Oct. 1, 1929. W. A. HARE 1,729,776

FURNACE

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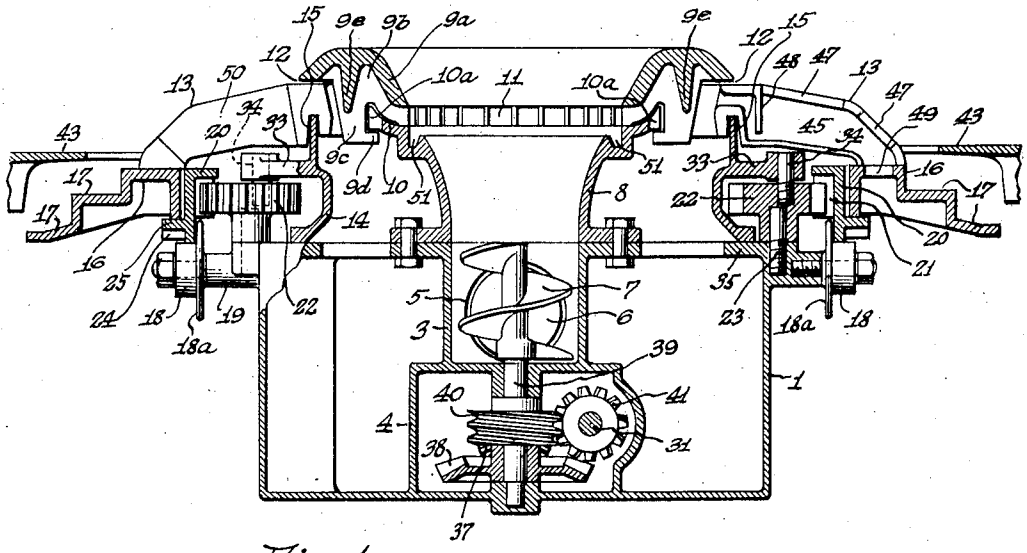


Fig. 1.

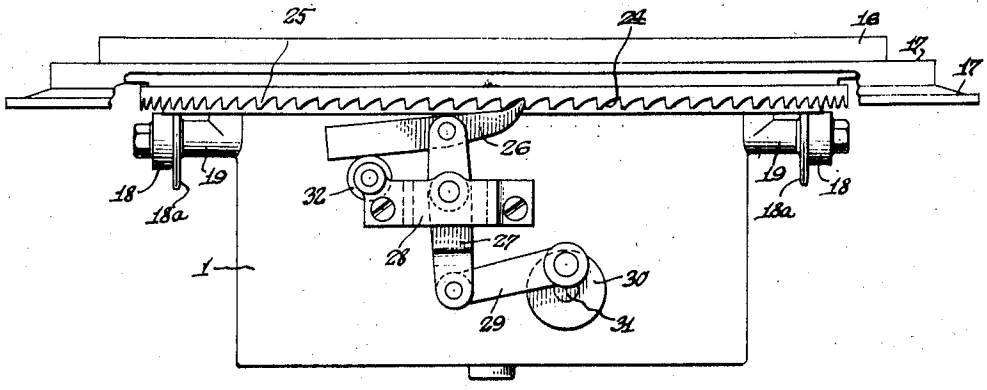


Fig. 2.

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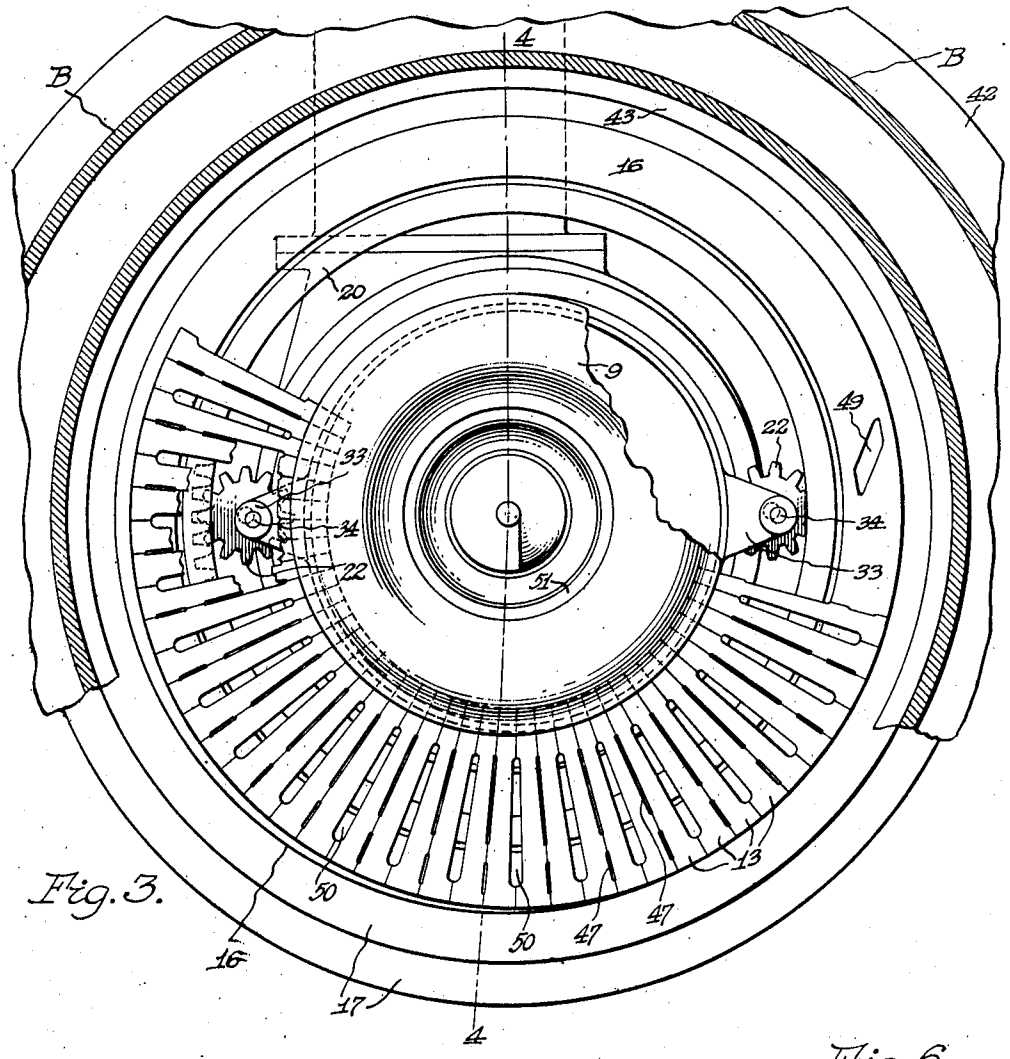


Fig. 3.

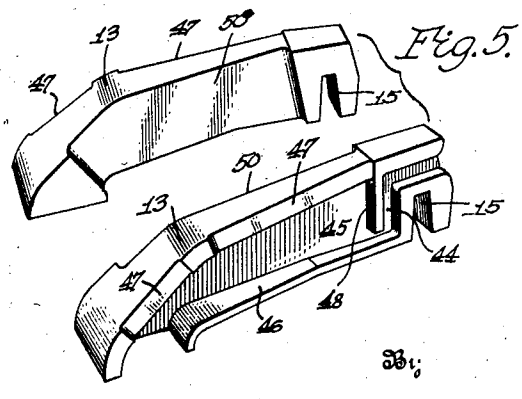


Fig. 5.

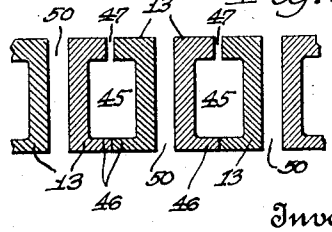


Fig. 6.

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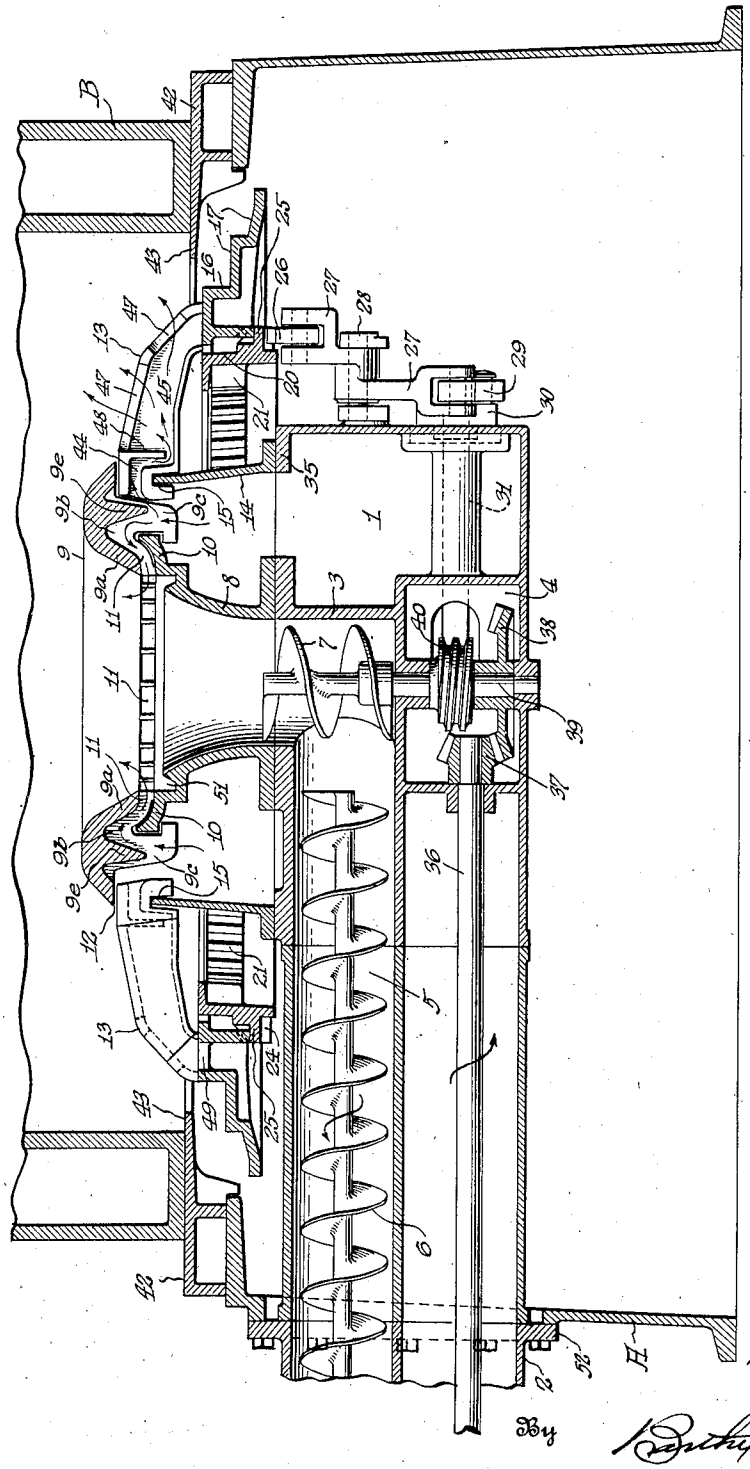


Fig. 4.

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1,729,776

UNITED STATES PATENT OFFICE

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FURNACE

Application filed February 8, 1926. Serial No. 86,786.

This invention relates to furnaces of the automatic stoker class and more particularly to automatic stokers designed for domestic use. An object of the invention is to provide a movable grate structure for the automatic elimination of ash and clinker which structure is applicable to domestic furnaces, particularly those of the round fire pot type. A further object is to provide such a great structure which is applicable to stokers of the under-feed type, and an arrangement whereby the feeding of fuel and the operation of the grate structure is effected in a simple and efficient manner. It is also an object to provide an automatic stoker of simple construction which may be readily applied to common types of domestic furnaces, and embodying a construction wherein the parts may be readily assembled and as readily disassembled for the purpose of replacement or repair. A further object is to provide in a stoker for the purpose and of the present type, a simple construction and arrangement for supplying air under pressure to the grate surface and retort for the purpose of maintaining combustion, and to provide certain other new and useful features in the construction and arrangement, whereby compactness and applicability are secured and cost of manufacture is reduced.

With the above and other ends in view, the invention consists in the matters hereinafter set forth and more particularly pointed out in the appended claims, reference being had to the accompanying drawing in which—

Figure 1 is a transverse vertical section through a structure illustrative of an embodiment of the present invention;

Fig. 2 is a side elevation of the structure shown in Fig. 1;

Fig. 3 is a plan view of the structure shown in Fig. 1 with portions broken away and in section to more clearly disclose the construction;

Fig. 4 is a transverse vertical section of the structure substantially upon the line 4—4 of Fig. 3;

Fig. 5 is a perspective view of a pair of grate bars; and

Fig. 6 is a transverse section of a plurality of bars in operative position.

In the drawings and as illustrated in Fig. 3, A indicates the base of any old and well known construction of domestic furnace upon which upper structure B forming the fire chamber of the furnace is supported in the usual manner. Within this base is supported a wind box 1 of circular formation in plan view, having a neck portion 2 extending through a door or other opening, in a side wall of the box A and through which neck portion air is supplied under pressure in any suitable manner, to the box. Arranged axially within the box 1 is a vertically extending fuel chamber 3 open at its upper end and supported by an axial gear chamber 4, the upper wall of which closes the lower end of the fuel chamber, and leading laterally from the fuel chamber 3 is a tubular fuel passage 5 which extends outwardly within the neck portion 2 of the wind box to a point outside the furnace to receive fuel at its outer end, as from a hopper or other holder, not shown, and within this tubular passage is a screw conveyor 6 for conveying the fuel inwardly to the fuel chamber 3 and to a vertically arranged screw conveyor 7 within said chamber. Secured directly upon the upper end of the chamber 3 is a retort comprising a tubular upwardly and outwardly flaring magazine 8 into the lower end of which fuel is forced by the screw 7 and a twyer or cap ring 9 which is supported upon the upper end of the magazine and forms an upward extension of the magazine and rounded upper end or throat therefor, said magazine and twyer ring thus together forming a retort or circular fire pot which is supported axially of and extends upwardly for a short distance within the lower end of the fire chamber of the furnace.

The twyer ring 9 is formed with an inwardly and downwardly extending flange 9^a, the upper surface of which forms a continuation of the outwardly flaring curved inner surface of the magazine 8 and the under surface of this flange is formed with ribs 9^b to rest upon an outwardly curved flange 10 on the upper end of the magazine 8 and space the twyer ring from the flange 10, thus provid-

ing air entrance openings 11 opening into the upper part of the retort with said ribs forming between them and between the twyer ring and flange 10, air passages which are in communication at their outer ends beyond the outer edge of the flange, with the air box 1 to receive air under pressure therefrom. Certain of said ribs 9^b are formed with downwardly extending portions 9^c to engage the periphery of the flange 10 and center the ring thereon. To detachably hold said ring in place, certain of these rib portions 9^c are formed with laterally and inwardly extending lugs 9^d to engage beneath said flange 10, said flange being formed with notches 10^a as shown in Fig. 1, to permit the lugs to pass therethrough in placing the ring, which lugs are turned out of alignment with said notches by turning the ring, to detachably hold the ring in place. The twyer ring 9 is also formed with an annular rib 9^e projecting downwardly from the under side of the ring and spaced from the periphery of the flange 10 to direct the upwardly flowing air under pressure into the outer ends of the air passages formed by the ribs 9^b. This annular rib 9^e also serves to divide the air stream and deflect a part thereof outwardly beneath the outer annular edge of the ring 9 and through a small space 12 between said edge and the inner ends of a series of radially extending grate bars 13 surrounding the twyer ring and extending outwardly therefrom, to supply a small amount of air under pressure to the upper or inner edge of said grate along the entire outer edge of the ring and maintain combustion along said edge.

The several grate bars 13 are supported at their inner ends upon the upper edge of a movable ring 14 for imparting thereto a movement for working the fuel flowing over the twyer ring from the retort or fire pot, outwardly along said bars and to cause the ash and clinker to pass from the outer ends of these bars and fall into the ash pit formed by the base A. To connect these several grate bars 13 to the ring 14 at their inner ends so that they will be caused to move therewith, each bar 13 is formed with a notch 15 at its inner end to receive the upper edge of the ring 14. All of the grate bars are thus detachably attached to the movable or grate bar actuating ring 14 to move therewith, said bars resting at their outer ends upon a rotatable supporting or ash ring 16 having a broad flat upper surface upon which the bars may rest and slide freely when motion is imparted thereto by the ring 14. This ash ring 16 is extended outwardly beyond the upper flat surface upon which the bars rest and is preferably formed with a series of annular steps 17 extending outwardly and downwardly beyond the upper bar supporting surface of the ring to receive the ash and clinker discharged from the ends of said bars, and this ash or grate bar supporting ring is rotated upon a plurality of rollers 18 rotatively mounted upon studs 19 projecting radially from the wall of the wind box 1, said ring 16 being rigidly attached to an annular gear member or ring gear 20 having gear teeth 21 on its inner side to engage pinions 22 mounted for rotation upon upwardly extending studs or pins 23 on the upper end of the wind box 1, said pinions being mounted to engage the ring gear at diametrically opposite points. This ring gear member rests with its lower edge riding upon the rollers 18 so that it, together with the ash ring may be freely rotated, and to impart an intermittent rotative movement thereto, said ring gear is formed with ratchet teeth 24 on the under side of an outwardly extending annular flange 25 on said ring gear, said ratchet being engaged by a pawl 26 pivoted intermediate its ends upon one end of a lever 27 having a pivoted support intermediate its ends upon a bracket 28 secured to the outer side of the wind box wall, the lower end of said lever 27 being connected by a link 29 to a crank disk 30 on the outer end of a drive shaft 31 which shaft extends through the wall of the wind box and across the same, and into the gear box 4. Rotation of shaft 31 therefore swings the lever 27 upon its support, through the crank and link connection, and as the pawl 26 is carried by the upper end of this lever, it will engage the ratchet teeth 24 during one movement of said lever, and rotate the ring gear in one direction, and during the other swinging movement of said lever, the pawl will ride over the teeth, imparting no movement to the ring gear. As said pawl is pivotally supported intermediate its ends, the weight of the tail end thereof will hold its opposite end in engagement with the ratchet teeth and to support the tail end of said pawl, a roller 32 is mounted upon the bracket 28. The tail end of the pawl rides freely upon the roller and the roller prevents the pawl from exerting an upward thrust on the ratchet ring, which thrust might otherwise tend to lift the ring gear off the supporting rollers 18, which rollers are provided with flanges 18^a to engage and center the ring gear concentric with the axis of the retort 8.

As the ring gear 20 is in constant engagement with the pinions 22, these pinions are driven by the rotation of the ring gear, and to impart motion from said pinions to the movable ring 14 to which ring the inner ends of the several radial grate bars 13 are connected so that said grate bars will be moved, said ring 14 is provided at diametrically opposite sides, with outwardly extending arms 33 which are formed integral with or rigidly attached at their inner ends to said ring 14, and at their outer ends are provided, each with an eye forming a bearing to receive a pin 34 on each pinion extending upwardly

from the side thereof and positioned laterally of the axis of turning movement of the said pinions to form crank pins for transmitting motion from said pinions to the ring 14. As said pinions 22 are positioned at diametrically opposite sides of the ring member 14 and as the arms 33 are rigidly connected to said ring, the motion of travel of the crank pins about the axes of the pinions, is directly imparted to the ring 14, thus imparting to all of the radial grate bars a motion defined by the travel of the crank pins during each rotation of the two pinions, the outer ends of the bars sliding upon the upper flat surface of the ash ring 16, and moving at their inner ends with the actuating ring 14, which ring slides freely upon the flat upper surface of an annular flange 35 on the upper end of the wall of the wind box 1.

Power for rotating the grate supporting ring 16 through the medium of the pawl 26 and ratchet 24 and for imparting movement to the several grate bars through the medium of the ring 14, is transmitted from any suitable source outside the furnace, such as an electric motor, not shown, by means of a drive shaft 36 extending inwardly through the neck portion 2 of the wind box, to the gear box 4, and upon the inner end of this shaft within the gear box, is a bevel pinion 37 in mesh with a bevel pinion 38 on the shaft 39 of the vertical conveyor screw 7 to drive said vertical shaft, and on this shaft 39 is a worm 40 in mesh with a worm gear 41 on the inner end of the shaft 31.

The several grate bars 13, as shown in Fig. 3, are tapered throughout their length and are of greater width at their outer than at their inner ends so that when placed side by side in radially extending position about the retort, they will fit closely together and form, in effect, a continuous annular grate spanning the space between the operating ring 14, and the ash ring 16, with the inner ends of the bars lying beneath the outer edge of the twyer ring 9 but free to move relative thereto, and substantially filling the space between the upper end of the grate bar operating ring 14 and said edge of said twyer ring, there being only sufficient space 12 between the upper face of the ends of the bars and the edge of the twyer ring to permit a small amount of air under pressure to escape from the wind box and maintain combustion upon the upper ends of the grate bars, which space is always kept clear by the movement of the bars relative to this cap ring of the twyer.

To prevent too rapid a discharge of ash and clinker from the lower or outer ends of the grate bars and from the ash ring 16, a filler ring member 42 is inserted between the upper end of the base A and the lower end of the structure B, said ring being formed with an inwardly extending annular flange 43, of an inner diameter to provide a narrow space between the outer ends of the grate bars and said flange, with the flange projecting inwardly over the stepped portion 17 of the ash ring 16. This filler ring also serves as an adapter to permit of the adapting of the base A to furnaces which may vary somewhat in diameter and also to vary the height of the base, ring adapters or filler rings of different sizes in diameter and cross-section being provided to take care of such variations.

As before stated, air under pressure is supplied to the wind box 1 and a portion of this air is admitted to the retort or fire pot through the passages formed between the ribs 9^b on the twyer ring 9 as described. Forced draft or a portion of this air under pressure also escapes through the annular space at the outer edge of the twyer ring to maintain combustion on the upper ends of the grate bars, and to provide forced draft for maintaining combustion upon the surface of the annular grate formed by the several grate bars 13, each bar is formed with a recessed side to co-operate with a like recessed side of an adjacent bar in forming a passage 44 open at the inner ends of the bars to receive air under pressure from the wind box and this passage opens into the inner end of a chamber 45 formed by recessing adjacent sides of adjacent bars so that one-half of each chamber will be in one bar and the other half in the other bar. When the bars are placed side by side in close contact, a closed chamber is formed extending throughout the main portion of the length of said bars and is open through the outer end or the end face which rests upon the ash ring 16 so that the outer ends of said chambers will be closed by said ring. The edge of the bottom wall 46 of the recess in one bar fits closely against the like wall of the recess in the adjacent bar, tightly closing the lower side of each chamber 45 but the upper walls of these recesses, the outer surface of which forms the upper grate surface, are formed to provide narrow longitudinal slots 47 opening through the grate surface and providing for the escape of air from the chambers 45, upwardly through the grate surface to maintain combustion thereon throughout the length thereof. A rib 48 on each bar cooperates with a like rib on an adjacent bar to form a division baffle between the inner end of each chamber 45 and passage 44 leading thereto, this baffle extending downwardly from the upper wall of the chamber to near the bottom wall 46 thereof, so that air under pressure will enter the upper or inner end of each chamber near the bottom thereof to blow any ash which may fall into the chamber through the slot 47, along the bottom toward the lower or outer end of the chamber, which end is closed by the ash ring. The grate bars are all so shaped as to provide an outwardly and downwardly inclined grate surface to

assist in the discharge of ash and clinker from their outer ends onto the ash ring and also to incline the chambers so that the ash entering through the air discharge slots in the grate surface, will readily find its way into the lower or outer end of each bar to be discharged therefrom when said lower open ends of the bars pass over an opening 49 (see Fig. 3) in the upper surface or wall of the ash ring upon which the outer ends of these bars rest and slide, the outer open end of each bar passing over said opening once during each complete rotation of the ash ring. In order that the discharge end of each bar may be gradually opened as said end passes over the opening 49, said opening is elongated with its length extending diagonally of the upper surface of the ash ring and its circular path of travel. The air pressure chambers of the several bars are therefore swept clean once during each rotation of the ash ring and during the remainder of such rotation, are closed by said ring except that the air under pressure contained in said chambers may at all times escape through the narrow slots 47 in the grate surface.

In order to supply air under natural draft to the grate surface, the side of each grate bar 13 opposite that which is recessed to form the chamber 45, is cut away throughout a major portion of its length to form, together with the adjacent bar which is cut away in a like manner, a slot 50, which slots open through both upper and lower surfaces of the grate structure formed by said bars and provide passages for the direct upward flow of air through the grate from the space below, or the ash pit, thus providing for the supplying of air to maintain combustion upon the grate by natural draft so that the fire may be maintained, should the means for supplying air under pressure to the wind box fail for any reason, and it is obvious that natural draft alone may be relied upon to maintain combustion upon the grate, by reason of the forming of the bars in this manner at both sides and providing natural draft slots at both sides of each bar, eliminating the forced draft air chambers. It will be noted that each bar adjacent its ends is of full width to contact adjacent bars and form tight joints therewith, providing in effect, continuous grate portions at the inner and outer ends of the bars, said inner ends thus together forming a wall to close or substantially close the space between the upper end edge of the operating ring 14 and the outer edge of the twyer ring 9.

Preferably, the retort member 8, adjacent its upper outwardly flaring end which is provided with the outwardly and upwardly curved annular flange 10, is formed with an internal upwardly open annular groove 51 adapted to receive and retain ash for the purpose of insulating this portion of the magazine or fire pot against the extreme heat generated at this point due to the entrance through the openings 11 directly above, of air under pressure into the fire pot. Overheating of the retort would distill out coal gases from the coal in the retort, which gases would pass downward in the retort through the coal in the chamber 3 and finally find their way out through the fuel passage 5. This overheating is prevented by the insulation provided by the ash caught in the groove 51.

The present construction provides for the application of the invention to the common types of house heating plants and may be applied to furnaces now in use by simply removing the base of the furnace and substituting a new base therefor, or in many instances the old base may be used and the present stoker installed therein after removing the old grates. The ring 42 for insertion between the base and upper part or body of the furnace, further insures adaptability and provides an inwardly extending flange or ledge to surround the grate structure with a restricted annular opening between this flange and outer ends of the grate bars so that the discharge of ash and clinker from the grate may be regulated, said opening being such that it will be clogged by accumulation of ash and clinker on the ash ring provided the ash ring is not moved, but a rotation of the ring will cause a discharge of the ash from the ring and therefore by regulating the speed of the ring, the discharge of ash and clinker may be accurately controlled to control the fire on the grate.

The construction whereby the retort ring cap 9 is detachably locked in place upon the retort and in turn detachably holds the several grate bars assembled upon their actuating ring 14, provides for ready assembly and disassembly, and an efficient movement of the entire grate structure is secured by the application of motion to the actuating ring 14 through the medium of two crank motions imparted in unison thereto by the pinions 22 and eccentric connection of the ring to these gears by the crank pins 34 on the gears and rigid arms 33 on the ring at diametrically opposite sides of the ring. The movement imparted to the grate structure is therefore a movement corresponding to the path of travel of the pins about the two axes of the pinions and without rotation of the grate structure upon its own axis. This motion as well as the motion of the ash ring 13, is intermittent due to the turning of the ash ring by the pawl and ratchet which imparts a very slow movement to the ring and consequently a slow intermittent rotation to the pinions 22 which are in engagement with the large ring gear carried by the ash ring. Because of this circular path of travel of the ring 14 defined by the path of travel of the cranks about the two centers, all of the radial grate bars forming the circular grate are moved in the direc-

tion of their length and the fire is gradually fed radially outward thereby from the retort or fire pot and the ash and clinker is discharged from their outer ends on to the ash ring which, by its rotative movement gradually discharges it into the ash pit. This longitudinal movement of the grate bars relative to the retort cap ring 9 which is stationary, also keeps the narrow air space between the upper ends of the bars and the outer edge of said cap ring clear so that air under pressure may enter the fire all along the edge of the cap and maintain combustion at the upper ends of the grates where the fuel forced upwardly in the retort overflows the cap ring.

The construction and arrangement of elements of the present invention particularly adapts the same to a circular construction and makes it particularly adaptable to furnaces having circular fire chambers but obviously the construction and arrangement may be varied within the scope of the appended claims, to adapt the invention to installations other than that illustrated. Further, the construction is such as to provide a very compact device which may be readily installed in a furnace base of the usual dimensions with the neck portion 2 through which fuel is fed and air under pressure is conducted, extending through the usual base opening or ash door, with said neck portion rigidly secured to the base by means of a flange 52 on the neck bolted or otherwise secured to the base around the opening, so that the entire structure within the base is supported by the neck portion, with the space all around the structure and beneath the same within the base, free from obstructing supports and so that the ash and clinker may be readily removed from the base or ash pit.

Having thus fully described my invention, what I claim is:—

1. In a furnace, the combination of a plurality of radially extending grate bars together forming a grate, and means for moving said grate bodily in a horizontal plane along a closed path having a vertical axis.

2. In a furnace, the combination of a plurality of radially extending grate bars together forming a circular grate, and means for imparting to said grate a non-rotative bodily circular movement in a horizontal plane.

3. In a furnace, the combination of a central fire pot, a plurality of grate bars together forming an annular grate surrounding said fire pot, and means for moving said bars longitudinally.

4. In a furnace, the combination of a central fire pot, a plurality of grate bars together forming an annular grate surrounding said fire pot, and means for imparting a bodily circular movement in a horizontal plane about upwardly extending axes.

5. In a furnace, the combination of a central fire pot, a plurality of grate bars extending radially from said fire pot and forming a grate surrounding the pot and movable relative thereto, means for feeding fuel into the lower end of the fire pot, and an ash ring at the outer ends of said grate bars.

6. In a furnace, the combination of a central fire pot, a plurality of grate bars extending radially from said fire pot and forming a grate surrounding the pot and movable relative thereto, a twyer ring on the upper end of the pot, means for moving the grate relative to the pot and means for introducing air under pressure into the fire pot through said ring.

7. In a furnace, the combination of a central fire pot, a plurality of grate bars extending radially from said fire pot and forming a grate surrounding the pot and movable relative thereto, said bars being formed to provide air discharge openings through the upper surface of the grate, a twyer ring on the upper end of said pot with its periphery overhanging the inner ends of said bars, means for introducing air under pressure into the fire pot through said ring and into the fire on the grate surface through said air discharge opening, and means for moving the grate relative to said fire pot.

8. In a furnace, the combination of a central fire pot, a plurality of grate bars extending radially from said fire pot and forming a grate surrounding the pot and movable relative thereto, a twyer ring on the upper end of the pot with its periphery overlying the inner ends of said bars, an ash ring at the outer ends of said bars to receive ash therefrom, means for moving said grate as a whole, relative to said pot and to said ash ring, and means for moving the ash ring relatively to the outer ends of said bars to effect the discharge of ash from the outer ends of the bars.

9. In a furnace, the combination of a central fire pot, a plurality of grate bars extending radially from said fire pot and forming a grate surrounding the pot and movable relative thereto, a twyer ring on the upper end of the pot with its periphery overlying the inner ends of said bars, an annular member supporting the inner ends of said bars, an ash ring supporting the outer ends of said bars, and means for moving said annular member to move the bars lengthwise.

10. A furnace as characterized in claim 9 including means for rotating said ash ring about the axis of the fire pot.

11. A furnace as characterized in claim 9 wherein said means for moving said annular member is actuated by a rotative movement of said ash ring.

12. An automatic stoker for domestic furnaces having a base provided with an opening in one side thereof, said stoker including an upwardly extending fire pot, a neck portion extending laterally of the fire

pot and forming a fuel passage leading to the lower end of the pot, said neck portion being extended through the opening in the base and secured to the base adjacent the opening, means in said neck portion for feeding fuel into the lower end of the fire pot, and a grate structure to receive fuel overflowing from the upper end of the fire pot, said stoker including said fire pot, grate and fuel feeding means being supported in said base solely by said neck portion.

13. A device of the character described and as characterized in claim 12, and wherein said neck portion is provided with a passage for air under pressure and a twyer is mounted upon the fire pot and provided with air passages opening into the fire pot and communicating with said passage in said neck portion.

14. A device of the character described and as characterized in claim 12, and wherein a driving shaft extends longitudinally of said neck portion therein and means is provided at the inner end of said shaft for transmitting motion therefrom to operate the grate structure and move the same relative to the fire pot.

15. A device of the character described and as set forth in claim 12, and a filler ring for interposition between the upper end of the furnace base and upper part of the furnace.

16. A device of the character described and as set forth in claim 12, and a filler ring for interposition between the upper end of the furnace base and upper part of the furnace, said ring being provided with a flange extending inwardly toward the end of said grate structure to restrict the discharge of ash and clinker from the grate.

17. An automatic stoker for domestic furnaces having a base provided with an opening in one side thereof, said stoker including a structure forming a fuel chamber and a neck portion forming a fuel passage leading to said chamber, said neck portion being arranged to extend through the opening in said base and to be secured to the base adjacent said opening with said neck portion forming the sole support for the structure upon said base, a fire pot mounted upon the structure above the fuel chamber, means in said neck portion for feeding fuel into the fuel chamber, means in the fuel chamber for feeding fuel into the lower end of the fire pot, a grate structure extending radially from the fire pot to receive fuel overflowing therefrom, said grate structure being mounted upon the structure forming the fuel chamber and neck portion, and means for moving the grate structure relative to the fire pot.

18. An automatic stoker as characterized in claim 17 and further characterized in that said structure forming said fuel chamber is also provided with a wind box and said neck portion of the structure is formed with a passage for air under pressure leading to the wind box, and a twyer on the fire pot formed with air passages opening into the pot and communicating with the wind box.

19. An automatic stoker as characterized in claim 17 and further characterized in that said neck portion is of a length to position the fire pot centrally of said base and said grate structure comprises a plurality of grate bars extending radially from said fire pot with their inner ends supported adjacent the upper end of the pot, and an ash ring forming a support for the outer ends of said bars and movable relative thereto and upon which the bars are free to move when the grate structure is moved relative to the fire pot.

20. An automatic stoker as characterized in claim 17 and further characterized in that said neck portion is of a length to position the fire pot centrally of said base and said grate structure comprises a plurality of grate bars extending radially from said fire pot with their inner ends supported adjacent the upper end of the pot, and an annular ash ring having an upper flat surface upon which the outer ends of the grate bars rest, said ash ring being formed with outwardly and downwardly stepped annular surfaces and mounted upon the structure forming the fuel chamber and support for the fire pot, for rotation about the fire pot axis.

21. An automatic stoker as characterized in claim 17 and further characterized in that said neck portion is of a length to position the fire pot centrally of said base and said grate structure comprises a plurality of grate bars extending radially from said fire pot with their inner ends supported adjacent the upper end of the pot, an annular ash ring having an upper flat surface upon which the outer ends of the grate bars rest, said ash ring being formed with outwardly and downwardly stepped annular surfaces and mounted upon the structure forming the fuel chamber and support for the fire pot for rotation about the fire pot axis, and an annular filler ring for interposition between the furnace base and upper furnace structure, said ring being formed with a flange extending inwardly over the stepped portion of the ash ring and restricting the annular opening between the outer ends of the grate bars and the furnace wall.

22. A furnace stoker including a supporting structure forming a wind box and a fuel chamber, a fire pot mounted upon said fuel chamber, a twyer mounted upon said fire pot and formed with air passages opening into the fire pot, a member providing a wall forming an upward extension of the wind box and movable relative thereto, a series of grate bars engaging the upper edge of said wall provided by said member and movable therewith, a flange on said twyer overlying the upper ends of the grate bars, said wind box

being in communication with said fire pot through said twyer and with the fire on the upper ends of the grate bars, through the space between said ends and the flange on said twyer.

23. A furnace stoker as characterized in claim 22 and including an ash receiving member upon which the outer ends of the grate bars are supported to move freely thereon and to span the space between said member forming an upward extension of the wind box and said ash receiving member, and means for moving said member forming the upward extension of the wind box wall, to move the grate bars relative to said twyer.

24. A furnace stoker including a member providing a wind box, a fuel chamber and a passage leading to the fuel chamber, an upwardly open and flared magazine on said fuel chamber to receive fuel therefrom and forming a fire pot, a twyer ring on the upper end of said magazine and formed with air passages communicating with said wind box, and a series of grate bars extending radially from the magazine with their inner ends underlying the outer edge of the twyer with a narrow space therebetween communicating with the wind box, said grate bars together forming a grate surrounding the fire pot and chambers within the grate with openings from said chambers through the grate surface, said chambers being in communication with the wind box through the inner ends of said bars.

25. A furnace stoker as characterized in claim 24 and wherein said grate bars are tapered longitudinally in plan view, with their outer ends of greatest width, whereby an annular grate is formed by placing said bars side by side and in contact throughout their length.

26. A furnace stoker as characterized in claim 24 and further characterized in that the air chambers in said grate open through an outer end portion of the bars, and in that a rotatable member is provided upon which the open outer ends of the bars rest to close said ends, said member being provided with an opening to register with the open ends of the bar during the rotation of the member relative to said bars.

27. A furnace stoker including a vertically arranged magazine with open upper and lower ends and formed with an outwardly extending flange adjacent its upper end formed with notches, a twyer ring on said magazine formed with air passages opening into the upper end of said magazine and formed with downwardly extending portions to center said twyer upon said flange on the magazine, said portions being provided with lugs to pass through the notches in said flange and detachably hold said twyer in place.

28. A furnace stoker as characterized in claim 27 and further characterized in that said twyer ring is formed with an outwardly extending peripheral flange to overlie the inner ends of grate bars, and a series of grate bars is supported side by side and in contact and in radially extending position to form an annular grate surrounding said magazine with the inner ends of said bars projecting beneath the outwardly extending flange of said twyer ring.

29. In a furnace stoker, the combination of a member forming a wind box open at the top, a fuel chamber open at the top and a fuel passage leading to the chamber, a magazine mounted upon the fuel chamber to receive fuel therefrom, means for conveying fuel through said passage into said chamber, an annular twyer on the upper end of the magazine formed with air passages opening into the magazine, an annular member upon the wind box forming an upward extension of the wall thereof surrounding the magazine, a series of grate bars operatively and detachably connected to and resting upon the upper edge of said annular member and together substantially filling the space between said edge of said annular member and the annular outer edge of said twyer with said bars together forming an annular grate surrounding the magazine, an ash ring rotatively supported upon said member forming said fuel passage, fuel chamber and wind box, upon which ash ring the outer ends of said grate bars rest, and means for moving the annular member upon which the inner ends of the grate bars rest, to move the grate relative to the magazine and twyer.

30. A furnace stoker as characterized in claim 29 and including a pawl and ratchet for rotating said ash ring about the axis of said magazine and said means for moving said annular member upon which the inner ends of the grate bars rest, includes cranks operatively connected to said annular member.

31. In a furnace, the combination of a plurality of grate bars forming a grate, and rotating means for imparting to said grate, a circular motion in a horizontal plane, said motion being defined by the revolution of said rotary means about upwardly extending axes.

32. In a furnace, the combination of a plurality of grate bars forming a grate, and means for imparting to said grate, a circular motion in a horizontal plane, said means including a plurality of cranks simultaneously rotatable about separate upwardly extending axes and defining by their revolution about said axes said circular motion.

In testimony whereof I affix my signature.

WILFRED A. HARE.