of the plates themselves in addition to the rotary movement. This peripheral eccentricity also causes a slicing action by the plates on clinkers which drop down between the edges of the plates and the furnace wall. To aid in the clinker cutting or crushing, the bosh ring 21 is of rugged construction.

It will be noted that each plate is an annulus and that certain of the plates, such as 22 and 26, are annuli of varying width, increasing through 180° and decreasing at the same rate through the remaining 180°. This condition arises, of course, only when the margin of the central opening is eccentric of the periphery. As set forth above, that is not a necessary condition in all cases to obtaining the desired eccentricity of the inner margins with respect to the grate axis or to the furnace wall, but is merely one way of obtaining or of actuating that eccentricity.

The centers of the circles defining the peripheries of plates 22, 26 and 29 are in a vertical plane which is the plane of symmetry of the annular plates 22, 26 which have eccentric openings. This is best shown in Figure 2. The eccentricity of all the plates is in a single radial direction.

The amount of lap of one plate over the plate next below is determined from the best angle of flow of the ash in question. For use in a furnace burning small size fuel, a lap equal to one and one half of the vertical spacing between plates, giving a flow angle of less than 45°, is found to be satisfactory.

The vertical spacing between plates is determined from a consideration of the amount of ash to be discharged and of the amount of gas to be delivered. For a furnace eight feet in diameter, a space of from four to six inches between the two lower plates 22 and 26 is satisfactory. The spacing of the plate 29 above plate 26, and that of the cone 31 above plate 29 are the same and, due to their being nearer the center, give a smaller volumetric delivery of gas than is given by the space between the lower and larger plates 22 and 26. This is desirable since near the center the fuel bed is thinner and less gas is required.

The grate members, other than the cap member 31, are described here as plates and are illustrated as being preferably flat. The flat members are cheaper to construct than say a slightly dished plate and are very satisfactory in use. The word plate is used to cover any substantially flat grate member which serves the purpose of supporting the fuel bed and of allowing the ashes to move, between it and an adjacent similar member, toward the central discharge openings.

It will be understood that, although the grate here shown is rotated, the fire-bed being deep does not move with it. As a result, it sometimes happens that the combustion

proceeds at a faster than normal rate in certain parts of the bed as, for instance, in the part directly under the gas outlet. Such uneven burning tends to build up a deeper body of ashes in these parts and to destroy the uniformity of the fire bed. To avoid these objectionable incidents of a stationery fire bed, stirrer arms 32 are provided. Each arm is secured to one of the grate plates as shown in Figs. 1 and 2 with the long axis of the upright portions and of the base flange 33 on a circle concentric with the furnace wall or substantially on the line of travel of the arm. The action of the stirrer arms is therefore principally one of cutting through the ash bed moving some ash ahead of it and the principal stress is in a plane through the securing bolts 54 on the line of travel of the arm. The arms therefore do not become loose or bent in such a short time as would make their use impracticable. If, in time, they do become bent, it is not necessary to replace them, but simply to reverse them. Two arms on a plate are sufficient.

The continual stirring of the lower portion of the fuel bed not only contributes to the maintenance of uniform combustion but aids in keeping the body of ashes in such condition that it moves through the spaces between plates to the central discharge openings. Added to this stirring is the action of the plates themselves in cutting through the ash bed and the two in conjunction make the present construction a very effective self clearing grate.

Mention has been made above of the conduit 18 which leads to the interior of the hollow post 11. This conduit serves as a means for introducing lubricant to the bearings, cooling water to the post and water for spraying the ashes. Water may be continuously delivered through conduit 18 to fill post 11 and to overflow at the top of the post down over the bearings 13 and 13′ and out through the clearance space between the lower end of flange 16 and the base 17. The water so discharged falls onto the ashes in the receiver below where it serves to cool the ashes and to lay the dust from them. It is found that a small amount of oil introduced at intervals of several hours or even once a day into the conduit is carried by the water to the bearings and sufficiently lubricates them.

The driving mechanism B for the grate will now be described. On the under side of plate 22 and near its periphery is a circular rack 33. A pawl 34 is mounted freely and eccentrically on a shaft 35 extending radially through the wall 36 of the grate box. A weight 34′ (Fig. 5) on the opposite side of the eccentric mounting urges the pawl 34 against the rack. As shaft 35 is rotated, it causes an oscillation of the pawl 34 tangent to the rack. Each forward stroke in this oscillation advances the rack one or more tooth lengths, as the case may be.

The pawl shaft 35 is rotated intermittently by a ratchet drive from an electric motor 42 with a speed reducer 42′. On the outer end of the shaft 35 and outside of the grate box wall 36, is a ratchet wheel 37 (Figs. 3 and 4). A yoked bracket 38, secured to the furnace, gives a bearing for shaft 35 and also carries a rocking arm 39 to which is attached a pawl 40. The arm 39 is rocked by a connecting rod 41, reciprocated by the motor 42 to which it is connected. The rod 41 may be connected to the rocking arm 39 at various points to give different lengths of stroke to the pawl 40. Thus a variable speed drive is provided.

The effective length of stroke of pawl 40 may be varied by the mechanism shown in Figure 4. A shield 43 is mounted on the bracket 38 so as to be tangent at one end to the ratchet wheel 37. It is adjustable on the bracket and thus its extent of overlap on the wheel may be varied. Assuming that for the connection between rod 41 and arm 39 shown in Figure 3, the angle of rocking of arm 39 is that indicated by the dotted lines in Figure 4, it is evident that the shield 43 lies within the range of movement of the pawl 40. As the pawl moves to the right (Fig. 4) in its driving stroke it travels on the shield 43 for a distance and then, at the end of the shield, it engages a tooth on the wheel 37 and turns the wheel during the remainder of its stroke. By this, a means is provided for varying the effective length of the stroke of the pawl 40 whose total stroke length is determined by the position of the end of the rod 41 on the arm 39. The pawl 40 is yieldingly held against the wheel 37 by a spring 40′ engaging a tail piece on the pawl and secured at the other end to the arm 39.

On the opposite side of the bracket 38 are anti-reversing stops 44. The ends of these stops ride on the ratchet wheel and are spaced a less distance than the pitch of the teeth on the ratchet wheel. It therefore is impossible to turn the wheel 37 backward as much as one tooth length as would be possible if but one stop were provided.

The operation will be briefly summarized. As the plates are rotated in unison, their edges slice the bed of ashes, cutting or crushing clinkers and generally putting the ash in a condition for flowing. The clearance between every two plates permits the ash to be received between them so that it may drop over the inner margin of the lower of the two. The openings in the plates, being eccentric of the furnace wall and with the grate axis, are presented in succession to various points in the fuel bed along their respective paths. At the same time, the outer margins give the effect of advancing and withdrawing with respect to any particular part of the furnace wall. As the space between any point on the

wall and the outer margins of the plates widens, ash drops down and when the grate turns so that that space narrows, ash is sliced off between plates and discharges over the inner margins. This action takes place successively at all points about the furnace area with the result that the ash is steadily and uniformly discharged.

By the grate construction described above, the ashes are removed without the need of opening doors to hoe them out. No water seal is necessary. It is possible with this grate to use higher pressure blast than with known constructions which either require a water seal or make necessary the frequent opening of doors in the ash pit for the clearing of the ash from the grates.

Grates apertured to allow discharge of the ash and introduction of blast have been attempted but have resulted in an inordinate loss of unburned fuel especially when small size fuel was used. By the present invention, the inexpensive small size fuels may be used with high efficiency. A deep ash bed may be maintained on the grate and combustion therein supported by reason of the high pressure blasts which are possible. The gases passing through the deep bed are well heated by the lower ash layers before they reach the zone of combustion and therefore do not cool the fire.

Repeated tests have shown that this grate is practical in that it is self clearing and over long periods requires no opening of doors in the ash pit; that is of advantage in permitting the use of high pressure blast and inexpensive fuels; that it maintains a deep and uniform ash bed and does not cause the loss of unburned fuel; and that the drive mechanism functions satisfactorily, free from clogging by ashes, and is perculiarly adapted to the present purpose in its mounting with most of its parts outside and with none directly in the region of falling ashes.

As stated above, it is possible to vary in many respects the particular grate construction disclosed in this specification, without making a departure from the substance of the invention which includes all such constructions as fairly respond to the following claims.

What I claim is—

1. A rotatable grate comprising a number of vertically spaced annular plates of progressively smaller size, the peripheries of certain of said annular plates being mutually eccentric, and the periphery of each of said plates above the bottom plate being defined by a circle substantially concentric with the circle defining the inner edge of the plate next below it.

2. A rotatable grate comprising a number of vertically spaced annular plates of progressively smaller size, the peripheries of certain of said annular plates being mutually eccentric, and the periphery of each of said plates above the bottom plate being defined by a circle substantially concentric with and larger than the circle defining the inner edge of the plate next below it.

3. In a furnace, an annular furnace wall, a grate rotatable within said wall, said grate comprising a number of annular plates, vertically spaced and of progressively smaller over-all diameter, the inner edges of certain of said plates being defined by circles eccentric of their respective peripheries, the plates being so positioned that the outer periphery of each plate is substantially concentric with the opening in the plate beneath it, the plate of largest diameter having its periphery closely adjacent to the furnace wall, together with a top cap member substantially concentric with and of larger size than the opening in the plate next below it.

4. A rotatable grate comprising a flat circular plate whose periphery is concentric with the rotative axis of the grate, said plate having a central opening eccentric of its periphery, a second circular flat plate thereabove whose periphery is substantially concentric with and of greater diameter than the central opening in the first plate, said second plate having a central opening eccentric of its periphery, a third circular flat plate thereabove whose periphery is substantially concentric with and of greater diameter than the opening in the second plate, said third plate having a central opening substantially concentric with its periphery, and a conical cap member substantially concentric with and of greater diameter than the opening in said third plate.

5. A rotatable grate comprising a hollow vertical post, bearings associated with said post, a hub rotatably mounted on said bearings and around said post, a cap sealing an end of said hub and shielding said hollow post and bearings, a grate mounted to rotate with said hub and a conduit for introducing a liquid to the interior of said post and thence to said bearings.

6. A rotatable grate comprising a hollow vertical post having a base flange, bearings associated with said post, a hub mounted on said post to have a running clearance from said base flange, a cap sealing an end of said hub and shielding said post and bearings and a conduit for introducing a liquid to the interior of said post and thence to said bearings.

7. In a furnace, a circular furnace wall and a rotatable grate comprising a lower plate with its outer margin close to the furnace wall and having an opening eccentric of the furnace wall, together with at least one other plate, of smaller size, thereabove having a central opening eccentric of the furnace wall, and a cap member above the opening in the upper plate, said cap and plates co-operating to form a full supporting area for the fuel

bed and being spaced vertically to provide lateral openings for the discharge of substantially all ash over the inner margins of said plates.

8. In a furnace having a cylindrical outer wall, a grate rotatable about the furnace axis and comprising a number of axially spaced annular plates of progressively smaller size, having their inner margins eccentric of the axis of the grate, and a cap member over but spaced above the opening in the smallest plate, the outer margin of each plate above the largest being substantially concentric with and larger than the opening in the next adjacent larger plate the outer margin of the largest plate extending adjacent said wall and said plates having clearance between them and cooperating with said furnace wall to effect the passage of ash between said plates to be discharged over their inner margins.

9. In a furnace, a furnace wall, a rotatable grate comprising a number of vertically spaced plates differing in size and having ash discharge openings, but presenting together substantially a full horizontal supporting area for the fuel bed, some of said plates being mounted eccentrically to their axis of rotation to cause the inner and outer rims of said plates to move laterally with a slicing action and cause said openings to be presented to different parts of the fuel bed.

10. In a furnace, a furnace wall, a rotatable grate comprising a number of vertically spaced over-lapping plates presenting together a substantially full supporting area for the fuel bed, some of said plates being mounted eccentrically with respect to their axis of rotation to cause the plates to slice through the fuel bed with an advancing and retracting effect with respect to the said wall whereby to present their overlapped margins to different parts of the fuel bed for ash discharge and their outer margins similarly to permit downward movement of the fuel bed between their outer margins and the wall.

11. In a furnace having a circular wall, a rotatable grate comprising a number of annular plates of progressively smaller size, the peripheries of at least two of said annular plates being mutually eccentric and the periphery of the largest plate extending adjacent said wall, said plates being axially spaced providing clearance between adjacent plates and cooperating with said furnace wall to effect the discharge of ash between said plates.

12. In a furnace, a circular furnace wall, a rotatable grate comprising a number of annular plates of progressively smaller diameter and vertically spaced to provide clearance between them for the discharge of substantially all ash over their inner margins, the lowest plate being of greatest diameter and having its periphery close to and substantially concentric with the furnace wall, the inner margins of said plates being eccentric of the furnace wall, together with a cap member spaced above the top plate and arranged over the opening therein.

13. A rotatable grate comprising a number of vertically spaced annular plates of progressively smaller size having their inner margins eccentric of the axis of the grate and providing clearance between them for discharge of ash over their inner margins, and stirrer arms, each stirrer arm having a base flange resting on one of said plates, and means securing said flange to said plate, said means being located on opposite sides of said arm substantially in the line of travel of said arm.

14. In a furnace having a vertical wall, a rotatable grate comprising a cap member together with a number of plates differing in size and having ash discharge openings eccentric of the axis of the grate, said plates being of such relative size and arrangement that their outer portions beyond the said openings present, together with the cap member, a substantially full horizontal supporting area for the fuel bed, and said plates above the top plate and said cap member being spaced vertically to provide clearance between them, said plates cooperating with said furnace wall to effect the discharge of substantially all ash by way of said openings.

In testimony whereof I have signed my name to this specification.

ALBERT LEET GALUSHA.

6

CERTIFICATE OF CORRECTION.

Patent No. 1,891,809. December 20, 1932.

ALBERT LEET GALUSHA.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 4, line 116, claim 6, after the word "said" insert the words "bearings and around the"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of February, A. D. 1933.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.