J. HARRIGAN.

FURNACE.

APPLICATION FILED DEC. 16, 1907.

**966,200.**

Patented Aug. 2, 1910.

4 SHEETS—SHEET 1.

Fig. 1.

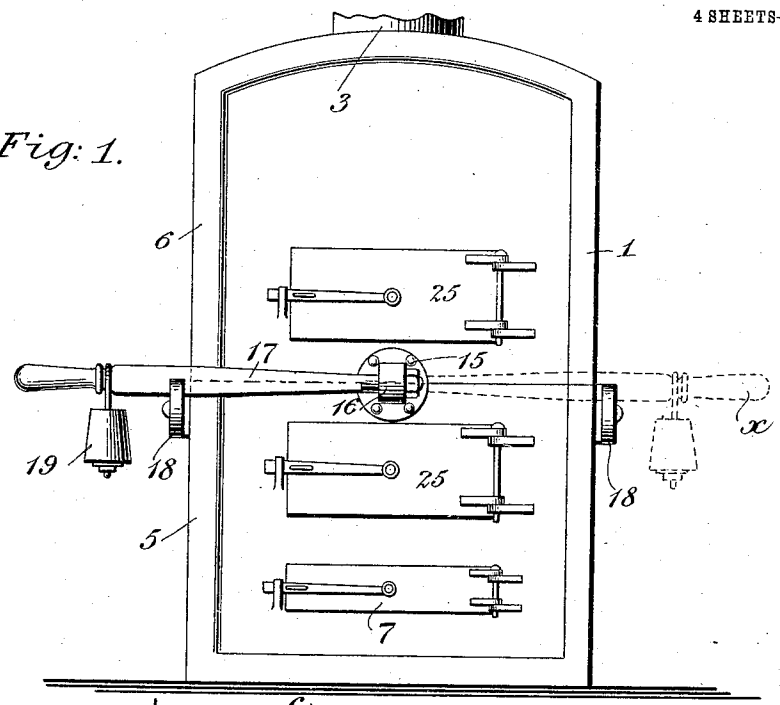
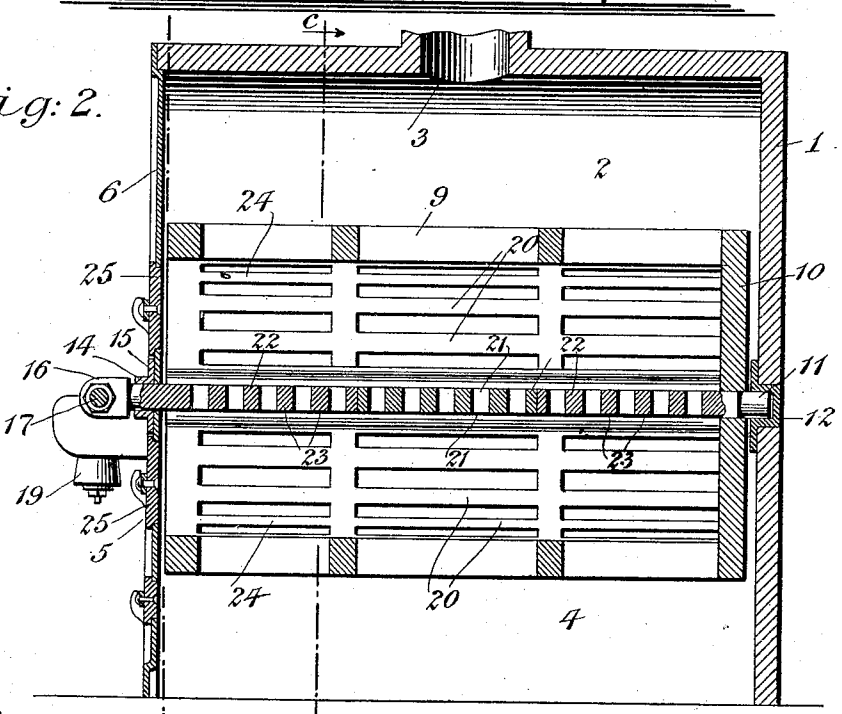



Fig. 2.




Witnesses:
John A. Rennie
P. Margulies.

Inventor
John Harrigan
By his Attorney

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4 SHEETS—SHEET 2.

Fig: 3.

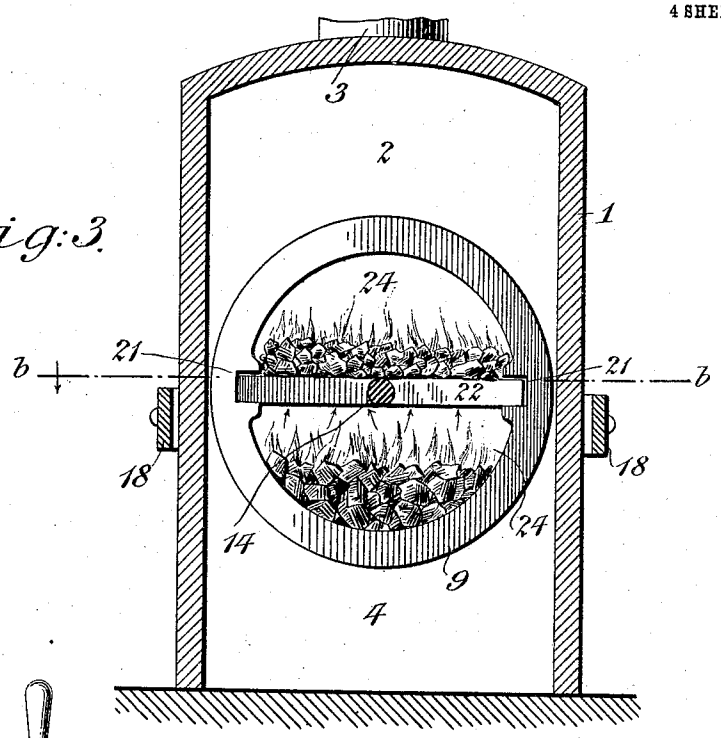
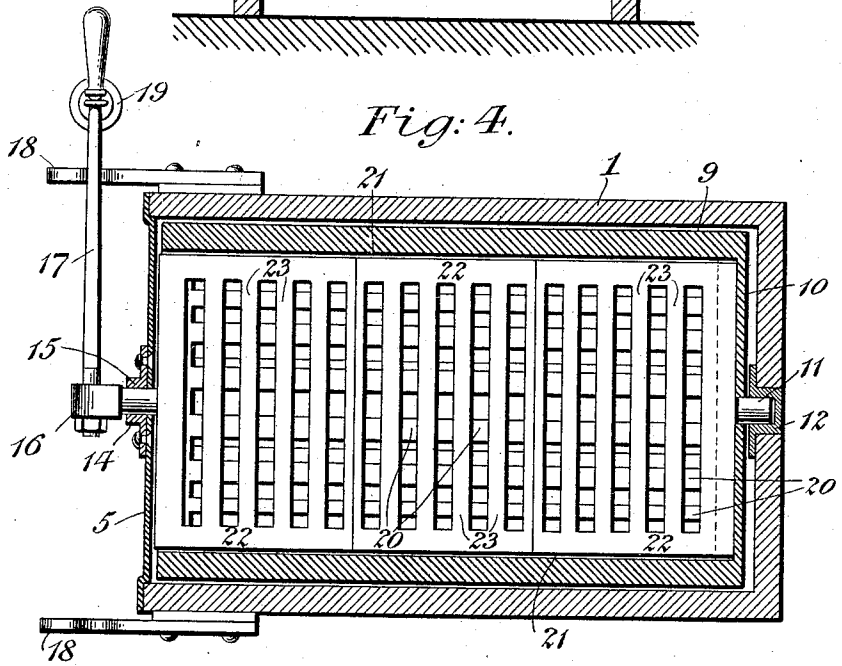



Fig: 4.

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4 SHEETS—SHEET 3.

Fig: 5.

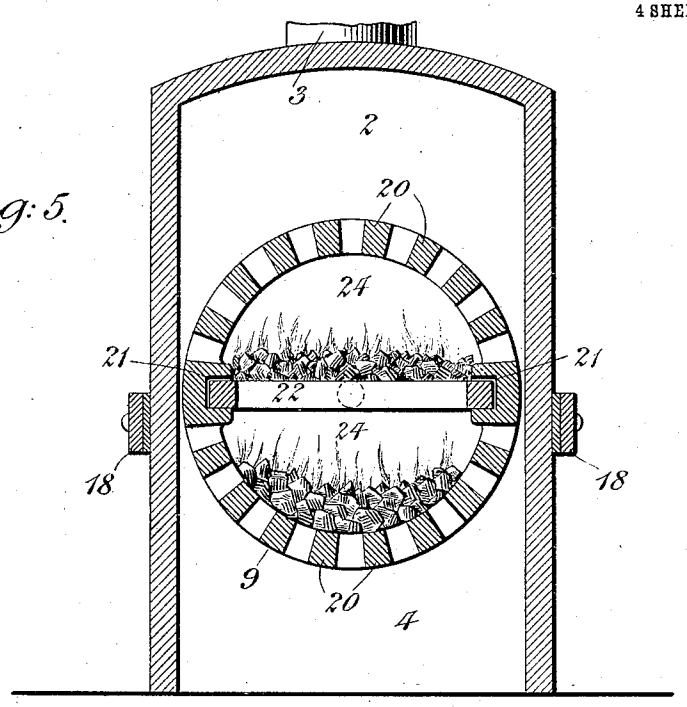
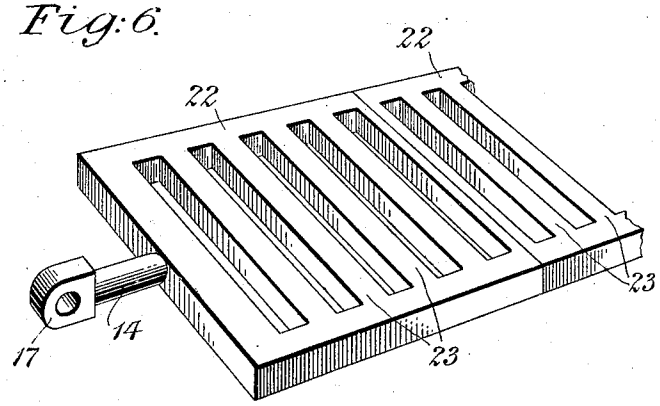



Fig: 6.

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4 SHEETS—SHEET 4.

Fig: 8.

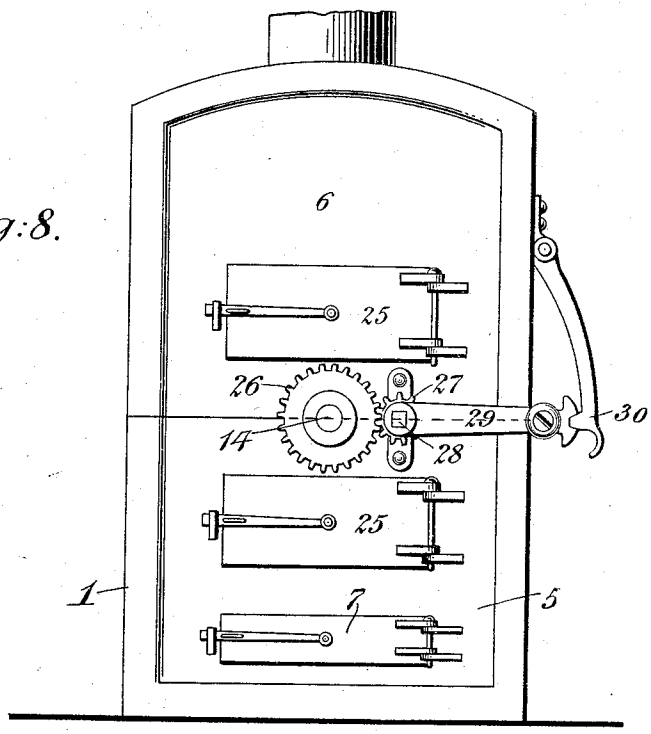
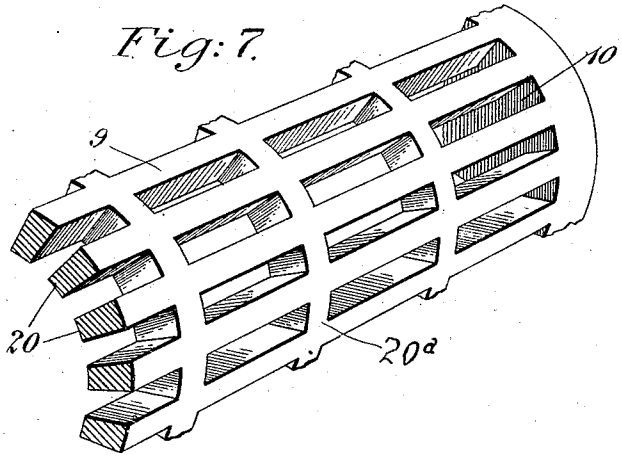



Fig: 7.

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THE NORRIS PETERS CO., WASHINGTON, D. C.

# UNITED STATES PATENT OFFICE.

JOHN HARRIGAN, OF BROOKLYN, NEW YORK.

## FURNACE.

966,200. Specification of Letters Patent. Patented Aug. 2, 1910.

Application filed December 16, 1907. Serial No. 406,606.

*To all whom it may concern:*

Be it known that I, JOHN HARRIGAN, a citizen of the United States, and a resident of Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Furnaces, of which the following is a specification.

This invention relates to certain improvements in that class of furnaces which are particularly designed and adapted for consuming fuel in such a substantially complete and effective manner as to avoid the production of smoke and of which the furnace shown and described in my copending patent application No. 538,352, filed January 17, 1910, is a type, and the object of the invention is to provide a furnace of this general character of a simple and comparatively inexpensive nature, and of a strong and durable construction, having novel and improved means for promoting the combustion of the fuel, so that the production of smoke due to the carrying off of minute particles of the fuel with the draft is effectively prevented, and a material economy is attained in the consumption of fuel.

The invention consists in certain novel features of the construction, and combinations and arrangements of the several parts of the improved furnace, whereby certain important advantages are attained, and the furnace is rendered simpler, less expensive, and otherwise better adapted and more convenient for use, all as will be hereinafter fully set forth.

The novel features of the invention will be carefully defined in the claims.

In order that my improvements may be the better understood, I will now proceed to describe the same with reference to the accompanying drawings, wherein—

Figure 1 is a front elevation of a furnace constructed according to my invention; Fig. 2 is a vertical section taken axially through the improved furnace; Fig. 3 is a vertical section taken transversely through the improved furnace; Fig. 4 is a sectional view taken horizontally through the improved furnace in the plane indicated by the line *b*—*b* in Fig. 3; Fig. 5 is a sectional view similar to Fig. 3, but taken vertically through the improved furnace in the plane indicated by the line *c*—*c* in Fig. 2; Fig. 6 is a fragmentary perspective view showing a feature of construction of the horizontal grate member of the improved furnace; Fig. 7 is a fragmentary perspective view showing certain features of construction of the revoluble grate member of the improved furnace, and—Fig. 8 is a front view similar to Fig. 1 but showing a modified formation of the grate actuating means which will be hereinafter described.

Referring first to Figs. 1 to 7, inclusive, 1 represents the wall or casing of the furnace, and 2 the fire chamber at the upper part thereof and communicating with the exit flue 3 for the products of combustion, while 4 represents the ash pit produced at the lower part of the furnace. As herein shown the front wall of the improved furnace is formed of upper and lower sections 5 and 6, meeting to produce a horizontal joint at the central part of the furnace front, the lower section 5 being provided in a well known way with an ash door 7, communicating with the ash pit 4 of the furnace.

At the central part of the furnace is arranged a fuel chamber of rounded or circular formation in cross section, said fuel chamber being formed, as herein shown, within a revoluble grate member 9, of substantially cylindrical or rounded form, the diameter of said revoluble grate member 9 being such that said member serves to effectively divide the fire chamber 2 of the furnace from the ash pit 4 thereof, the opposite sides of said member 9 being closely adjacent to the opposite walls of the furnace casing, as clearly shown in Figs. 3 and 4. The rear end portion of this chambered revoluble grate member 9 is herein shown provided with a closure 10, and with a centrally arranged trunnion 11 which is mounted for turning movement in a socket or bearing 12 produced at the rear wall of the furnace casing, so as to effectively support said revoluble grate member therein at its rear end, as clearly shown in Figs. 2 and 4 of the drawing.

The forward part of the chambered grate member 9 is similarly provided with a forwardly directed trunnion 14, alined with said rear trunnion 11 and with the axis of said member 9, and having a bearing at 15 between the lower and upper sections 5 and 6 of the furnace front. The construction of the trunnions 11 and 14 herein illustrated will be hereinafter described and the horizontal joint between the sections 5 and 6 of

the furnace front as herein shown is such as permits the grate member 9 to be readily withdrawn from the furnace casing for purposes of repair when the upper section 6 of the furnace front is detached. By this arrangement of the chambered revoluble grate member 9 with alined trunnions 11 and 14 at its rear and forward ends, it will be seen that said member is adapted for turning or rocking movement within the furnace casing, and in order to permit of conveniently actuating said grate member to revolve or rock the same, I have shown the forward end of the trunnion 14 provided with a socket 16 wherein is inserted one end of a lever 17, the opposite end of which is adapted, when said lever is reversely moved to turn or rock said member 9, to rest upon one or the other of two supports 18, 18, produced at opposite sides of the furnace front, as clearly shown in Figs. 1 and 4.

A weight 19 is shown detachably connected with the outer end of the lever 17 so as to serve for holding said lever and the grate member 9 connected therewith against accidental turning movement, and it will be evident that upon the removal of said weight from the lever 17, the latter may be thrown over from the position shown in full lines in Fig. 1 to that shown in dotted lines at $x$ in said figure or vice versa, so as to impart a half revolution to the cylindrical grate member, after which said weight 19 may be again attached to the lever 17, thereby affording means for holding the same securely in adjusted position until it is again desired to turn or rock the grate member in a reverse direction.

The chambered revoluble grate member 9 is formed with apertured or perforated walls adapted for the free passage of products of combustion and air supply from and to the fuel contained in the rounded fuel chamber within said chambered grate member, a preferred and very serviceable construction of said walls being shown in the detail view, Fig. 7, wherein the walls of said member 9 are shown as formed with parallel longitudinally extended grate bars 20, 20, spaced apart to permit the free passage of the air, flames and hot gases between them under the influence of the draft, said parallel longitudinally extended grate bars 20 being tied and connected together in an integral sense at their ends and at suitable intermediate points by means of arched transverse braces or connecting bars or members $20^a$, which conform to and form parts of the perimetral wall of said chambered grate member 9.

At its opposite sides, the chambered revoluble grate member 9 is provided with spaced inwardly directed flanges or projections, parallel with each other, and forming between them guide ways 21, 21 located at diametrically opposite sides of the member 9, and adapted to receive and support the opposite edge portions of diametrically extended apertured grate members or sections 22, 22, which are extended transversely through the fuel chamber within said member 9, the parts being so arranged and proportioned that when the lever 17 is in a position of rest in contact with either of the supports 18, 18 at opposite sides of the furnace front, said transverse grate members or sections 22, 22 shall extend horizontally through the central part of the fuel chamber within said member 9 in such a manner as to divide said fuel chamber into upper and lower semi-circular fire boxes or compartments 24, 24.

As shown in the drawings, there are three of the transverse grate members or sections 22, 22, each of which is formed of a plurality of integrally connected parallel grate bars spaced apart from each other, as shown at 23, 23, and extended diametrically through and across the fuel chamber within the chambered revoluble grate member 9, the extremities of such integrally connected and diametrically extended grate bars 23, 23 being engaged and supported in the guide ways 21, 21 at diametrically opposite sides of the member 9 in such a manner as to effectively brace and strengthen said chambered grate member. It will be evident that the members or sections 22, 22 may, however, be integrally connected so as to form a single horizontal grate member without departure from the invention. I do not therefore, broadly claim herein this arrangement of the transversely extended removable grate member operating the brace, the chambered cylindrical grate member since the same forms a part of my co-pending application aforesaid.

The rear transverse grate member or section 22 carries the rear trunnion 11 for the chambered member 9, said trunnion 11 being integrally formed upon said rear section or member 22 and being arranged to project rearwardly through a central opening in the closure 10 at the rear end of the member 9 with its extremity protruding therefrom for engagement with the bearing 12 at the rear wall of the furnace casing. In a similar manner the forward trunnion 14 for the cylindrical grate member 9 is integrally produced upon the forward transverse grate section 22 as clearly shown in Figs. 2, 4 and 6.

The perimetral wall of the chambered revoluble grate member 9 is uniformly apertured around its entire surface, excepting where the guide ways 21, 21 are produced at its opposite sides, by which construction it will be seen that free entry and discharge of air and gases is permitted to and from the respective fire boxes or compartments

24, 24, not merely at bottom and top of such fire boxes or compartments, but also around the sides thereof.

The lower and upper sections 5 and 6 of the furnace front are provided with fire doors 25, 25 which, when opened, afford communication through the furnace front with the respective fire boxes or compartments 24, 24 of the fuel chamber within the chambered member 9, below and above the horizontal grate members or sections thereof, and in the operation of the improved furnace, a charge of coal is thrown through the respective fire doors 25, 25 into each of said fire boxes 24, 24 the charge within the upper fire box resting upon the horizontal grate members or sections 22, while the charge within the lower fire box rests upon the grate bars 20, 20, at the lower part of the peripheral wall of the chambered grate member 9, as clearly shown in Figs. 3 and 5.

After the fire boxes 24, 24 shall have been charged and the fires kindled therein, the fuel in said fire boxes will be allowed to burn for a sufficient time to attain a certain degree of incandescence, and to permit the gases which are produced in the initial stages of the combustion to be given off, after which a fresh charge of fuel will be supplied to the lower fire box 24 to replenish the fire therein.

It will be seen that, since the opposite sides of the cylindrical revoluble member 9 are in close proximity to the opposite side walls of the furnace casing, the flames and hot gases produced from this charge of fresh or green fuel within the lowermost fire box 24 are caused to pass upward under the influence of the draft through the interstices between the transverse grate bars 23, 23 of the sections 22, 22, so as to be subjected to the influence of the incandescent fuel supported upon said transverse grate bars 23, 23 within the uppermost fire box, whereby the minute particles of fuel carried upward by the draft from said lowermost fire box are consumed, and the production of smoke due to the escape of such minute particles of fuel at the exit flue is effectively prevented, while at the same time a material economy is attained in the consumption of fuel and increased heating effect is assured.

When the fresh or green fuel in the lowermost fire box shall have in turn attained a condition of incandescence, the weight 19 is removed from the lever 17, whereupon the operator, grasping said lever, imparts a half revolution to the chambered grate member 9, so that the positions of the fire boxes 24, 24 are reversed, and the incandescent fuel which had hitherto remained at the lower part of the fuel chamber in member 9 is elevated upon the transverse apertured grate sections 22, 22 so as to be supported at the upper part of the fuel chamber, and the fuel which had hitherto been supported upon said transverse grate sections 22 within the upper part of the fuel chamber is lowered to the lower part of the said fuel chamber, after which the lower charging door 25 is opened, and an additional charge of fresh or green fuel is thrown into the then lowermost fire box 24 to replenish the fire contained therein, the smoke and hot gases thus produced in said lowermost fire box being also carried upward under the influence of the draft, through the interstices of the transverse grate sections 22, and subjected to the consuming action of the incandescent fuel in the then uppermost fire box 24.

The transverse grate sections 22, 22, being insertible at the forward end of the cylindrical grate member 9, which is open for this purpose, assures a material advantage and convenience by permitting ready withdrawal, insertion and substitution of said transverse grate sections upon the taking down of the upper section 6 of the furnace front, so that repairs may be quickly and inexpensively made in case said sections 22, 22 become warped or burned out, and also permitting the cylindrical member 9 to be formed, as herein shown, with an integral peripheral wall, unprovided with joints, if this construction of said member 9 be found desirable in practice.

The provision of the weight 19 or equivalent means for holding the cylindrical grate member 9 against turning or rotary movement is particularly desirable for use in the structure herein shown, for the reason that as said member 9 turns within the furnace casing, the fuel within the lower fire box is caused to bank at the angle between the flattened transverse grate sections 22 and the curved wall of the member 9 in such a manner as to tend to overbalance the cylindrical member at one side when the positions of the fire boxes are reversed. Such being the case, it will be evident that the employment of said holding means effectively prevents accidental displacement of the parts after adjustment, such as would be likely to occur from such overbalancing of the member 9.

The lever 17 should be locked after each supply of green fuel to the lowermost fire box, and the operation of turning or rocking the chambered member 9 is repeated during the use of the improved furnace, fresh charges of green fuel being repeatedly thrown into the lowermost fire box after each such turning or rocking of said chambered grate member, whereby it will be seen that the fire may be retained at such a high state of efficiency as may be desirable without production of smoke. The rocking or turning of the member 9 also serves to stir the fires in the respective fire boxes 24, 24 with a minimum loss of fuel, the apertures

of the transverse grate members 22 and of the perimetral wall of member 9 permitting free discharge of ashes during such turning or rocking movement.

The chambered member 9, being apertured around substantially its entire circumference, insures a supply of air at the opposite sides of the lowermost fire box 24 in excess of what is required for the combustion of the fuel therein, and such excessive air supply suffices to insure the effective combustion of the fuel in the uppermost fire box 24, passing up through the lower fire box and through the apertured transverse grate sections 22, so as to feed the fire upon said grate sections and thereby preventing the deadening of the incandescent fuel in the upper fire box such as would be likely to occur were the entire air supply drawn through the burning fuel in the lowermost fire box.

From the above description it will be seen that the improved furnace is of an extremely simple and comparatively inexpensive nature, and is particularly well adapted for use by reason of the economy in the consumption of fuel and the prevention of the production of smoke attained by its employment, and it will also be obvious from the above description that the furnace is susceptible of considerable change without material departure from the principles and spirit of the invention, and for this reason I do not desire to be understood as limiting myself to the precise formation and arrangement of the several parts of the device herein set forth in carrying out my invention in practice. For example, as shown in Fig. 8, an arrangement of gearing may be employed for turning or rocking the chambered grate member 9, in lieu of the lever 17 shown in the preceding figures, said gearing comprising a wheel 26 held upon the forward trunnion 14 of member 9 and meshing with a pinion 27, the shaft 28 of which carries a crank handle 29, with which is engaged a detent 30, serving to hold said crank handle against accidental movement. The gears 26, 27 are so proportioned that a half revolution is imparted to the member 9 at each complete rotation of the pinion 27, whereby it will be seen that at each half revolution of the member 9, the crank handle 29 is brought into position for locking engagement with the detent 30.

Having thus described my invention, what I claim and desire to secure by Letters Patent is—

1. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member arranged to turn in the casing and having apertured walls forming grate surfaces, guides at opposite sides of said members, and a grate extended transversely through said chambered member with its opposite edges removably engaged with the guides at opposite sides of said chambered member, said transverse grate dividing said chambered member into upper and lower fire boxes, one of which is adapted for communication with the exit flue and the other of which is adapted for communication with the charging door, and the opposite ends of said transverse grate having pivotal supporting means at opposite ends of said chambered member.

2. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member arranged to turn in said casing and provided with guides at its opposite sides, and an apertured grate extended transversely through said chambered member and having its opposite sides removably engaged with the guides at the opposite sides of said chambered member and dividing said chambered member into upper and lower fire boxes, one of which is adapted for communication with the exit flue and the other of which is adapted for communication with the charging door.

3. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member arranged in the casing, and an apertured grate removably arranged within said chambered member and extended transversely through the same, and dividing said chambered member into upper and lower fire boxes, one of which is adapted for communication with the exit flue and the other of which is adapted for communication with the charging door, the opposite ends of said transverse grate having journals whereon the device is supported for turning movement.

4. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member arranged in the casing, an apertured grate removably arranged within said chambered member, and extended transversely through the same and dividing said chambered member into upper and lower fire boxes, one of which is adapted for communication with the exit flue and the other of which is adapted for communication with the charging door, the opposite ends of said transverse grate having journals whereon the device is supported for turning movement, a part operatively connected with one of said journals to impart turning movement thereto, and means, engageable with said part to hold the same against movement.

5. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member mounted to turn in the casing,

an apertured grate extended transversely through said chambered member and adapted, when positioned horizontally, to divide said member into upper and lower fire boxes, one of which is adapted for communication with the exit flue and the other of which is adapted for communication with the charging door, and means capable of operation to hold said chambered member against turning movement in the casing when said apertured transverse grate is horizontally positioned.

6. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member mounted to turn in the casing and provided with internal guides, and an apertured grate insertible at the end of said chambered member and engageable with the internal guides thereof, said apertured grate being extended transversely through the chambered member and dividing the same into upper and lower fire boxes, one of which is adapted for communication with the exit flue, and the other of which is adapted for communication with the charging door.

7. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member within the casing and having guides at opposite sides, trunnions at opposite ends of said chambered member whereon said member is adapted to turn, and an apertured grate extended through said chambered member between said trunnions and having its opposite sides engaged with said guides, and dividing said chambered member into upper and lower fire boxes, one of which is adapted for communication with the exit flue, and the other of which is adapted for communication with the charging door.

8. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member mounted to turn within the casing and provided with guides at its opposite sides, and an apertured grate comprising sections extended transversely across said chambered member with ends supported by the guides at opposite sides thereof, and dividing said chambered member into upper and lower fire boxes, one of which is adapted for communication with the exit flue, and the other of which is adapted for communication with the charging door.

9. A furnace of the character described having a casing provided with an exit flue and with a charging door, a chambered member mounted to turn within the casing and provided with guides at its opposite sides, and open at one end, and an apertured grate comprising sections insertible at the open end of the chambered member, said sections being transversely extended across the chambered member with ends supported by the guides at opposite sides thereof, and dividing said chambered member into upper and lower fire boxes, one of which is adapted for communication with the exit flue, and the other of which is adapted for communication with the charging door.

In witness whereof I have hereunto signed my name this 10 day of December 1907, in the presence of two subscribing witnesses.

JOHN HARRIGAN.

Witnesses:

J. L. CAPLINGER,

F. W. WIMAN.