

Nov. 17, 1931.

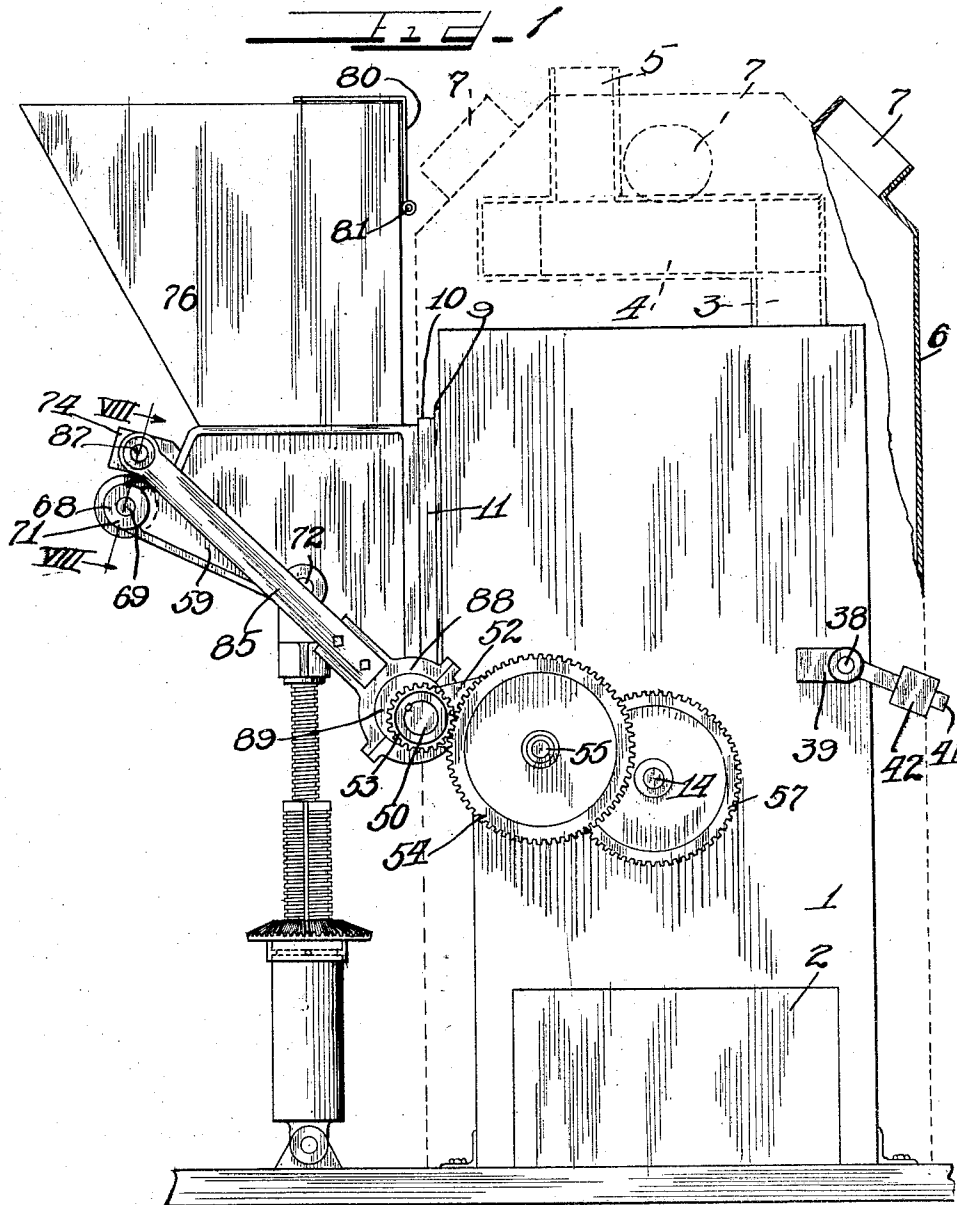
C. B. MAGRATH

1,831,816

HEATING DEVICE

Filed Oct. 26, 1929

4 Sheets-Sheet 1



INVENTOR  
Charles B. Magrath.

By *Charles B. Magrath* ATTY

Nov. 17, 1931.

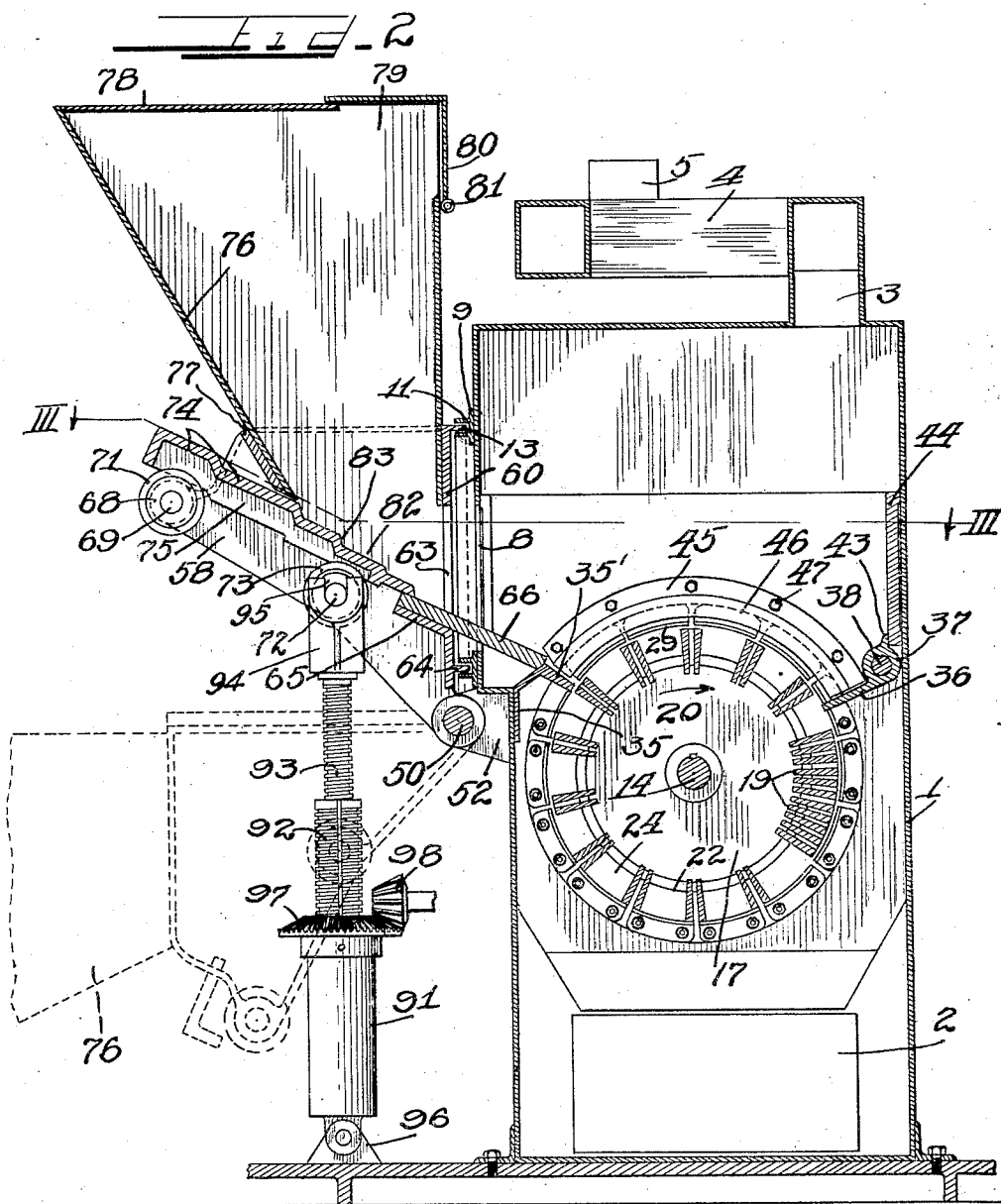
C. B. MAGRATH

**1,831,816**

## HEATING DEVICE

Filed Oct. 26, 1929

4 Sheets-Sheet 2



Inventor  
Charles B. Magrath.

64 Charles Mills Attys

Nov. 17, 1931.

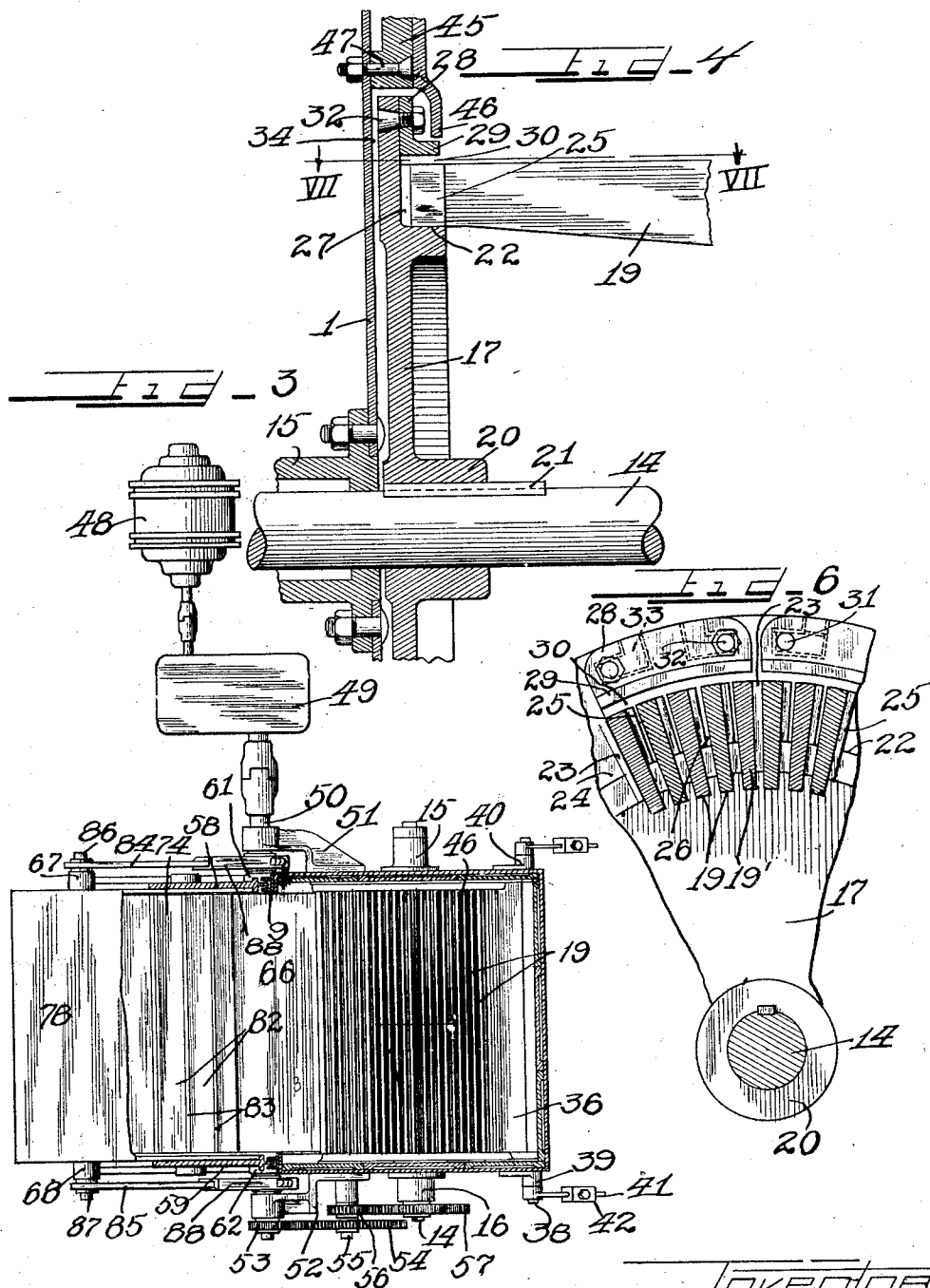
C. B. MAGRATH

1,831,816

HEATING DEVICE

Filed Oct. 26, 1929

4 Sheets-Sheet 3



INVENTOR  
Charles B. Magrath

Charles B. Magrath  
BY Attys

Nov. 17, 1931.

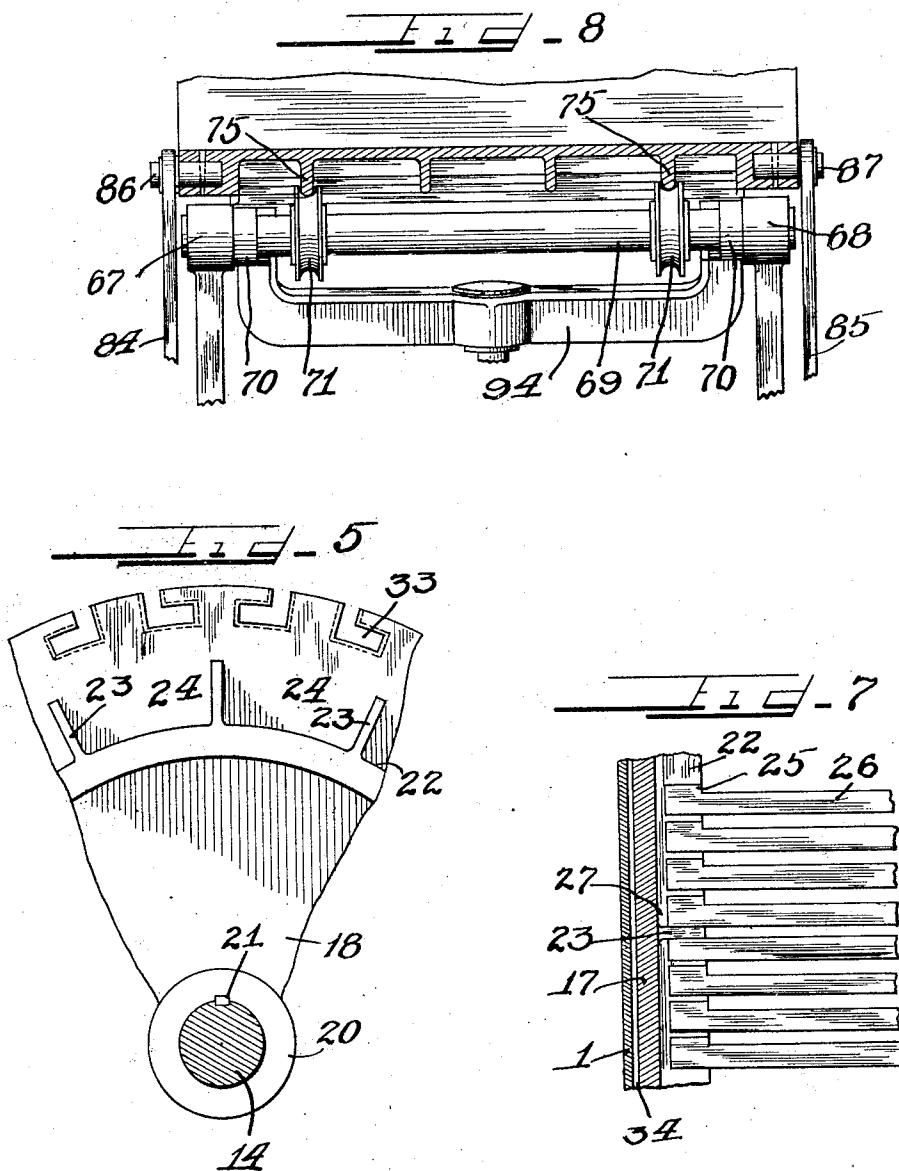
C. B. MAGRATH

1,831,816

HEATING DEVICE

Filed Oct. 26, 1929

4 Sheets-Sheet 4



INVENTOR  
Charles B. Magrath.

Charles Mills

BY

ATTY

## UNITED STATES PATENT OFFICE

CHARLES B. MAGRATH, OF CHICAGO, ILLINOIS

## HEATING DEVICE

Application filed October 26, 1929. Serial No. 402,576.

My invention relates to heating devices in which the fuel is coal or similar hard fuel.

An important object of the invention is to provide a cylindrical grate rotatable on its cylindrical axis and to receive at one side thereof the fuel which is then carried along the top of the grate through an arc of movement thereof to be consumed during such travel.

10. Another important object is to provide improved structure and arrangement for feeding the fuel into the furnace on to the rotating grate, such structure being preferably in the form of a hopper for receiving fuel when in a lowered position, together with improved elevating mechanism for raising the hopper into fuel charging position.

15. Another important object is to provide improved means for positively forcing and feeding the fuel from the feeding mechanism on to the rotating grate at a speed proportional to the rate of combustion of the fuel on the rotating grate.

20. Another important object is to provide improved mechanism for collecting the consumed fuel residue or ash and depositing such ashes into the ash pit of the furnace.

25. A further important object is to provide improved supporting structure for the grate bars so that such bars may have limited longitudinal, radial, and circumferential movement or clearance in order to move and shift sufficiently relatively during rotation of the cylindrical grate structure to dislodge any cinders, slag, slate or other hard matter which might tend to clog the grate passages.

30. A further object is to provide adequate guard and baffle structure for preventing the unburned coal from falling directly into the ash pit and to assist in guiding and locating the fuel on top of the cylinder so that it will be uniformly and efficiently consumed.

35. The above enumerated and other features of my invention are incorporated in the structure disclosed on the drawings in which:

40. Figure 1 is a side elevational view,  
45. Figure 2 is a vertical sectional view,

Figure 3 is a sectional view on line III—III of Figure 2,

Figure 4 is an enlarged diametral section of one end of the rotating grate structure and part of the furnace wall,

Figure 5 is an enlarged inside elevation of a segment of one of the grate bar carrier disks of the rotating structure.

Figure 6 is a view similar to Figure 5 and showing the mounting of the grate bars on the carrier disks,

Figure 7 is a section on plane VII—VII of Figure 4, and

Figure 8 is an enlarged section on plane VIII—VIII of Figure 1.

Referring to Figures 1 and 2, I have more or less diagrammatically illustrated a hot air furnace but it is to be understood that my improved grate structure and fuel feed mechanism may be applied with equal facility and efficiency to hot water furnaces or to steam furnaces or boilers. The furnace shown comprises the rectangular furnace shell 1 of sheet steel having an ash door 2 at its lower end and the smoke outlet 3 at the top leading to the smoke box 4 from which a duct 5 extends for communication with a chimney. An outer rectangular shell 6 of sheet steel surrounds and is spaced away from the furnace shell and encloses the smoke box. Air received within this shell is heated by contact with the furnace walls and is delivered to outlets 7 to the rooms or spaces to be heated.

At one side and near the top the furnace shell 1 has the opening 8 for the inlet of fuel and secured to the outer side of the shell and surrounding this opening is a rectangular frame 9 which extends through the opening 10 formed in the adjacent wall of the hot air shell 6. The frame 9 has parallel outwardly extending flanges 11 and 12 forming a sealing groove to be used for a purpose hereinafter to be specified.

The fuel inlet opening 8 extends transversely across the furnace shell and below said opening and parallel therewith extends a shaft 14 for supporting the rotating grate structure. The shaft extends through and is journaled in bearing structures 15 and 16 se-

cured to the furnace walls. The grate cylinder comprises the carrier disks 17 and 18 for supporting grate bars 19 extending in axial direction and circumferentially spaced  
 5 around the disks. The carrier disks are alike and each has a hub 20 rigidly secured to the shaft 14 as by means of a key 21. Each disk has also an annular shoulder 22 on its inner side on which the ends of the grate bars rest,  
 10 and the disks are so spaced apart on the shaft that the cylindrical grate structure will extend from one side wall to the other of the furnace in alignment with the fuel inlet opening 8.

15 Extending radially outwardly from the shoulder 22 on each disk are dividing walls 23 which divide the shoulder space circumferentially into a plurality of grate receiving spaces 24. In the arrangement shown  
 20 each space receives five grate bars, four of which have spacer lugs 25 at their ends and one bar 19' which does not have such lugs. The adjacent dividing walls 23 will take the place of such lugs, and the grate bars are  
 25 thus separated by suitable spaces for the passage of air for the combustion of fuel and also for the passage of consumed fuel or ash. In order to facilitate the passage of ash and cinders and to prevent clogging of the inter-  
 30 bar spaces by clinkers, slate, or other unconsumed material, circumferential clearance spaces 26 are left between the bars 19 to permit limited circumferential relative movement thereof, and the bars also terminate  
 35 short of the carrier disks to leave clearance spaces 27 so that the bars may have limited longitudinal movement.

To confine the grate bar groups in their spaces 24 on the carrier disks, a bar retaining plate 28 is secured adjacent to each space  
 40 24 on the respective carrier disks. Each plate has a flange 29 overhanging the ends of the respective grate bar group, and in order to permit limited radial movement of the bars  
 45 in addition to their limited circumferential and longitudinal movement, the flanges 29 are positioned to leave the clearance space 30. With this limited circumferential longitudinal and radial movement or play of the grate  
 50 bars they may move and shift relatively while the grate bar structure is revolving and shake loose and dislodge any matter which might tend to clog up the grate passageways.

Provision is made for detaching the bar retaining plates when it is desired to replace  
 55 worn or broken grate bars. Each plate has a bolt hole 31 at each end for receiving a bolt 32. As replacement and repairs are usually made while the grate structure is within the furnace, and there is only small  
 60 clearance space 34 between the furnace walls and the outer sides of the carrier disks, the bolts are provided with conical or counter-sink heads as clearly shown in Figure 4, and  
 65 these heads pass through and engage in cor-

respondingly tapered slots 33 in the carrier disks, the slots for each space 24 extending first radially and then in opposite directions circumferentially. When it is desired to remove a retainer plate the nuts on the inner  
 70 ends of its bolts are first turned or otherwise forced off to release the plate so that it can be removed. The bolts are then loosened in the slots and slid circumferentially and radially in the slots and from the disk. After  
 75 the necessary grate bar repairs or replacements have been made new bolts are slipped into the slots and the retainer plate and the nuts reapplied. When in place the bolts engage against the outer circumferential end  
 80 of the slot and thus securely lock the retainer plate in circumferential and radial position.

A bracket or apron structure 35 is secured to the furnace wall below the coal inlet 8 and extends the full width of the furnace, its inner end 35' extending radially to the grate  
 85 surface. This structure assists in guiding fresh fuel to the top of the rotating grate structure and also prevents the raw fuel from falling downwardly between the grate structure and the furnace wall to the ash pit.

Along the rear side of the furnace shell and a distance above the grate axis extends the ash apron or plate 36 which is secured by its  
 90 hub 37 to a shaft 38 extending through the furnace and journaled in bearings 39 and 40 secured to the furnace walls at the outside thereof. The apron extends the full width of the furnace shell and radially to the grate  
 95 surface, being inclined downwardly slightly as best shown in Figure 2. Secured to the outer ends of the shaft 38 are levers 41 carrying counterweights 42, these weights tending  
 100 to rotate the shaft 38 to hold the ash plate in normal position and with the stop projections 43 against a suitable stop. As shown  
 105 in Figure 2 this stop could be the lining plate 44 secured to the furnace wall above the ash plate.

Above each end of the cylindrical grate structure a guard bracket 45 is secured to the  
 110 adjacent side wall of the furnace shell 1 and extends from the coal apron 35' to the ash plate 36. Each bracket structure has a flange 46 overhanging the edge of the adjacent carrier disk and extending to within a short  
 115 distance of the flanges 29 of the grate bar retainer plate. These brackets prevent the fuel from falling down between the end disks and the adjacent furnace walls and assist in  
 120 guiding the fuel as it is carried by the grate structure to be consumed. These brackets also protect the supporting bolts for the retainer plates against the excessive heat of the furnace. The brackets are preferably  
 125 detachably secured as by means of bolts 47 so that they can be removed when it is desired to remove and replace grate bars through the fuel inlet 8 of the furnace.

Coal fed in through the opening 8 of the 130

furnace will be received by the rotating grate cylinder and will be carried thereby slowly across the furnace at a rate in accord with the rate of combustion so that by the time the coal reaches the ash plate 36 it will be consumed. Ash as it is formed will drop through between the grate bars into the ash pit and some of the ash will be carried to the ash plate. The weight of the ash added to that of the plate will cause the plate to swing downwardly against the force of the counterweights but such downward swing will be sufficient only to allow the accumulated ash to be discharged downwardly behind the grate cylinder into the ash pit, any unburned coal above the ash being retained on the grate by the plate. The ash plate thus functions to discharge accumulated ash and to prevent unburned fuel from dropping into the ash pit between the grate cylinder and the rear wall of the furnace.

Any suitable means may be employed for rotating the grate cylinder. I have shown an electric motor 48. This motor, through suitable reduction mechanism 49 (not shown in detail) drives a shaft 50. This shaft extends along the front of the furnace a short distance below the fuel opening 8 and is journaled in bearing brackets 51 and 52 secured to the furnace side walls. At its outer end this shaft carries a geared pinion 53 which meshes with an idler gear 54 journaled on a stub shaft 55 secured on the furnace wall. Secured to rotate with the gear 54 is a pinion 56 which meshes with the gear 57 secured to the adjacent end of the grate cylinder supporting shaft 14. Through the reduction mechanism 49 and the reduction gearing the grate cylinder will be rotated at a sufficiently slow speed to synchronize with the rate of combustion of the fuel.

The fuel is fed into the furnace from a hopper structure which is adapted to be lowered to receive a charge of fuel and to be raised into position to discharge such fuel into the furnace. The hopper structure comprises a supporting frame having side walls 58 and 59 and a front wall 60. The side walls are approximately triangular in shape and at their lower inner corners have the hubs 61 and 62 which receive the drive shaft 50 so that the hopper is pivoted to swing on said shaft. The front wall 60 has the rectangular opening 63 for registering with the fuel inlet opening 8 of the furnace, and this wall also has a flange 64 extending therefrom to engage in the sealing notch 13 of the frame 11 when the hopper is in upper or fuel charging position as shown in Figure 2.

From the lower edge of the opening 63 a ledge 65 extends outwardly and inclines slightly upwardly, and secured on this ledge is the guide plate or apron 66 which extends through the openings 63 and 8 up to the flange 35' within the furnace when the hopper

structure is in raised or fuel charging position, as indicated in Figure 2.

At the outer corners of the hopper base side walls are the bearing lugs 67 and 68 which journal a shaft 69 which is held in axial alignment by its collars 70 engaging with the lugs. A distance inwardly of said collars this shaft has channelled wheels or rollers 71 secured thereto. Between the shaft 69 and the pivot shaft 50 a shaft 72 is journaled and confined in the hopper base side walls in the same manner as is the shaft 69 and this shaft 72 carries grooved or channelled rollers 73 which align with the rollers on the shaft 69. On these rollers is mounted a fuel feeder plate 74 having ribs 75 on its under side forming rails for engaging the channelled rollers 71 and 73 so that the feeder plate is mounted for reciprocation on the hopper base. The roller shaft 72 is in a frame below that of the shaft 69 so that the feeder plate is inclined and at the same angle as the feed apron 66 which is mounted on the inclined ledge 65, and the front end of the feeder plate always rests on the apron 66 so that the apron forms a continuation of the reciprocating feeder plate for the travel of fuel from the plate to the apron.

The feeder plate extends the full distance between the side walls of the hopper base and above the plate a hopper reservoir 76 is secured to the base. The front wall of the hopper may be secured to the front wall 60 of the base and the inclined rear wall of the reservoir may be secured to the inclined wall 77 extending between the base sides. The reservoir has the top closure wall 78 and the inner part of this wall and the upper part of the front wall of the reservoir are cut away to leave an entrance 79 through which coal can be charged into the hopper structure, and this entrance may be closed by a door 80 hinged at 81 in any suitable manner.

The feeder plate has a plurality of steps 82 forming a plurality of abutments or feed shoulders 83. The coal in the reservoir rests on the feeder plate and on the apron 66 and tends to move by the force of gravity into the furnace as it is gradually taken on by the grate and carried through the furnace. However, to insure a uniform positive feed at the proper rate, the reciprocating feeder plate is provided and as this plate moves outwardly coal will drop on to the steps in front of the shoulders 83 and then when the plate is shifted inwardly these shoulders push the fuel on to the apron 66 and advance it into the furnace to the grate. The reciprocation of the plate against the coal also agitates all of the coal in the reservoir so that it will not clog but will move down freely to the plate and into the furnace.

As a means for effecting the reciprocation of the feeder plate uniformly and at the proper rate, I have shown eccentric rods

84 and 85 engaged at their outer ends by pins 86 and 87 extending from the feeder plate and at their inner ends having eccentric straps or heads 88 receiving the disks 89 eccentrically secured on the drive shaft 50. The reciprocation of the feeder plate is thus automatic and in synchronism with the rotation of the grate cylinder so that the feeding of fuel to the furnace will be in accurate accordance with the rate of combustion of the fuel in the furnace.

On Figure 2, the dotted lines show the hopper structure swung downwardly so that it can be replenished by charging coal into it through the opening 79. As a means for lowering and raising the hopper structure, I have shown a screw jack. The jack comprises the body 91 for the jack screw tubes 92 which in turn threadedly receive the jack screw 93. The screw 93 is secured at its upper end to a head 94 having the slot 95 for receiving the shaft 72 on the hopper base. The jack body 91 is pivoted at its lower end to a bracket 96 secured to the floor in front of the furnace. A bevel gear 97 is journaled on the upper end of the body 91 and is splined to the jack screw 92. With this arrangement, when the gear 97 is turned the jack structure is either extended or retracted and a driving pinion for the gear 97 may be either manually operated or connected with a suitable driving device such as a motor. Although not shown, it is readily conceivable that a controllable driving connection could be extended from the drive shaft 50 to the pinion 98 so that the motor 48 would furnish the power for operating the jack. By means of this jack arrangement a heavily loaded hopper structure may be readily raised into charging position. Instead of the mechanical jack arrangement for raising and lowering the hopper structure it is evident that electromagnetic, pneumatic, or other suitable mechanisms could be utilized.

When the hopper structure is lowered the apron 66 swings therewith and outwardly through the opening 8, and when the hopper structure is returned to its upper position this apron will again pass through the opening 8 and abut against the guide flange 35' so that there will be an uninterrupted path for the fuel from the hopper to the grate surface. The air supply for the combustion is received at the bottom of the furnace and passes upwardly through the rotating cylinder between the grate bars, the guard structures 35 and 45 and the ash plate 36 confining the air flow to this path. The grate bars come into successive cooperation with the fuel and are subjected to the combustion heat for only part of the complete rotation of the grate cylinder which gives them a chance to cool off periodically thus prolonging the life thereof. The clearance spaces which permit the relative movement of the grate bars en-

ables them to purge themselves of any deposits or incrustations or any other foreign matter and the air passages between the bars will be kept open and clean at all times.

I thus produce a simple, economical and efficient heating device and I do not desire to be limited to the exact structure and operation shown and described as modifications may be made without departing from the scope or spirit of the invention.

I claim as my invention:

1. A rotatable cylindrical grate structure for furnaces comprising a supporting axle, grate bar carrier disks mounted on said axle and each having an internal shoulder concentric with the axle, walls spaced apart on said shoulders, groups of grate bars extending at their ends into the respective spaces between said walls, and detachable means secured to said disks for confining said bars in said spaces, the bars in each space being adapted for relative movement to a limited degree.

2. A rotatable cylindrical grate structure for furnaces comprising a supporting axle, grate bar carrier disks mounted on said axle and each disk being divided circumferentially into a plurality of supporting spaces, groups of grate bars extending at their ends into the respective spaces on said disks to be thereby supported by said disks, the bars of each group being free for limited relative movement during rotation of the grate structure.

3. A cylindrical grate structure comprising an axle, grate bar carrier disks on said axle each having a plurality of circumferentially arranged receiving spaces, groups of grate bars extending at their ends into the respective spaces on said disks and said grate bars together forming a cylindrical grate surface, and detachable means on said disks for holding said bars in said spaces.

4. A cylindrical grate structure comprising an axle, grate bar carrier disks on said axle each having a plurality of circumferentially arranged receiving spaces, groups of grate bars extending at their ends into the respective spaces on said disks and said grate bars together forming a cylindrical grate surface, and detachable means on said disks for holding said bars in said spaces, there being clearance between said bars and disks for limited relative circumferential, radial and longitudinal movement of said bars.

5. A cylindrical grate structure comprising an axle, grate bar carrier disks on said axle, each having a plurality of circumferentially arranged receiving spaces, groups of grate bars extending at their ends into the respective spaces on said disks and said grate bars together forming a cylindrical grate surface, individual retainer plates detachably secured to said carrier disks at said spaces for confining the bar ends in said spaces, there

being clearance space between said plate and the bar ends and the clearance space between said bars and carrier disks for permitting relative circumferential radial and longitudinal movement of said bars during rotation of the grate structure.

mitting limited relative circumferential radial and longitudinal movement of said bars during rotation of the grate structure.

In testimony whereof I have hereunto subscribed my name at Chicago, Cook County, 70 Illinois.

CHARLES B. MAGRATH.

6. A cylindrical grate structure comprising an axle, grate bar carrier disks on said axle, each having a plurality of circumferentially arranged receiving spaces, groups of grate bars extending at their ends into the respective spaces on said disks and said grate bars together forming a cylindrical grate surface, there being a pair of oppositely extending bayonet slots in said carrier disks adjacent to each of said spaces, a retainer plate at each of said spaces and bolts extending through the corresponding bayonet slots for detachably securing the plates to the carrier disks, said plates confining said grate bars to said spaces, lugs on said grate bars for spacing said bars circumferentially, there being clearance space between said retainer plates and said bars for permitting relative radial movement of said bars during rotation of said grate structure.

7. In a heating structure, the combination of a furnace housing, a cylindrical grate structure mounted within said housing to rotate on a horizontal axis, said grate structure comprising an axle, grate bar carrier disks on said axle each having an annular supporting shoulder, and grate bars engaging at their ends on said shoulders, lugs on said bars for spacing them circumferentially, retainer plates detachably secured to said carrier disks for preventing radial displacement of said bars from said shoulders, and guard structures secured to the furnace walls and overhanging said retainer plates for preventing escape of fuel from said grate longitudinally thereof.

8. A cylindrical grate structure comprising an axle, grate bar carrier disks on said axle each having an annular ledge thereon, radial walls extending outwardly from said ledges and forming therewith a circumferential row of spaces on each carrier disk, groups of grate bars extending at their ends into the respective spaces on said disks and said grate bars together forming a cylindrical grate surface, circumferential spacing lugs on said bars, and detachable retainer plates on said carrier disks for confining the bars to said ledges.

9. A rotatable cylindrical grate structure comprising an axle, grate bar carrier disks on said axle, each having a circular row of receiving spaces concentric with said axle, a group of grate bars extending at their ends into opposite spaces on said disks and together forming a cylindrical grate surface, and circumferentially extending spacer lugs on said bars, there being clearance between said bars and the walls of said spaces for per-

75

80

85

90

95

100

105

110

115

120

125

130