No. 862,730. PATENTED AUG. 6, 1907.

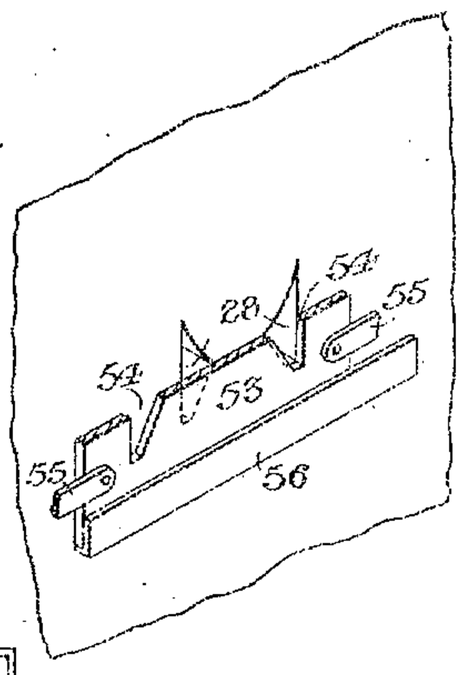
W. GRAHAM.

STEAM BOILER FURNACE.

APPLICATION FILED MAY 14, 1901.

4 SHEETS—SHEET 1.

Fig. 7.



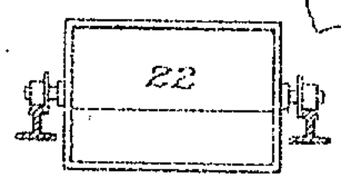
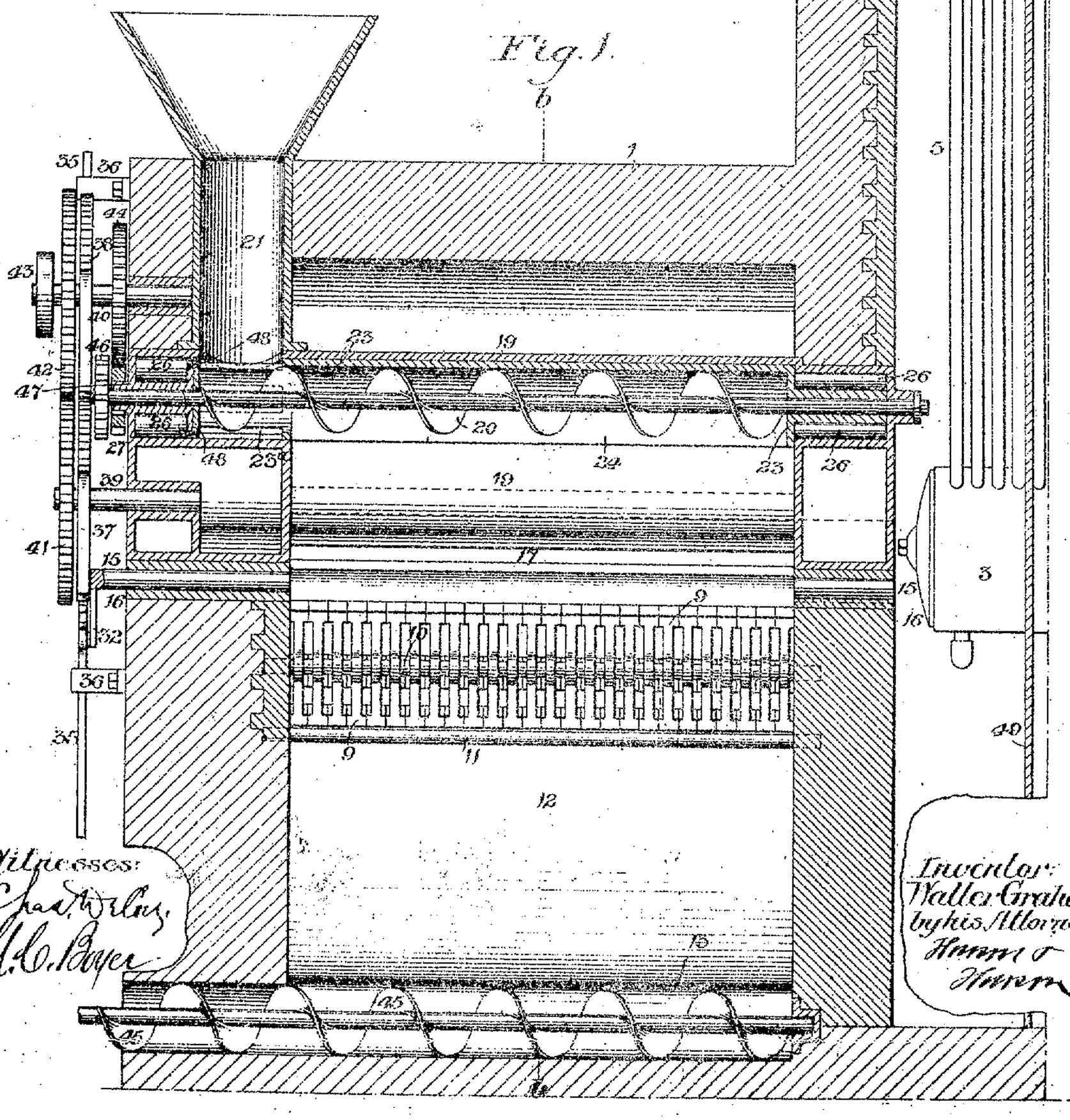


Fig. 1.



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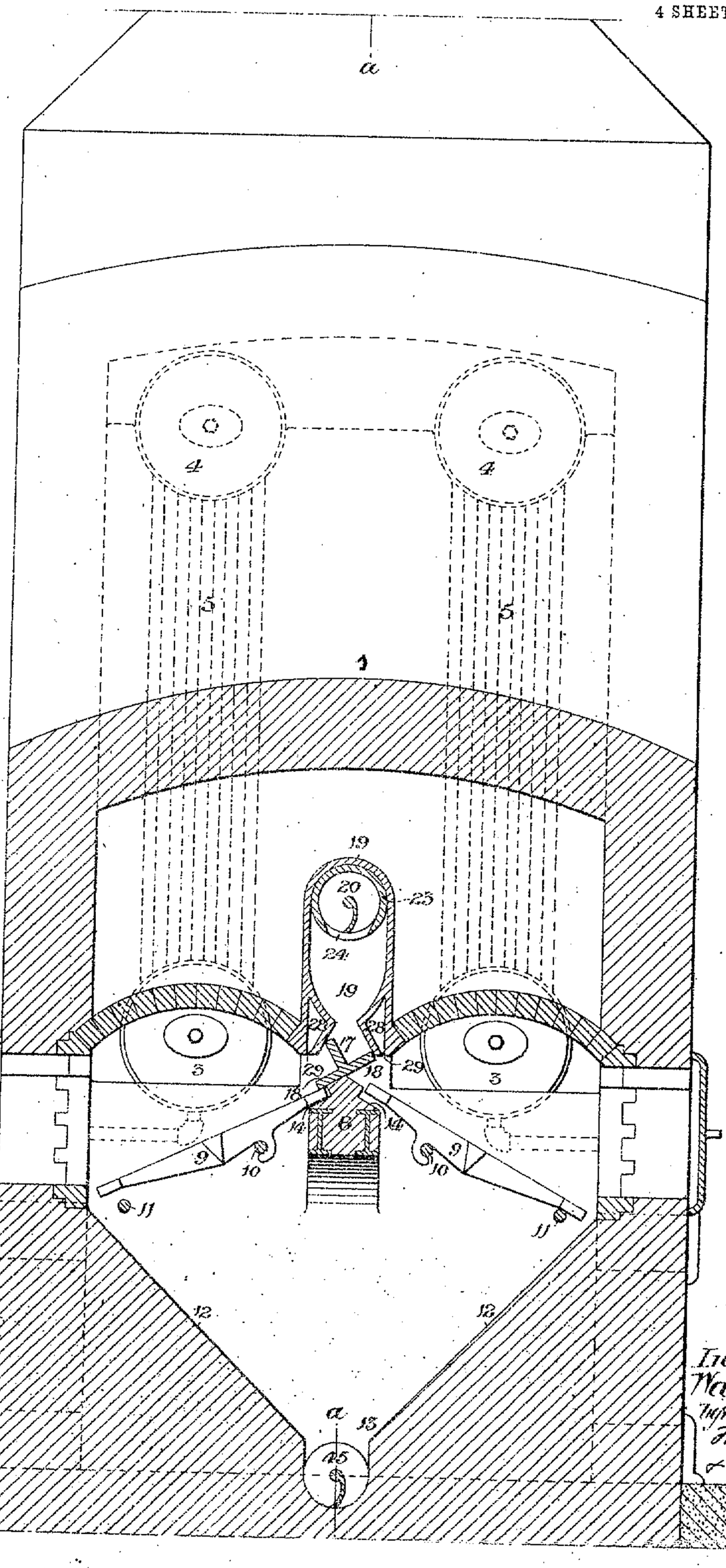
4 SHEETS—SHEET 2.

Fig. 2.



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4 SHEETS—SHEET 3.

Fig. 3.

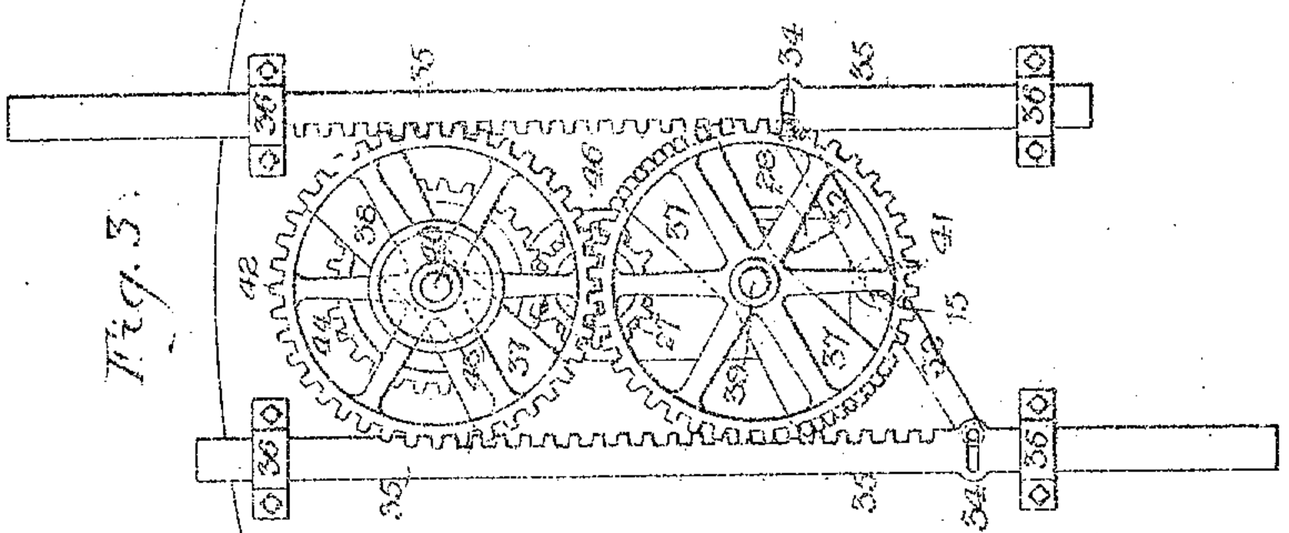
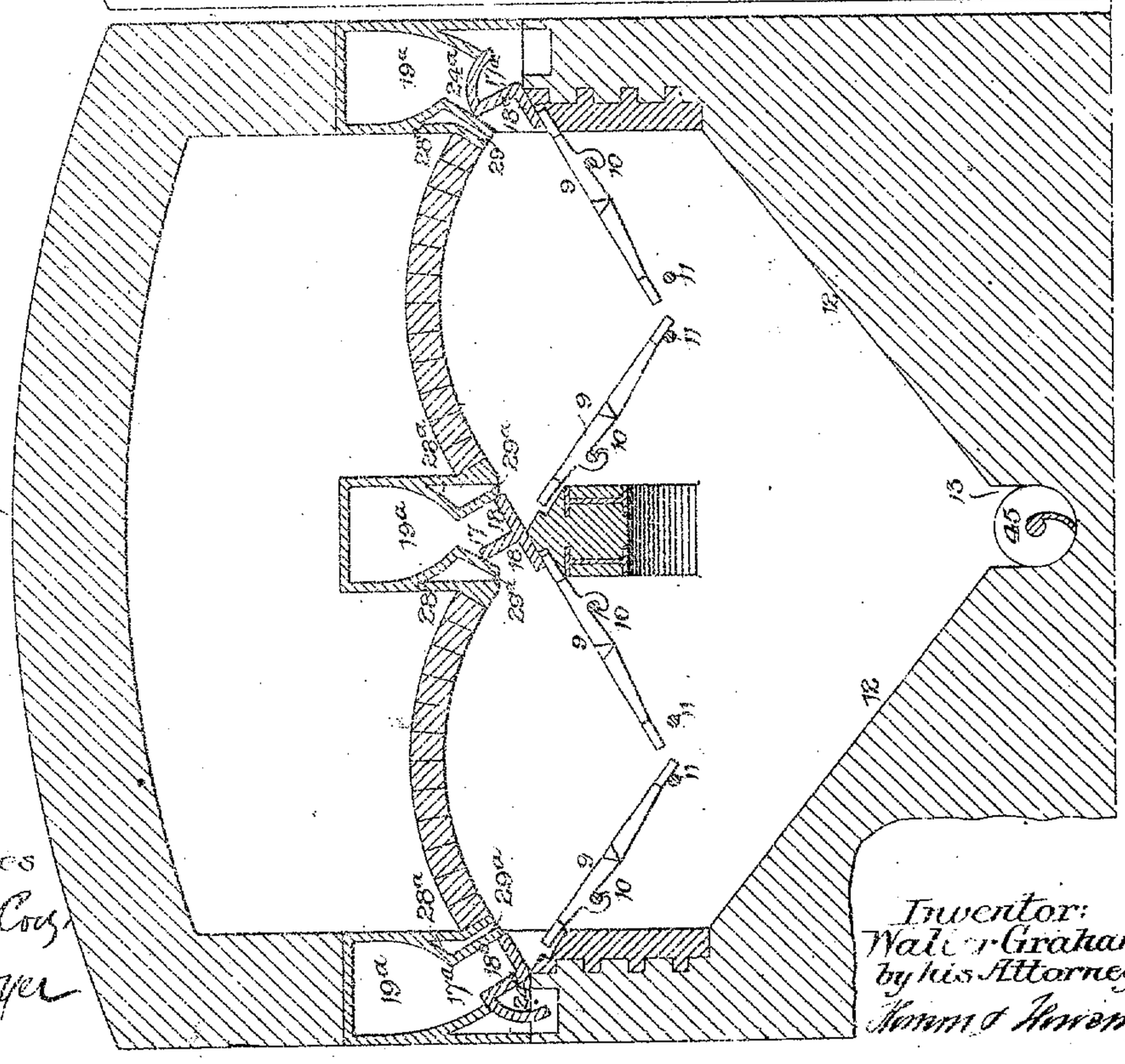


Fig. 5.



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4 SHEETS—SHEET 4.

Fig. 6.

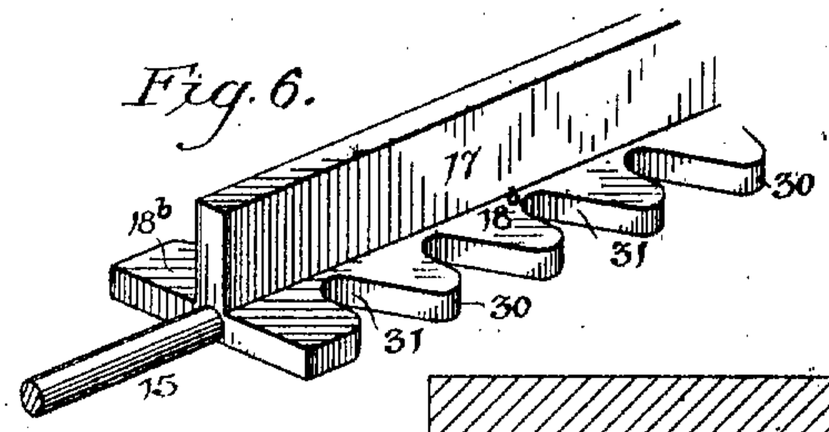
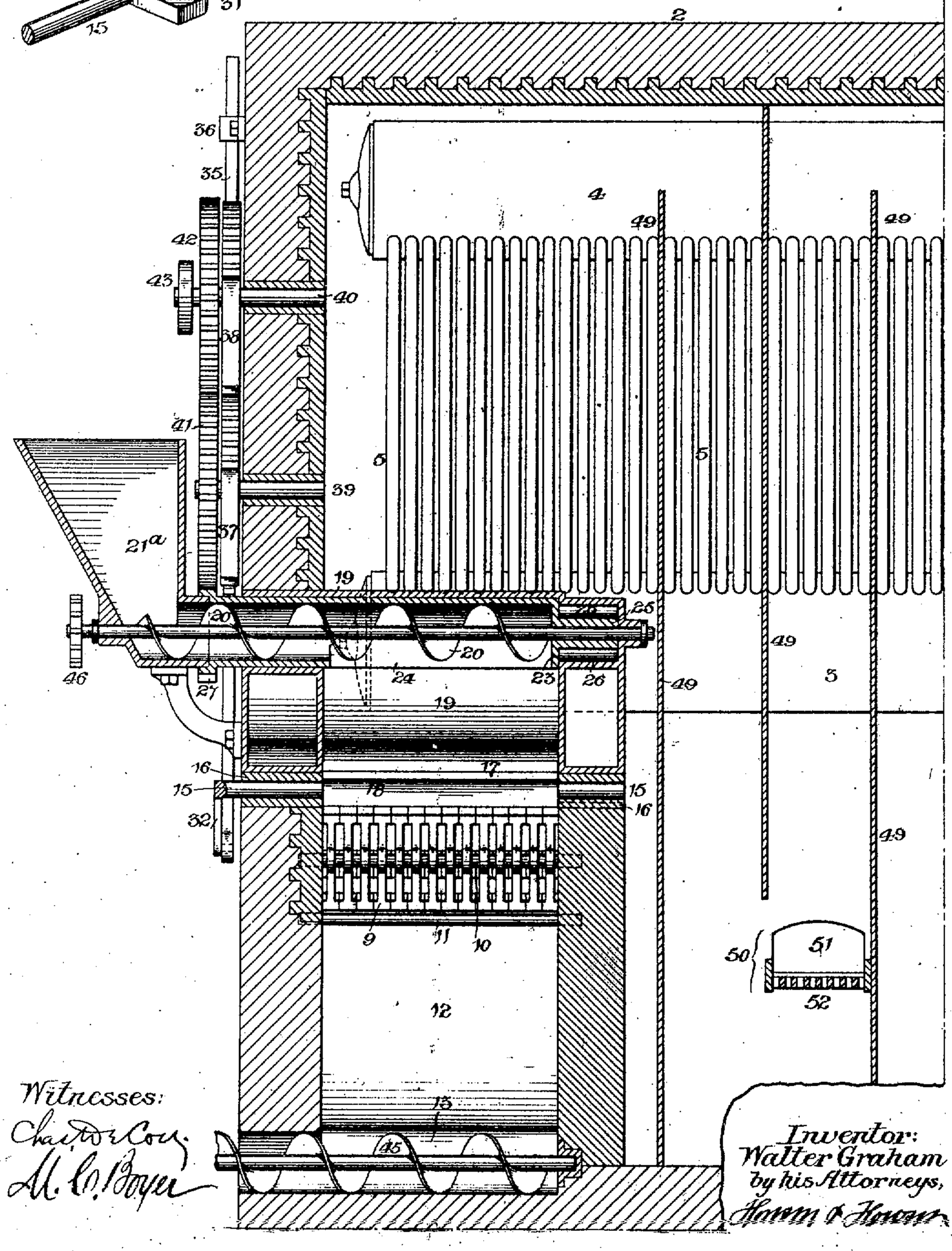


Fig. 4.



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UNITED STATES PATENT OFFICE.

WALTER GRAHAM, OF ARDMORE, PENNSYLVANIA.

STEAM-BOILER FURNACE.

No. 862,730. Specification of Letters Patent. Patented Aug. 6, 1907.

Application filed May 14, 1901. Serial No. 60,168.

To all whom it may concern:

Be it known that I, WALTER GRAHAM, a citizen of the United States, and a resident of Ardmore, Montgomery county, Pennsylvania, have invented certain Improvements in Steam-Boiler Furnaces, of which the following is a specification.

My invention relates to improvements in steam generators, and particularly to certain improvements in automatic stoking and smoke consuming devices for the furnaces of such generators.

The improvements in the stoking and smoke consuming devices which I have constructed, are such that I am enabled to distribute the fuel evenly and at regular intervals over the grate bars; effect a preliminary coking of such fuel upon coking plates before it is discharged onto the grate; consume the gases arising during the coking operation and the subsequent burning of the solid fuel, and automatically rake the fire as such fuel is distributed over the grate bars.

My invention also includes special means for feeding the fuel from a hopper to the coking plates and special mechanism for moving said coking plates so that the fuel may be discharged therefrom onto the grate bars.

My invention also includes special means of preheating the air and feeding the same, together with the gases generated by the coking of the fuel, at the point of the discharge of such fuel over the grate. The feed of such heated air is automatically regulated by the speed of the stoking mechanism.

Other features of my invention will be more fully pointed out hereinafter, reference being had to the accompanying drawings, in which:—

Figure 1, illustrates a longitudinal section of my improved steam boiler furnace, taken on the line *a*—*a*, Fig. 2; Fig. 2, is a sectional elevation of the furnace chamber, taken on the line *b*—*b*, Fig. 1; Fig. 3, is a front elevation of the furnace chamber, showing the means for driving the feeding and stoking apparatus; Fig. 4, is a sectional view similar to Fig. 1, illustrating a modified form of the structure, in which the furnace chamber is arranged within the boiler chamber, and beneath a portion of the tubes of the same; Fig. 5, is a sectional view, similar to Fig. 2, illustrating a form of furnace chamber in which a double set of grate bars is used, and Figs. 6 and 7, are views illustrating details of the invention.

In the drawings, 1 represents an inclosing structure for the furnace which is shown as adjoining an inclosing structure 2 for a suitable form of boiler. In the present instance, such boiler comprises lower mud drums 3 and upper steam drums 4; communication between these drums being afforded by pipes 5. In the furnace chamber a wall or arch 8 is arranged, and the grate bars 9, supported in the present instance by the cross bars 10 and 11, are disposed so as to be inclined from said wall or arch toward the side walls 12, which latter incline toward the ash pit 13.

The apex of the wall or arch 8 is disposed between the lower drums 3 and at a point just above the lower portion of the same, and this apex is grooved at 14 to receive the ends of the grate bars; such grooving being of a depth to permit the bars to be depressed at this end so as to shake the same and thus automatically effect the raking of the fire.

The grate bars 9 may rest on both arch and side walls, in which case, the cross bars 10 and 11 may be dispensed with; or they may rest on the side walls and said bars 10 and 11, dispensing with the central supporting arch.

Mounted on suitable spindles 15 which are journaled at 16 in the walls of the inclosing structure 1, is a rocking member 17 of inverted T-shape in cross section, and having the bottom side plates 18. This member 17 is adapted to be oscillated or rocked across the top of the apex of the wall or arch 8. Disposed directly above this structure and partly inclosing the same is a box-like hopper or casing 19, in the upper portion of which suitable conveying mechanism for the fuel may be arranged, or said hopper may be entirely open at the top, and hand fed. This hopper 19 serves to supply the T-shaped member 17 with fuel. The side extensions 18 of this member serve as coking plates, while the upright central portion acts as a shovel.

As a means of conveying the fuel, I may use an Archimedean screw 20 or other conveyer, such conveyer leading from a hopper 21 into which the fuel may be dumped from an endless conveyer indicated at 22. This screw conveyer works in a rotatable casing 23, journaled in the front and rear ends of the casing 19, and this rotatable casing 23 is provided with a longitudinal aperture 24, whereby the fuel carried into the same by the screw 20, or other means, may be dumped at regular intervals onto the coking plates 18 of the T-shaped rocking member 17. This casing 23 is reduced at the ends at 25 so as to prevent any longitudinal movement of the same, and rollers 26 are provided in order that its movement may be as easy as possible. For the purpose of rotating this casing 23, I mount a gear wheel 27 on the end of the same, which gear wheel may be driven from any suitable source of power.

The fuel after it has been dumped onto the coking plates 18 of the rocking member 17, remains on said plates within the casing 19 for a short period of time, and being heated by the products of combustion arising from the burning fuel, the fuel within the casing will be coked on the coking plates, and the gases set loose by the coking operation will be burned as this coked fuel is discharged over the bed of the fire when

the rocking member 17 is oscillated. In order to insure perfect combustion of such gases, I provide for the admission of air to the furnace as the fuel is discharged by the plates 18, by arranging chambers 28 adjacent to the casing 19, such chambers communicating with the atmosphere. The air within said chambers being heated as the fuel is coked on the plates 18, such heated air will be fed into the furnace through the apertures 29, simultaneously with the discharge of the fuel therein.

I provide special means for oscillating the rocking member 17 at regular intervals, which may be predetermined, and I arrange the ends of the grate bars in the path of the coking plates 18, so that as said plates are moved, they will strike the ends of the grate bars and thoroughly agitate the rake of the fire. The fire will thus be kept clean by the continual shaking of said grate bars.

In Fig. 6, I have shown a modified form of rocking member which is provided with coking plates 18^b having alternate side projections and depressions 30 and 31. By this means only the alternate grate bars will be agitated by the coking plates.

When the rocking member 17 has discharged the contents of one coking plate onto one side of the fire, the other coking plate is brought into position to receive a supply of fuel for the opposite grate bars. The parts are so arranged that the screw conveyer 20 will carry a proper quantity of fuel into the casing 23 during the rotation of the same between the times when its longitudinal aperture 24 is in position to discharge such fuel, and the next supply of the latter will be dropped onto the opposite coking plate 18. The fuel so disposed, undergoes the same treatment as before noted, and at the proper time said rocking member 17 is moved so as to dump the coal onto the opposite grate, such movement of the rocking member shaking the grate bars and helping to clean the fire.

I do not wish to limit myself to any particular mechanism for oscillating or rocking the member 12, but in Figs. 1, 3 and 4, I have shown means for accomplishing this object.

Carried at the outside of the spindle 15 for said rocking member 17, is a lever 32, having projecting pins 33 at its ends, such pins adapted to slots 34 in the lower ends of vertically movable bars 35. These bars are guided in brackets 36 mounted on the front wall of the furnace casing, and are moved up and down by means of the gear segments 37 and 38, mounted on the shafts 39 and 40, respectively. For the purpose of driving these gear segments 37 and 38, I provide the gear wheels 41 and 42, which mesh together beyond the rack bars 35, and which may be driven from any suitable source of power, for instance, the belt wheel 43. To drive the rotatable casing 23, a gear wheel 44 is mounted on the shaft 40, which gear wheel meshes with the gear wheel 27 carried by the end of said casing, so that these parts may be driven together and the gearing is so timed that said casing will dump its contents twice during the rotation of the gear wheels 41 and 42, said rocking member 17 being oscillated twice during the same period of time.

For the purpose of collecting and disposing of the ashes shaken from the grate, I incline the walls 12 of the ash pit as shown, and form a semi-circular trough 13 at the bottom of the same, within which is mounted a screw conveyer 45 for carrying away such ashes. This conveyer may load to any desired point, and may be driven by any suitable means.

The screw 20 for conveying fuel to the rotatable casing 23, may be driven from the mechanism for operating the shaking or oscillating member 17 and the rotating casing 23, or it may be driven by any other suitable means. For the purpose of transmitting such power, the shaft of this conveyer carries a gear or chain wheel 46.

In order to permit the mounting of the conveyer screw 20 within the rotatable casing 23, the end of the casing is made in a separate piece 47, secured to the main portion by set screws 48. To permit the fuel from the hopper 21 to enter the casing 23, the latter is slotted at 23^a, as clearly shown in Fig. 1.

It will be understood, of course, that my improved furnace is capable of employment with various types of steam boilers. In Figs. 1 and 4, it is shown in connection with a type of boiler in which baffle plates 49 are used to divert the products of combustion passing from the fire chambers of the furnace, and in which auxiliary fires 50, fed at 51 from the side walls of the furnace casing and having grate bars 52, are situated adjacent the baffle plates for the purpose of consuming the gaseous portions of the products of combustion.

I prefer to feed air alternately to the air chambers 28 from the atmosphere, and in Fig. 7, I show a damper or valve 53 for cutting off one of said chambers 28 when the other is open to the atmosphere. By this means, the chamber which is closed is filling with heated air during the coking operation on one of the plates 18, and when it is desired to spread such coked fuel upon the grate bars, the chamber 28 which has been closed to the atmosphere, will be opened and the hot air therein will be distributed, with the coked fuel, and thereby insure perfect combustion. The register plate 53 has the openings 54, by which the ends of the chambers 28 are alternately opened and closed to the atmosphere. Secured to each end of said plate 53 are the links 55, which are connected to a suitable portion of the mechanism for oscillating the grate bars in order that said plate may be moved back and forth. To guide this plate, I provide the flanged member 56 which may be secured to the front of the furnace in any suitable manner.

The structure shown in Fig. 1, comprising a furnace and stoking apparatus, is applicable to almost any vertical tube boiler now in present use, and may be connected thereto and when so connected, will serve to heat such boiler. The structure of such furnace and stoking apparatus is practically independent of the boiler structure. In Fig. 4, however, I have shown a structure in which the furnace, stoking apparatus and boiler are contained within a single built up casing. In this form of apparatus the fuel is fed entirely from the front of the furnace through a hopper 21^a. Other slight changes are made in the mechanism for operating the fuel feeding apparatus, and the oscillating member carrying the coking plates. It will be understood, however, that these changes do not affect the operation of the apparatus, as in all other respects the operation is exactly the same as that of the apparatus shown in Fig. 1.

In Fig. 5, I have illustrated a form of furnace in which duplex grate bars are used, four sets of bars in all being shown, forming substantially two fire chambers. The

two central sets of grate bars are fed from a hopper 19^a at the bottom of which is the usual oscillating member as shown in Fig. 1, carrying the coking plates. The operation of this portion of the structure is substantially the same as the structure shown in Fig. 1, the usual air chambers shown at 28^a, with the apertures 29^a, being also employed. In order to feed the sets of side grate bars, however, I provide the oscillating members 17^a having a single coking plate 18^a. These members are driven from the same mechanism driving the member 17, but when the said coking plates are in engagement with the grate bars as shown at the right hand side of Fig. 5, it is necessary to close the lower portion of the hoppers 19^a and for this purpose I provide the curved extensions 24^a, which are carried by the members 17^a. In this structure, all of these oscillating members and coking plates may be operated as in the other forms of the structure, the only thing necessary being to duplicate a portion of such apparatus and provide suitable connections between said parts.

I do not wish to limit myself to the precise construction as herein shown and described, but

Having thus described my invention, I claim and desire to secure by Letters Patent:

1. The combination in a furnace, of a series of grate bars, a fuel hopper having a pair of outlets, and an oscillating bottom for said hopper for feeding fuel directly to said grate bars, said bottom being so constructed as to close one outlet of the hopper while delivering fuel through the other outlet.

2. The combination in a furnace, of a series of movable grate bars, supports for said grate bars, and an oscillating member for feeding fuel to the grate bars and oscillating said bars at the same time.

3. The combination in a furnace, of two sets of movable grate bars for separate fires, supports for said grate bars, and an oscillating member for feeding fuel to said grate bars alternately, said member serving also to oscillate the grate bars.

4. The combination in a furnace, of a series of inclined grate bars, supports for said bars so arranged as to permit movement of the latter at the upper portion of the same, and an oscillating member for feeding fuel to the grate bars, said member serving also to oscillate said bars during the fuel feeding operation.

5. The combination in a furnace, of a series of inclined grate bars for separate fires, supports for said grate bars so arranged as to permit movement of the latter at the upper portion of the same, and an oscillating member for feeding fuel to the fires alternately, said member serving also to oscillate each set of grate bars during the fuel feeding operation.

6. The combination in a furnace, of a series of inclined grate bars for separate fires, supports for said grate bars so arranged as to permit movement of the latter at the upper portion of the same, and a duplex oscillating member for feeding fuel to the fires alternately, said member serving also to oscillate each set of grate bars during the fuel feeding operation.

7. The combination in a furnace, of a series of grate bars, a fuel hopper having a pair of outlets, an oscillating bottom for said hopper for feeding fuel directly to said grate bars, and continuously operated means for supplying said hopper and the oscillating bottom with fuel, said bottom being so constructed as to close one outlet of the hopper while delivering fuel through the other outlet.

8. The combination in a furnace, of a series of movable grate bars, supports for said bars so arranged as to permit movement of the latter, an oscillating member for feeding fuel to said bars, said member serving also to contact with and rock the grate bars when feeding the fuel, and means for supplying said oscillating member with fuel.

9. The combination in a furnace, of a series of grate bars, supports for said bars so arranged as to permit movement of the latter, a member for supplying fuel to said bars, means for oscillating said member in contact with the bars to move the same, and provision for introducing air in the chamber as the fuel is spread on the grate bars, said oscillating member acting in certain positions as a complete closure for the fuel outlet of the hopper.

10. The combination in a furnace, of a series of grate bars, an oscillating member for receiving and supplying fuel to said bars, said member lying within the heat zone of the furnace whereby the fuel will be partially coked before it is fed to the grate bars, and provision for introducing air in the furnace simultaneously with the discharge of the partially coked fuel over the grate bars, said oscillating member acting in certain positions as a complete closure for the fuel outlet of the hopper.

11. The combination in a furnace, of a pair of combustion chambers, a hopper located between said chambers, an oscillating bottom for said hopper for feeding fuel to the combustion chambers, air chambers adjacent the lower part of said hopper within the heat zone and in communication with the atmosphere, and means for regulating the supply of air discharged into the combustion chambers from said air chambers, said hopper bottom being so constructed as to close one outlet of the hopper while delivering fuel through the other outlet.

12. The combination in a furnace, of a pair of combustion chambers, a hopper located between said chambers, an oscillating bottom for said hopper, means for feeding fuel to said bottom, means for operating the same whereby fuel may be fed to the combustion chambers alternately, said bottom being so constructed as to cut off the outlet to one combustion chamber while feeding fuel to the other, air chambers arranged at the lower part of the hopper within the heat zone, said air chambers communicating with the atmosphere, and means for delivering a supply of air as the fuel is discharged into said combustion chambers.

13. The combination in a furnace, of a series of movable inclined grate bars, supports for said bars arranged to permit movement of the opposite ends of the same in different directions, an oscillating member for feeding fuel to said grate bars and for rocking the same, and a rotatable hopper in line with the oscillating member for supplying fuel thereto.

14. The combination in a furnace, of the grate bars, a fuel feeding hopper arranged above the furnace chamber, a movable bottom for said hopper, side extensions carried by said bottom and forming coking plates, means for delivering fuel onto said coking plates, and means for moving the bottom so as to discharge the coked fuel over the grate bars, said bottom being so constructed as to close one outlet of the hopper while delivering fuel through the other outlet.

15. The combination in a furnace, of the grate bars, a fuel feeding hopper arranged above the furnace chamber, a movable bottom for said hopper, side extensions carried by said hopper and forming coking plates, means for delivering fuel onto said coking plates, means for moving the bottom so as to discharge the coked fuel over the grate bars, said bottom being so constructed as to close one outlet of the hopper while delivering fuel through the other outlet, and means for supplying air simultaneously with the deposit of the fuel.

16. The combination in a furnace, of the grates, a fuel hopper arranged at the center of the same, an oscillating member forming the bottom of said hopper, side extensions carried by said oscillating member and forming coking plates, means for delivering fuel from the hopper to said bottom, and means for oscillating the latter so as to discharge the fuel over the grates, said bottom being so constructed as to close one outlet of the hopper while delivering fuel through the other outlet.

17. The combination in a furnace, of a feeding hopper arranged at the center of the same, a movable bottom for said hopper having side extensions forming coking plates, a rotating cylinder arranged at the upper part of said hopper, means for feeding fuel into said cylinder, means for rotating the cylinder, and means for oscillating the movable bottom of the feed hopper, said bottom acting under certain conditions as a complete closure for the fuel outlet of the hopper, all of said parts combined to operate at predetermined intervals.

18. The combination in a furnace, of a series of combustion chambers therein, a fuel hopper arranged within the furnace chamber, an oscillating bottom for said hopper, air chambers in communication with the atmosphere arranged at the lower part of said hopper and opening into the combustion chambers, means for feeding fuel to the oscillating bottom of the hopper, mechanism connected therewith for oscillating said hopper bottom, and mechanism for regulating the amount of air fed to the fires, said bottom acting at times as a complete closure for the fuel outlet of the hopper.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

WALTER GRAHAM.

Witnesses:
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