T. H. GARLAND.

FIRE BOX.

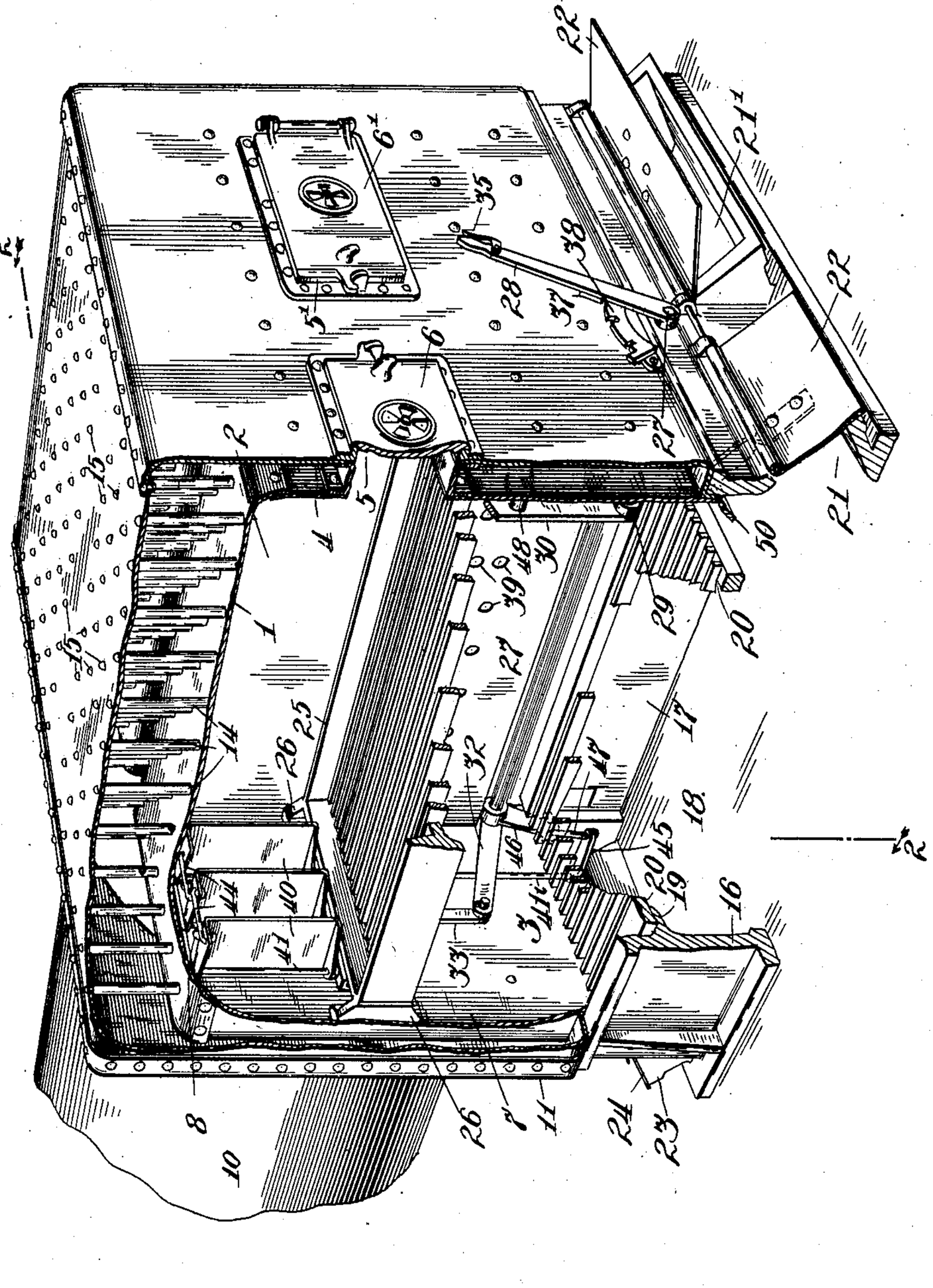
APPLICATION FILED MAR. 12, 1910.

997,988.

Patented July 18, 1911.

4 SHEETS—SHEET 1.

Fig. 1.



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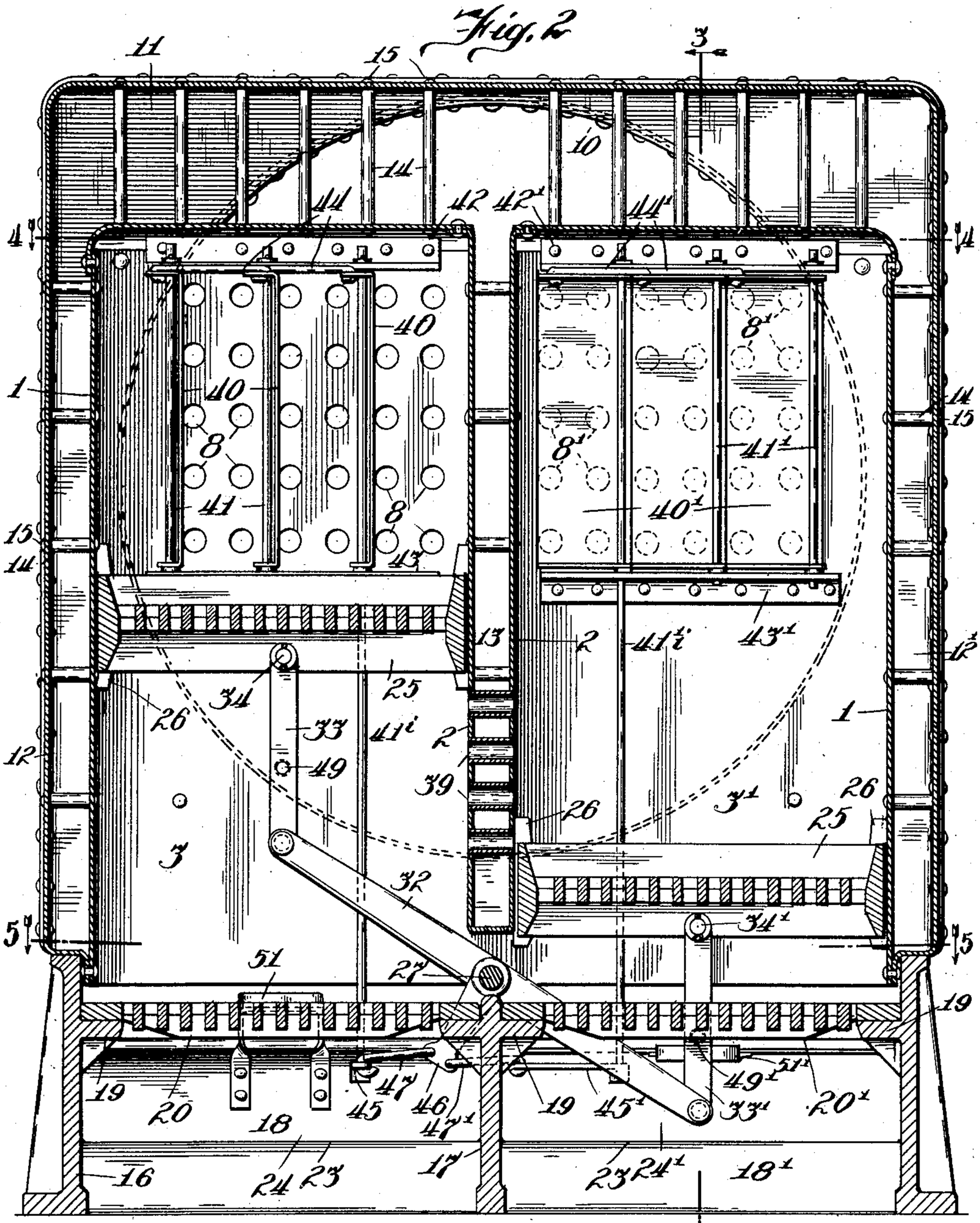
4 SHEETS—SHEET 2.

Fig. 2



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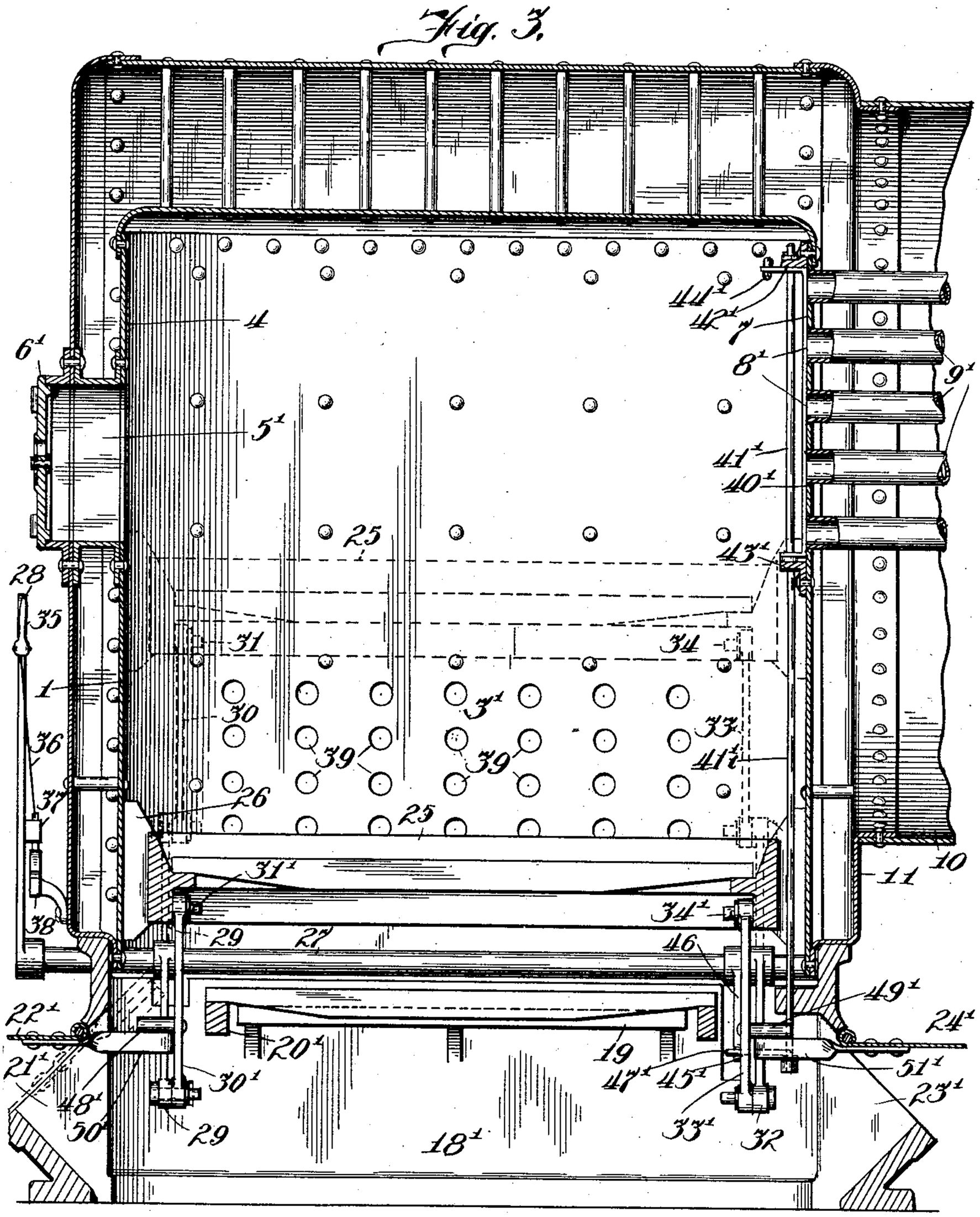
4 SHEETS—SHEET 3.

Fig. 3.



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4 SHEETS—SHEET 4.

Fig. 4.

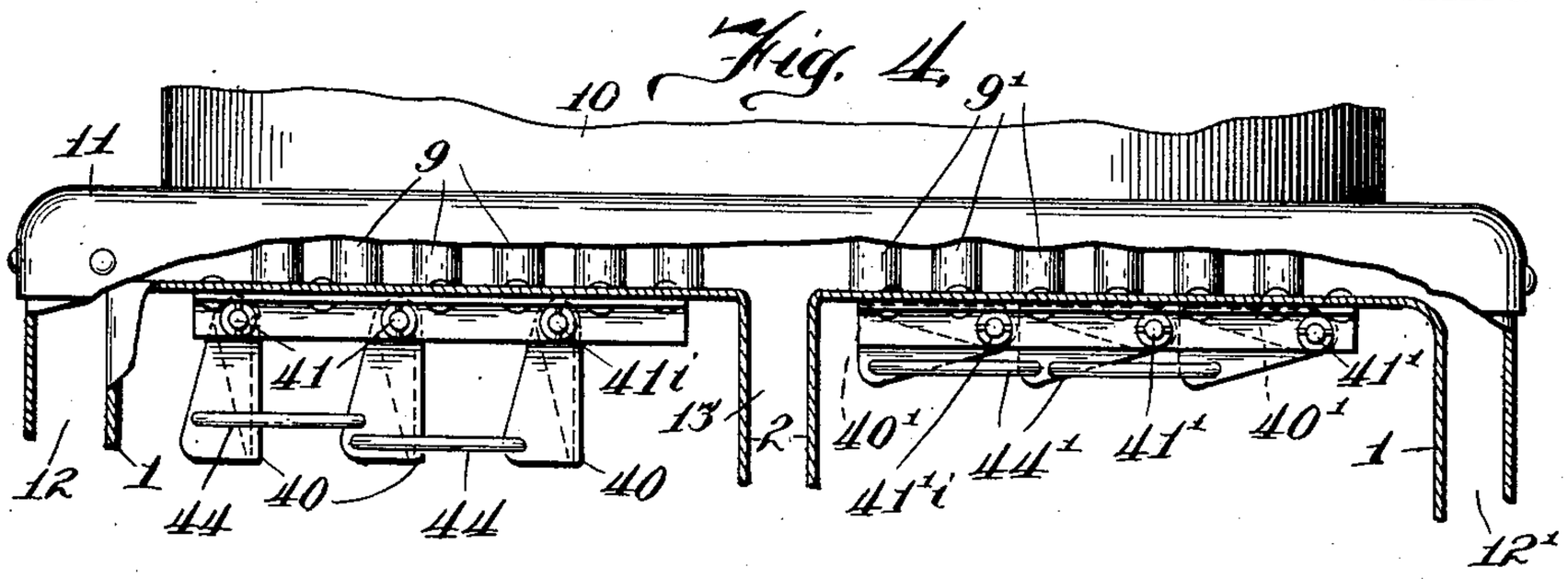
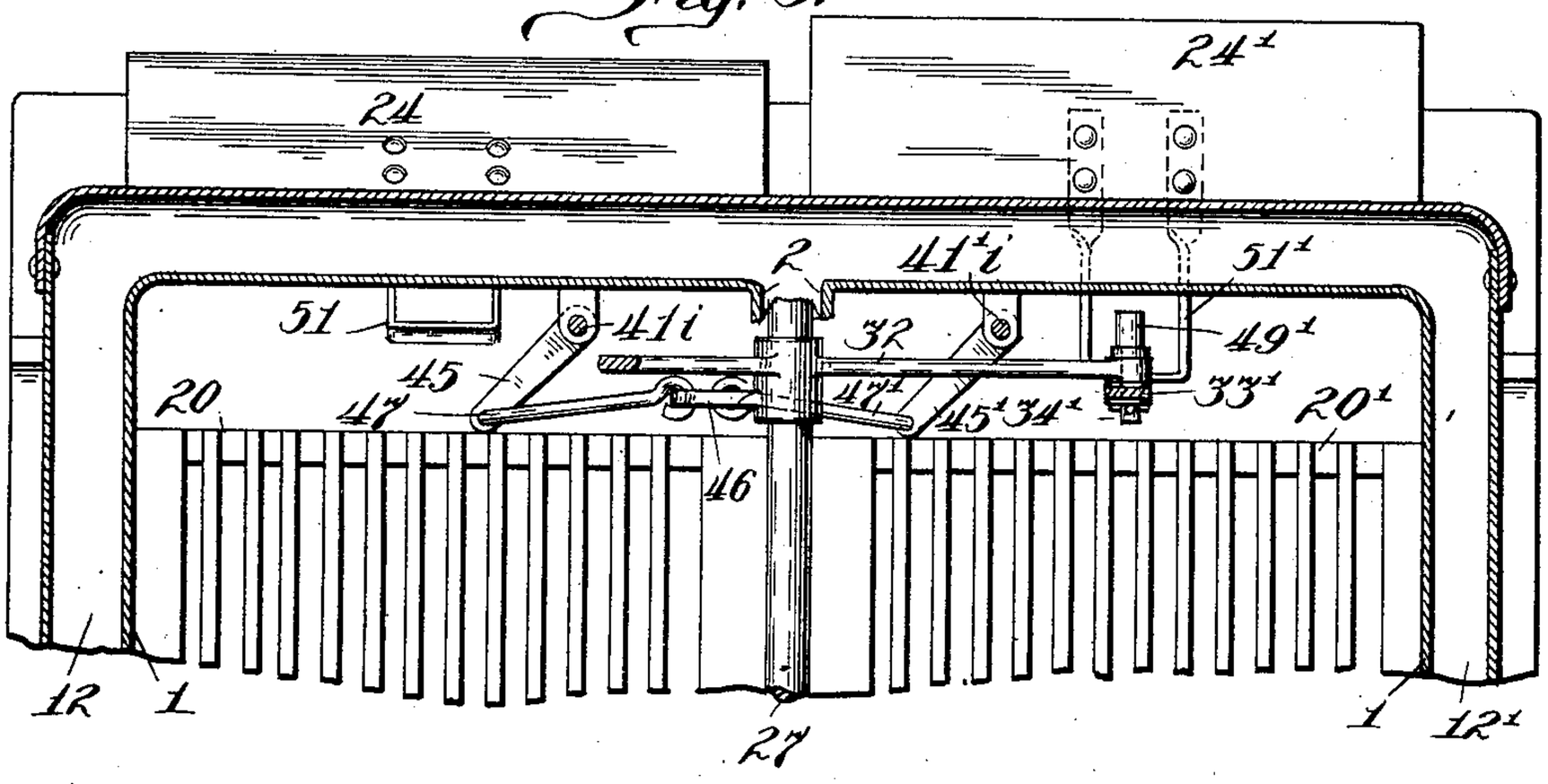


Fig. 5.



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UNITED STATES PATENT OFFICE.

THOMAS HENRY GARLAND, OF CHICAGO, ILLINOIS.

FIRE-BOX.

997,988. Specification of Letters Patent. **Patented July 18, 1911.**

Application filed March 12, 1910. Serial No. 548,942.

To all whom it may concern:

Be it known that I, THOMAS HENRY GARLAND, a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in a Fire-Box, of which the following is a full, clear, and precise specification.

My invention relates to furnaces and particularly to fire-boxes operating in conjunction with boilers, and the invention contemplates improved construction, arrangement and operation.

Among the important objects of my invention are to provide a construction involving a plurality of fire boxes or furnace sections, preferably two; to provide in each section a main grate which is vertically bodily movable; to provide an outlet from each section to a chimney or the flues of a boiler; to provide improved mechanism for controlling the relative vertical bodily movement of the main grates of the sections; to provide mechanism automatically controlled to adjust the outlets from the sections to the chimney or flues in accordance with the vertical positions of the grates; to provide intercommunicating passageways between the sections and to so arrange said passageways that the smoke and gases from the lowermost grate, which is charged with green coal, will be forced to pass upwardly through the raised grate to be entirely consumed before reaching the flues or chimney; to provide draft openings for the sections automatically controlled upon the bodily adjustment of said sections and so controlled that the draft for a raised grate must enter through the lowered grate and through the intercommunicating passageways whereby the smoke and gases from the green coal on the lowered grate are thoroughly intermingled with air and their combustion upon passage through the raised grate rendered more complete; to provide in each section an auxiliary grate or intercepting grate between the main grate and ash pit for receiving hot coals falling through the main grates so that the heat from the falling coals can be more fully utilized for aiding in the combustion of gases and smoke flowing through the intercommunicating passageways; to provide for improved construction and arrangement whereby the vertically movable main grates are perfectly balanced so that their vertical adjustment can be readily and easily accomplished; and in general to provide a more simple, a more easily operated, a more automatic and a more efficient mechanism of the class referred to.

One embodiment of my invention is fully described in the following specification and illustrated on the accompanying drawings, in which drawings—

Figure 1 is a perspective view of a fire box with a section of a boiler attached thereto and part of the side wall thereof removed, and interior parts shown in section to more clearly illustrate the arrangement, Fig. 2 is a sectional view taken on plane 2—2, Fig. 1, Fig. 3 is a sectional view taken on plane 3—3, Fig. 2, Fig. 4 is a plan view taken from plane 4—4, Fig. 2, showing the rear end of the fire-box and showing particularly the controlling mechanism for the outlets from the fire-box sections, and Fig. 5 is a plan view taken from plane 5—5, Fig. 2, of the rear end of the fire-box, showing particularly the lever mechanism for controlling the outlet adjusting mechanism.

The fire-box shown is rectangular in shape and comprises a main housing or shell 1 through which extends a vertical central partition 2 which divides the housing into a left and right compartment 3 and 3′. The front wall 4 of this housing has fuel feed openings 5 and 5′ leading respectively to compartments 3 and 3′ and controlled by doors 6 and 6′. The rear wall 7 of the housing has sets of outlet openings 8 and 8′ leading respectively from the upper parts of compartments 3 and 3′, and these outlets may communicate first with a common compartment connected with the ends of flue sets 9 and 9′, or, as shown, may communicate directly with these flue sets which extend through a boiler shell 10 in which water is to be heated. As shown this boiler shell connects with an outer shell 11 surrounding the top and sides of the fire-box and forming the side water legs 12 and 12′. The partition 2 is shown double to form a central water leg 13, so that the fire-box sections are intimately surrounded by water to be heated. The main housing and the outer shell are suitably spaced apart and held rigid with reference to each other by means

of spacers 14 and bolts 15. This shell frame of the fire-box rests on a rectangular bed frame 16 having the central longitudinal partition 17 for dividing the bed frame into left and right ash pits 18 and 18′. The side walls of the bed frame and the partition 17 thereof have laterally extending shelves 19 for supporting auxiliary grate frames 20 and 20′, these grate frames terminating short of the front and rear walls of the bed frame, as best shown in Fig. 3. The front wall of the bed frame has draft openings 21 and 21′ controlled by draft doors 22 and 22′ respectively, while the rear wall of the bed frame has draft openings 23 and 23′ controlled by draft doors 24 and 24′ respectively. Draft openings 21 and 23 communicate with the ash pit 18, and openings 21′ and 23′ communicate with the ash pit 18′. These draft openings also enable the removal of ashes from the ash pits.

In each of the compartments 3 and 3′ there is a main grate frame 25 bodily movable vertically in the compartment and having at its corners guide extensions 26 engaging in the corners of the compartment to guide the grate frame in its vertical movement. Passing longitudinally centrally through the fire-box between the partition 17 and the partition 2 is a shaft 27 whose ends are suitably journaled in the bed frame and whose front end terminates outside of the bed frame in a lever 28 whereby the shaft may be rocked. At its front end the shaft carries a beam 29 extending laterally into compartments 3 and 3′ into the spaces between the front wall of the bed frame and the adjacent ends of the grate frames 20 and 20′. In the compartment 3 the end of the beam pivots to the lower end of a link 30 whose upper end pivots to a pin 31 at the front end of the main grate frame 25 in said compartment. The opposite end of the beam pivots to a link 30′ whose upper end pivots to the pin 31′ at the front end of the main grate frame in compartment 3′. The rear end of shaft 27 carries a beam 32 parallel with beam 29, the left end of this beam 32 pivoting to link 33 whose upper end pivots to the pin 34 at the rear end of the grate frame 25 in compartment 3. The right end of the beam 32 pivots to link 33′ whose upper end pivots to the pin 34′ at the rear end of the main grate frame in compartment 3′. With this arrangement, as the lever 28 is swung to rock the shaft 27 the beams 29 and 32 will be swung to cause vertical movement of the main grate frames 25 in their respective compartments, movement of one grate frame in one direction being accompanied by simultaneous movement of the other grate frame in the opposite direction, and the adjustment is such that when the lever 28 is in vertical position the grate frames will be in a common horizontal plane. The range of movement of each main grate frame is from a short distance above the corresponding intercepting grate 20, 20′ to the lower end of the corresponding set of outlets 8, 8′. The lever 28 has a finger grip 35 connected by a rod 36 with a block 37 adapted to coöperate with the notched segment 38 to lock the lever 28 in vertical position or in inclined position at the left or right of such vertical position. As illustrated, the lever has been swung to the right and the main grate frame in compartment 3 is in its upper position and the grate frame in compartment 3′ is in its lower position. Through the partition 2 or water leg 13 I provide a plurality of intercommunicating passageways 39 which are arranged in a longitudinal zone which is entirely included between the movable grate frames when these grate frames are in their extreme relative positions, as shown particularly in Fig. 2.

For controlling the set of outlets 8 I provide a number of shutters 40 hinged at their rear edges to rods 41 extending between shelves 42 and 43 provided on the rear wall 7 of the fire-box housing, while the front ends of the shutters are connected together by links 44 for causing the shutters to move in unison from an open to a closed position. In a similar manner shutters 40′ are provided for the outlets 8′ from compartment 3′, these shutters being pivoted on rods 41′ journaled in shelves 42′ and 43′ and having their free ends linked together by links 44′. The innermost rods 41^{i} and $41'^{i}$ of the shutter sets are rigidly secured to their respective shutters and extend downwardly and terminate respectively in crank arms 45 and 45′. Extending from the shaft 27 at right angles to the rear beam 32 thereon is a lever 46 pivoted to the inner ends of links 47 and 47′ whose outer ends pivot to the ends of crank arms 45 and 45′. With this arrangement rotation of shaft 27 will cause simultaneous rotation of shafts 41^{i} and $41'^{i}$ so that the shutters will be moved to open position in the compartment in which the main grate frame is rising and so that the shutters in the other compartment in which the grate frame is descending will be moved to closed position.

As best shown in Figs. 1 and 2, the grate frame in compartment 3 is in its uppermost position and the shutters are entirely open to expose the outlets 8, while in compartment 3′ the grate frame is in its lowermost position and the shutters are closed, the zone of intercommunicating passageways 39, in this position of the grate frames, lying entirely between the grate frames. In practice when one of the grate frames is to be charged with green coal the lever 28 is swung to drop this grate frame, whereupon

green coal is fed thereto through the feed door. As shown in the figures, the grate frame in compartment 3′ has been lowered and fuel is charged thereto through the opening 5′. The gases and smoke from the green coal cannot escape into the flues or chimney, as the shutters 40′ are closed, but must pass through the inter-communicating passageways into compartment 3 below the raised grate frame in said compartment and must pass through the hot fire on this grate frame, the result being that the gases and smoke are entirely consumed, and the wasteful escape of unburned gases and the issuance of smoke through the chimney is prevented. After the green coal has been sufficiently ignited so that no further gases or smoke will issue therefrom and when the opposite grate frame requires replenishing the lever 28 is swung to the opposite side to drop the grate frame in compartment 3 and to raise that in compartment 3′, this adjustment resulting automatically in the closing of shutters 40 and opening of shutters 40′, and then when green fuel is charged to the grate frame in compartment 3 the gases and smoke must pass through the intercommunicating passageways 39 and through the hot fire in compartment 3′ to be entirely consumed. As soon as the charged fuel on the grate frames becomes sufficiently ignited the frames can, of course, be adjusted to any relative position, as for example, the lever 28 can be swung to vertical position to bring the grate frames in a common horizontal plane, in which position both sets of shutters will be open and both sets of flues effective to heat the water in the boiler. Any live coals falling from the main grate frames will be intercepted by the stationary grate frames 20 and 20′, and their remaining heat will be utilized to assist in burning and consuming gases and smoke issuing into one compartment from the other through the intercommunicating passageways. After these live coals are burned out and become disintegrated the resulting ashes fall through the stationary grate frames into the ash pit. Thus all available heat is extracted from the coal, the gases are all thoroughly burned and the resulting heat fully utilized, and the smoke is entirely consumed.

The draft doors 22 and 22′, and 24 and 24′ may be adjusted by hand to regulate the draft, but are preferably adjusted automatically in correspondence with the adjustments of the movable grate frames. For this purpose the links 30, 30′ and 33, 33′ are provided with pins 48, 48′ and 49, 49′ respectively, which co-act with bails 50, 50′ and 51, 51′ respectively. The positions of the pins are such that when a grate frame is lowered in one compartment the corresponding pins will engage with the bails of the corresponding front and rear draft doors to swing these doors to open position, the doors of the other compartment remaining closed. Draft can, therefore, only enter the compartment with the lowered grate frame and must pass through the green fuel to thoroughly mix with the gases and smoke before reaching the hot fire in the other compartment through the inter-communicating passageways, thus assuring the complete consumption of gases and smoke. When the relative position of the grate frames is reversed the previously open draft doors will be closed and the other draft doors opened. The draft doors for the compartment in which the grate frame is raised are free to be opened manually if greater draft is desired, or for the purpose of removing the ashes from the ash pit.

With my improved arrangement, therefore, the gases and smoke cannot escape but are forced to pass through a hot fire to be entirely consumed. The sections of the fire-box with all the apparatus therein are exactly similar, and the parts in one compartment controlled from the shaft 27 balance the similar parts controlled from the shaft in the other compartment so that very little effort is necessary to produce the various adjustments by means of lever 28. The parts are all free to move readily and can be quickly disconnected or assembled. One of the grates always has a hot fire so that the heat delivered by the furnace is uniform. In single grate furnaces or fire boxes the fire is periodically choked by the application thereto of cold green fuel.

Changes and modifications could readily be made which would still come within the scope of my invention, and I do not, therefore, desire to be limited to the constructions, arrangements and operations shown, but I desire to secure the following claims by Letters Patent:

1. In a fire-box, the combination of walls for dividing the fire-box into two compartments, a grate for each compartment vertically movable therein, mechanism for controlling the movements of said grates whereby one grate may be raised higher than the other, there being communicating passageway between said compartments, and means for causing products of combustion to flow from the lower grate through said communicating passageway and through the raised grate.

2. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate for each compartment vertically movable therein, mechanism for effecting the simultaneous vertical movement of the grates in opposite directions, there being limited communicating passageway between the compartments, and means for causing the products of combustion from

one grate to pass through said communicating passageway and through the other grate.

3. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate in each compartment vertically movable therein, oscillatory mechanism supporting said grates and adapted when actuated to raise one grate and lower the other, there being communicating passageway between the compartments limited to the zone between the raised and lowered grates, heat outlets from said compartments, and means for causing the production of combustion from the lower grate to flow through the communicating passageway and through the raised grate before reaching the heat outlets.

4. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in each compartment vertically movable therein, heat outlets from each compartment, controlling mechanism in each compartment for the outlets therefrom, there being communicating passageway between the compartments, mechanism for effecting relative vertical movement of the grate frames whereby one grate frame may be raised and the other lowered, and means arranged so that said mechanisms coöperate to cause the products of combustion from the lowered grate in the one compartment to flow through the communicating passageway into the other compartment and through the grate and into the outlets for said other compartment.

5. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in each compartment vertically movable therein, supporting mechanism for said grate frames adapted to be actuated to raise either grate frame and to lower the other, there being communicating passageway between the compartments limited to the zone between the raised and lowered grate frames, heat outlets from each compartment, shutter mechanism in each compartment for controlling said heat outlets, and interconnecting mechanism between said grate frame supporting mechanism and said shutter mechanism operable upon adjustment of the grate frames to open the heat outlets in the compartment in which the grate frame is raised and to close the outlets in the compartment in which the grate frame is lowered whereby the products of combustion from the lowered grate frame are restricted to flow through the communicating passageway and through the raised grate frame.

6. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in each compartment vertically movable therein, oscillatory mechanism connected with said grate frames and adapted to be actuated to effect relative vertical adjustment of the frate frames in opposite directions, there being passageway between the compartments restricted to the zone between the grate frames when one is in raised position and the other in lowered position, heat outlets from each compartment above the grate frame therein when in its raised position, shutter mechanism in each compartment for controlling the heat outlets therefrom, and interconnecting mechanism between said shutter mechanism and oscillatory mechanism operative to actuate the shutter mechanism to close the outlets above the lowered grate frame and to open the outlets above the raised grate frame whereby products of combustion from the lowered grate are restricted to flow through the communicating passageway and through the raised grate frame and through the outlets above said raised grate frame.

7. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in each compartment vertically movable therein, oscillatory mechanism connected with said grate frames and adapted to be actuated to effect relative vertical adjustment of the grate frames in opposite directions, there being passageway between the compartments restricted to the zone between the grate frames when one is in raised position and the other in lowered position, heat outlets from each compartment above the grate frame therein when in its raised position, shutter mechanism in each compartment for controlling the heat outlets therefrom, interconnecting mechanism between said shutter mechanism and oscillatory mechanism operative to actuate the shutter mechanism to close the outlets above the lowered grate frame and to open the outlets above the raised grate frame whereby products of combustion from the lowered grate are restricted to flow through the communicating passageway and through the raised grate frame and through the outlets above said raised grate frame, draft mechanism for each compartment, and actuating mechanism for said draft mechanism interconnected with said oscillatory mechanism to open the draft mechanism for one compartment when the grate frame of said compartment is lowered and to close the draft mechanism of the other compartment in which the grate frame is raised, whereby the draft for the raised grate frame must first pass through the lowered grate frame to mix with the products of combustion of said lowered grate frame.

8. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in

each compartment vertically movable therein, heat outlets from each compartment, shutter mechanism in each compartment for controlling the outlets therefor, and mechanism for simultaneously controlling the relative vertical adjustment of the grate frames and the operation of the shutter mechanism to cause the grate frame in one compartment to be lowered and the shutter mechanism actuated to close the outlets and to raise the grate frame in the other compartment and to actuate the shutter mechanism to open the outlets, there being communicating passageway between the compartments, the products of combustion from the lower grate frame being restricted to flow through said communicating passageway into the other compartment and through the raised grate frame and outlets for said other compartment.

9. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in each compartment vertically movable therein, a shaft extending longitudinally between said compartments, beams on said shaft connected at their ends with said grate frames whereby rotation of said shaft will cause simultaneous relative vertical adjustment of the grate frames in opposite directions, there being communicating passageway between the compartments limited to a zone between the grate frames when one is raised and the other lowered, heat outlets for each compartment, and means controlled upon adjustment of said grate frames for closing the outlets above the lowered grate frame and for opening the outlets above the raised grate frame whereby the products of combustion from the lowered frame are restricted to flow through the communicating passageway and through the raised grate frame.

10. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in each compartment vertically movable therein, a shaft extending longitudinally between said compartments, beams on said shaft connected at their ends with said grate frames whereby rotation of said shaft will cause simultaneous relative vertical adjustment of the grate frames in opposite directions, there being communicating passageway between the compartments limited to a zone between the grate frames when one is raised and the other lowered, heat outlets for each compartment, means controlled upon adjustment of said grate frames for closing the outlets above the lowered grate frame and for opening the outlets above the raised grate frame whereby the products of combustion from the lowered frame are restricted to flow through the communicating passageway and through the raised grate frame, draft inlets for each compartment below the grate frame therein, and means controlled automatically upon adjustment of the grate frames for opening the draft inlets below the lowered grate frame and for closing the draft inlets below the raised grate frame whereby draft must first pass through the lowered grate frame to mingle with the products of combustion from said frame.

11. In a fire-box, the combination of walls dividing the fire-box into two compartments, a grate frame carrying a grate in each compartment adapted to be moved vertically therein, actuating mechanism for simultaneously raising either grate frame and lowering the other, heat outlets from each compartment, shutter mechanism in each compartment controlling the heat outlets therein, draft mechanism for each compartment, there being passageway between the compartments limited to a zone between the grate frames when one is raised and the other lowered, actuating mechanism for the shutter mechanism, actuating mechanism for the draft mechanism, the actuating mechanism for the shutter mechanism and draft mechanism being interconnected with the actuating mechanism for the grate frames whereby lowering of a grate frame in one compartment will be accompanied by closure of the shutter mechanism and opening of the draft mechanism, and raising of the grate frame in the other compartment will be accompanied by opening of the shutter mechanism and closure of the draft mechanism.

12. In a fire-box, the combination of walls for dividing the fire-box into two compartments, a grate for each compartment vertically movable therein, mechanism for controlling the movements of said grates whereby one grate may be raised higher than the other, there being communicating passageways from one compartment to the other when one of said grates is raised and the other lowered, means for causing products of combustion to flow from the lower grate through said communicating passageway and through the raised grate, and a stationary grate in each compartment below the vertical movable grate therein and disposed below the path of flow between said compartments.

13. In a furnace, the combination of a fire-box, a wall dividing the fire-box into compartments, said compartments being in direct communication with each other through an intercommunicating passageway, and each formed to discharge the products of combustion, a grate in each compartment, means for adjusting each grate to one side or the other of said passageway, and means for alternating the flow of said gases through said compartments.

14. In a furnace, the combination of a fire-box, a wall dividing the fire-box into compartments, said compartments being in

direct communication with each other through an intercommunicating passageway, and each formed to discharge the products of combustion, a grate in each compartment, means for alternately adjusting said grates, the one above and the other below said passageway, whereby the gases from the compartment in which the grate is below the passageway may be caused to pass through the grate of the other compartment, and means for alternating the flow of said gases through said compartments.

In witness hereof, I hereunto subscribe my name this 10th day of March, A. D., 1910.

THOMAS HENRY GARLAND.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."