(No Model.)

6 Sheets—Sheet 1.

C. R. GREUTER.

FURNACE GRATE.

No. 567,974. Patented Sept. 22, 1896.

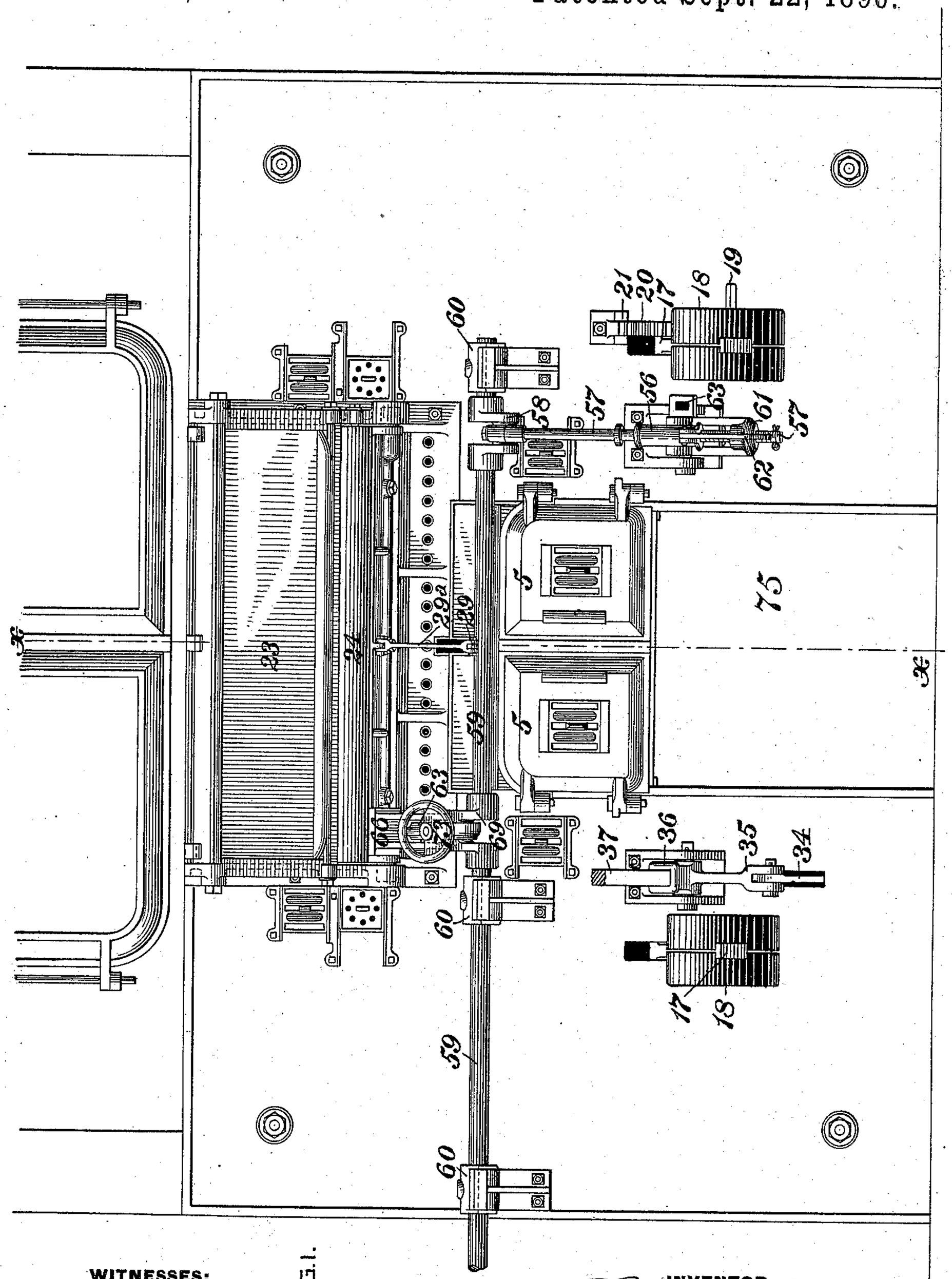

FIG. 1.

WITNESSES:

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Chas. F. Miller.

INVENTOR,

Chas. R. Greuter

by J. Howden Bell,

Att'y.

(No Model.)

6 Sheets—Sheet 2.

C. R. GREUTER.

FURNACE GRATE.

No. 567,974. Patented Sept. 22, 1896.

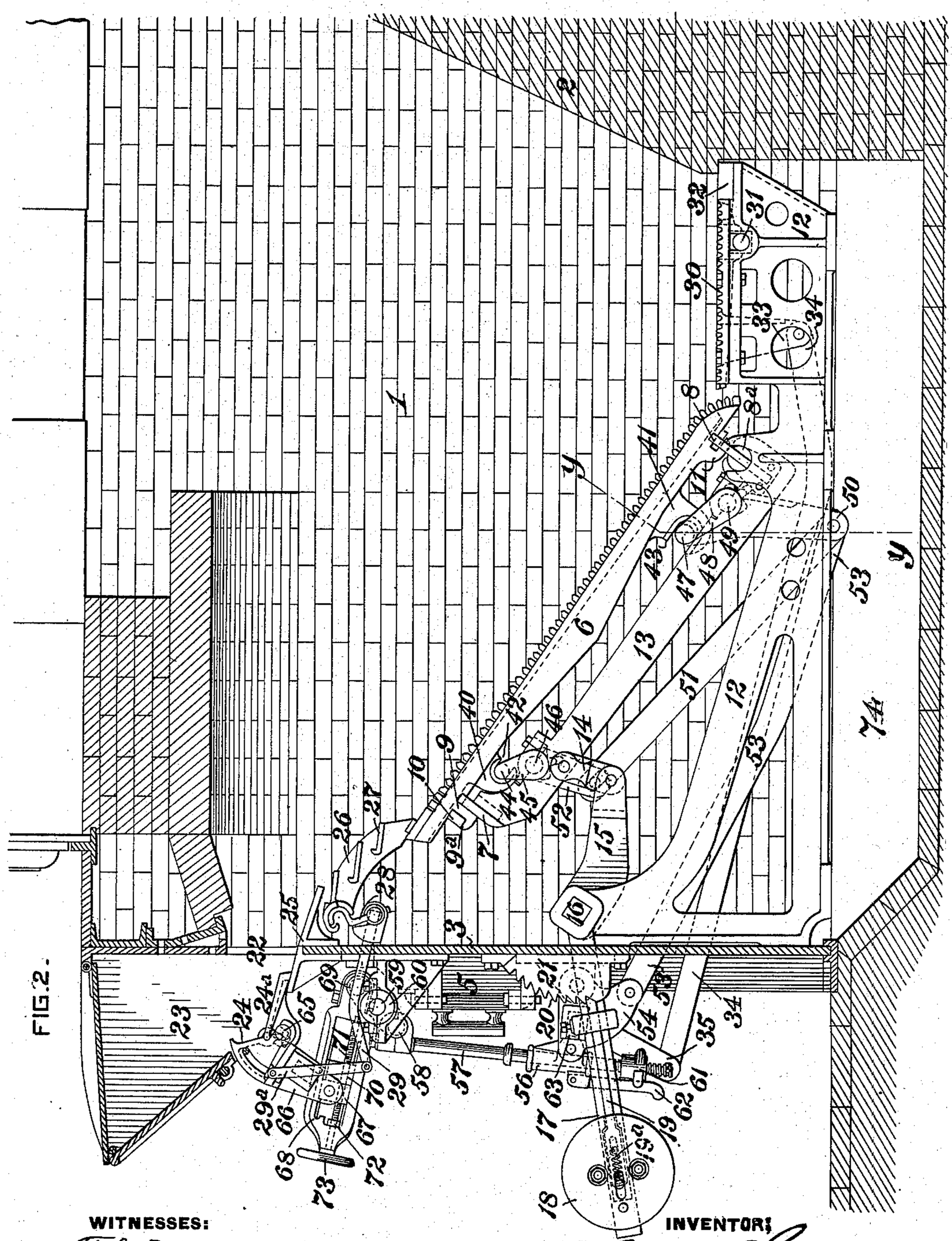

FIG. 2.

WITNESSES:

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6 Sheets—Sheet 3.

C. R. GREUTER.

FURNACE GRATE.

No. 567,974. Patented Sept. 22, 1896.

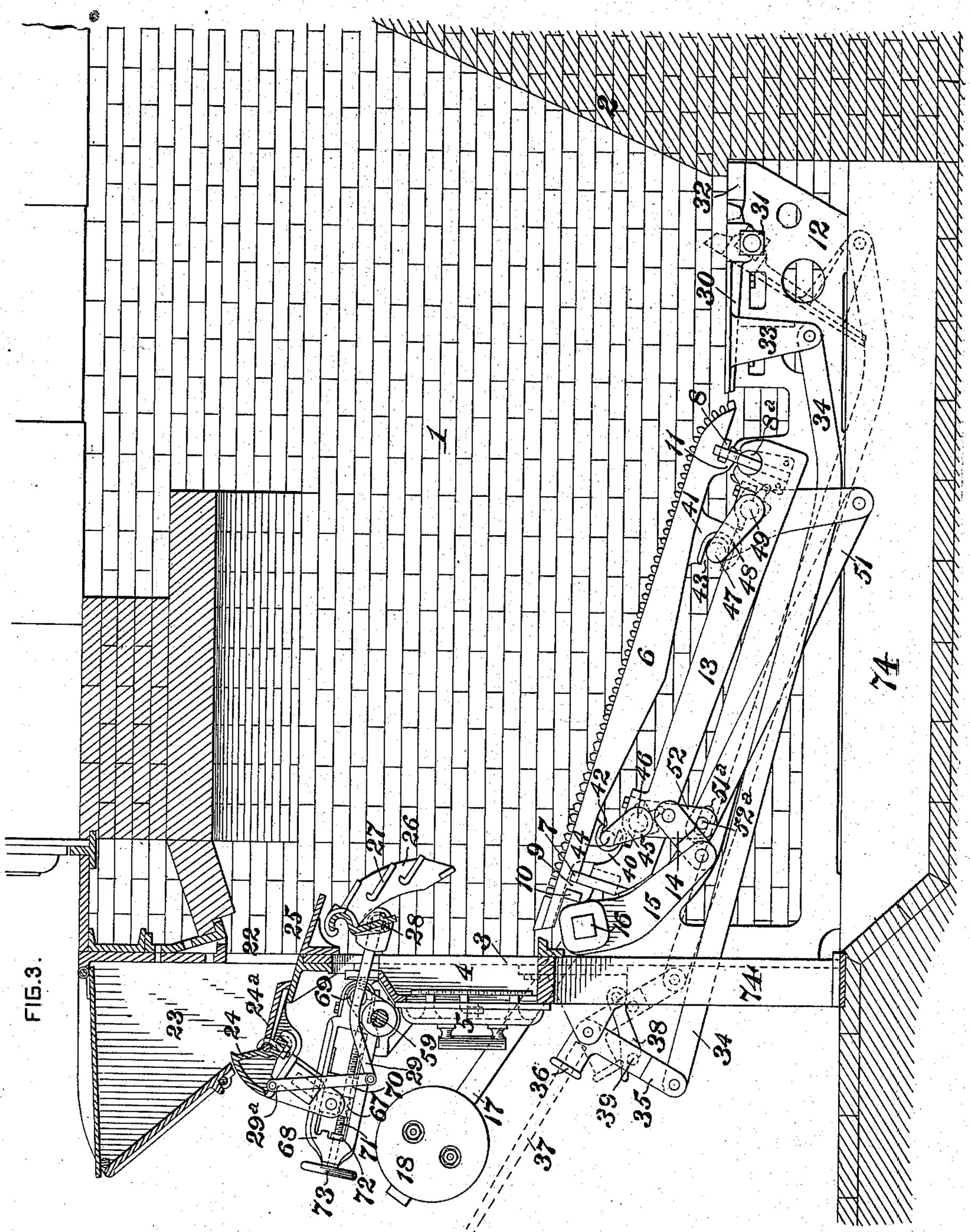

FIG. 3.

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(No Model.)

6 Sheets—Sheet 4.

C. R. GREUTER.

FURNACE GRATE.

No. 567,974. Patented Sept. 22, 1896.

FIG. 4.

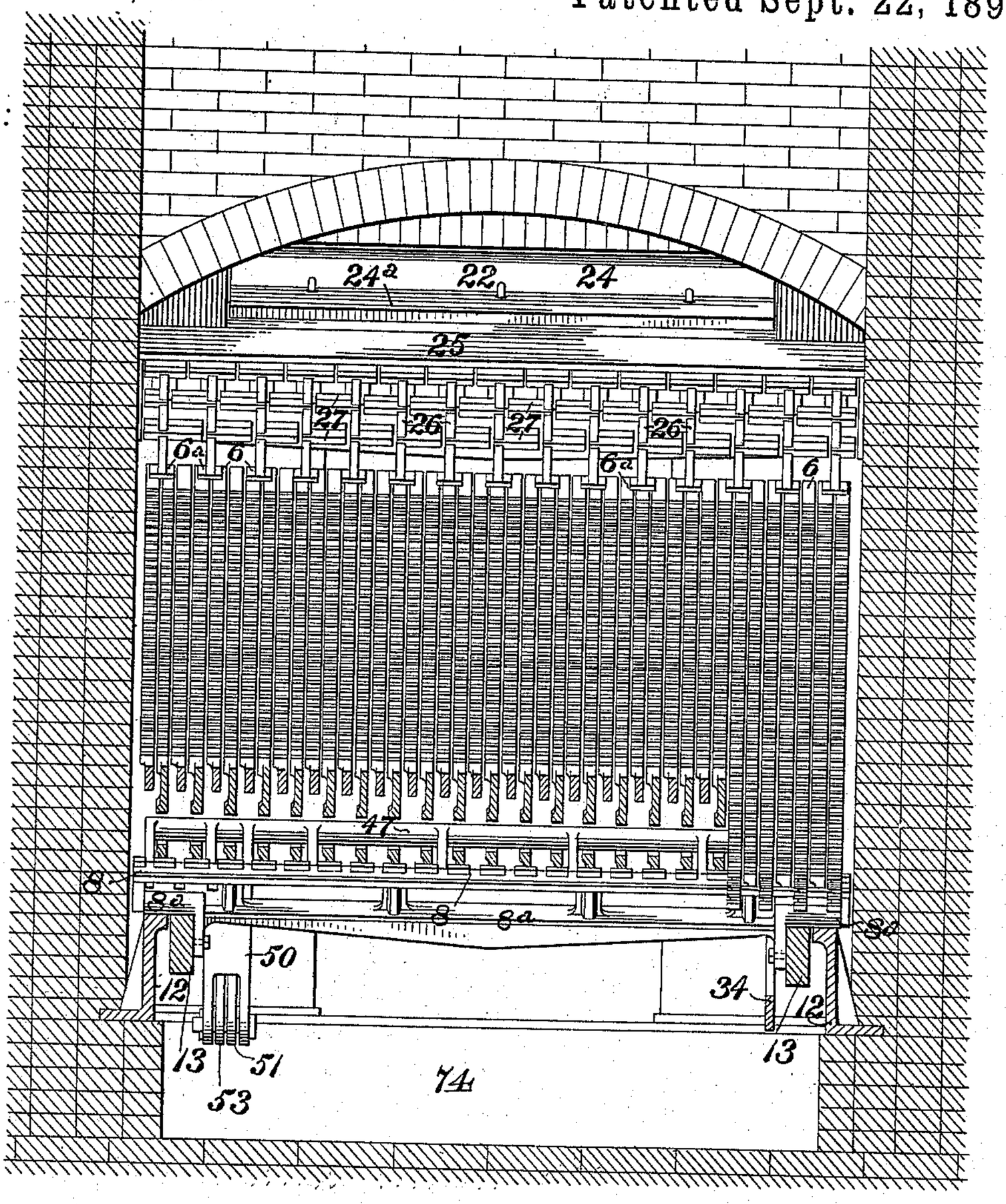


FIG. 7.

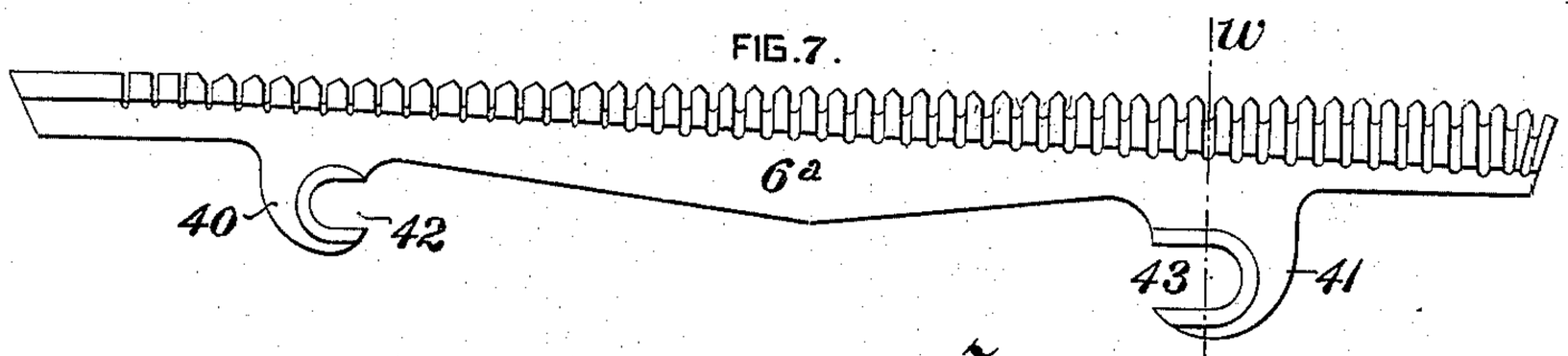
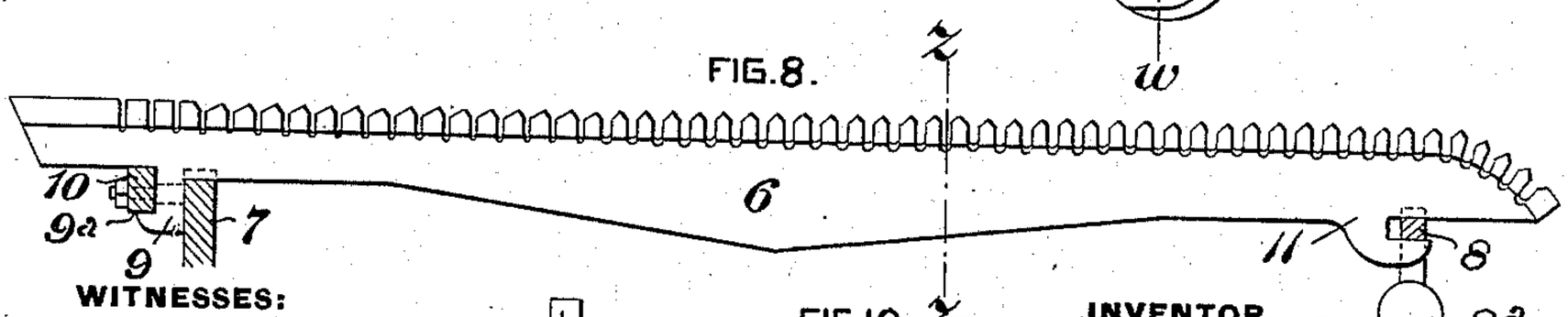


FIG. 8.



WITNESSES:

T. J. Hogan.

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FIG. 9

FIG. 10.

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(No Model.)

6 Sheets—Sheet 5.

C. R. GREUTER.

FURNACE GRATE.

No. 567,974. Patented Sept. 22, 1896.

FIG. 5.

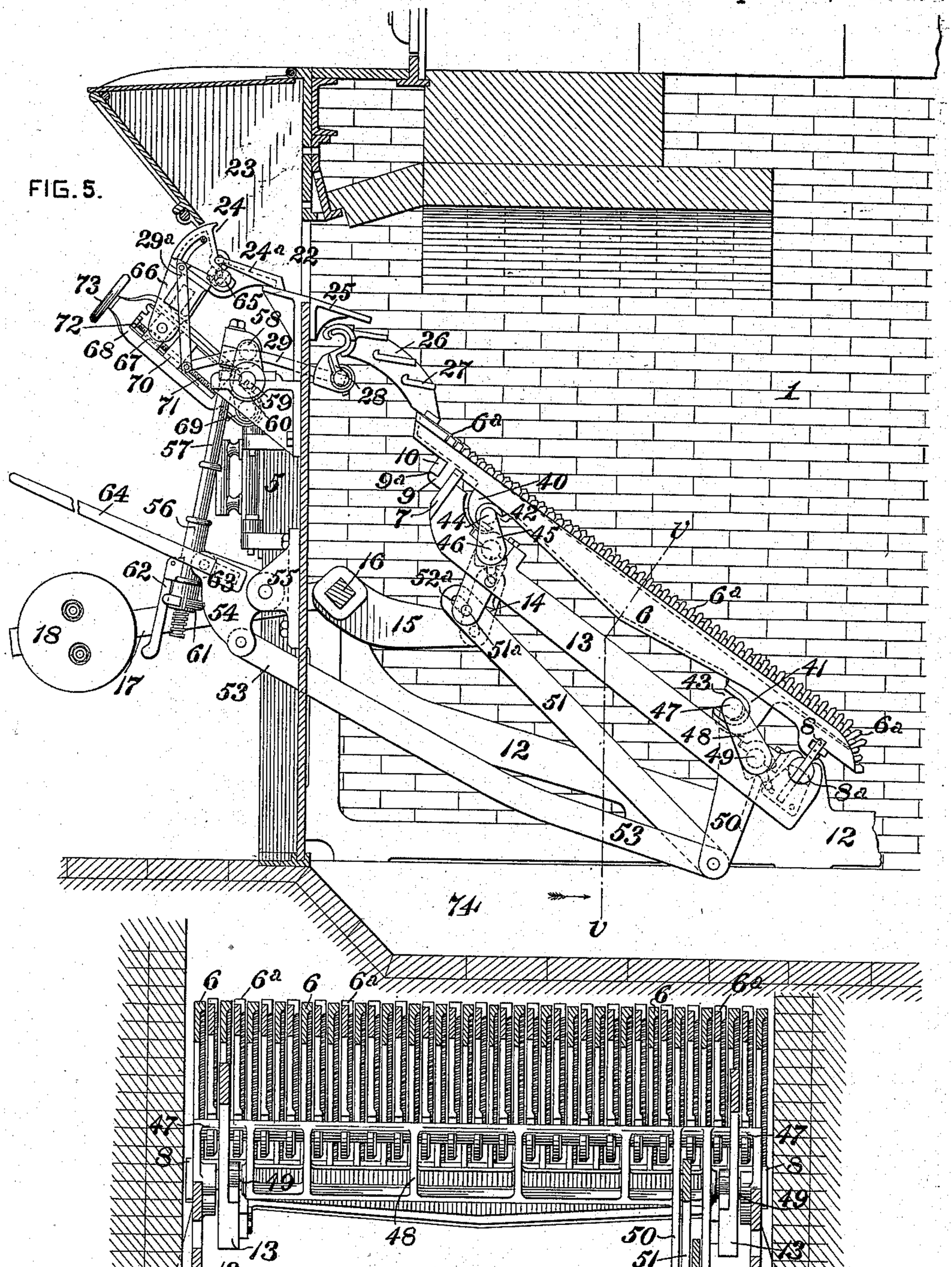

FIG. 6.

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by J. Howden Bell,

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(No Model.) 6 Sheets—Sheet 6.

C. R. GREUTER.

FURNACE GRATE.

No. 567,974. Patented Sept. 22, 1896.

FIG. 11.

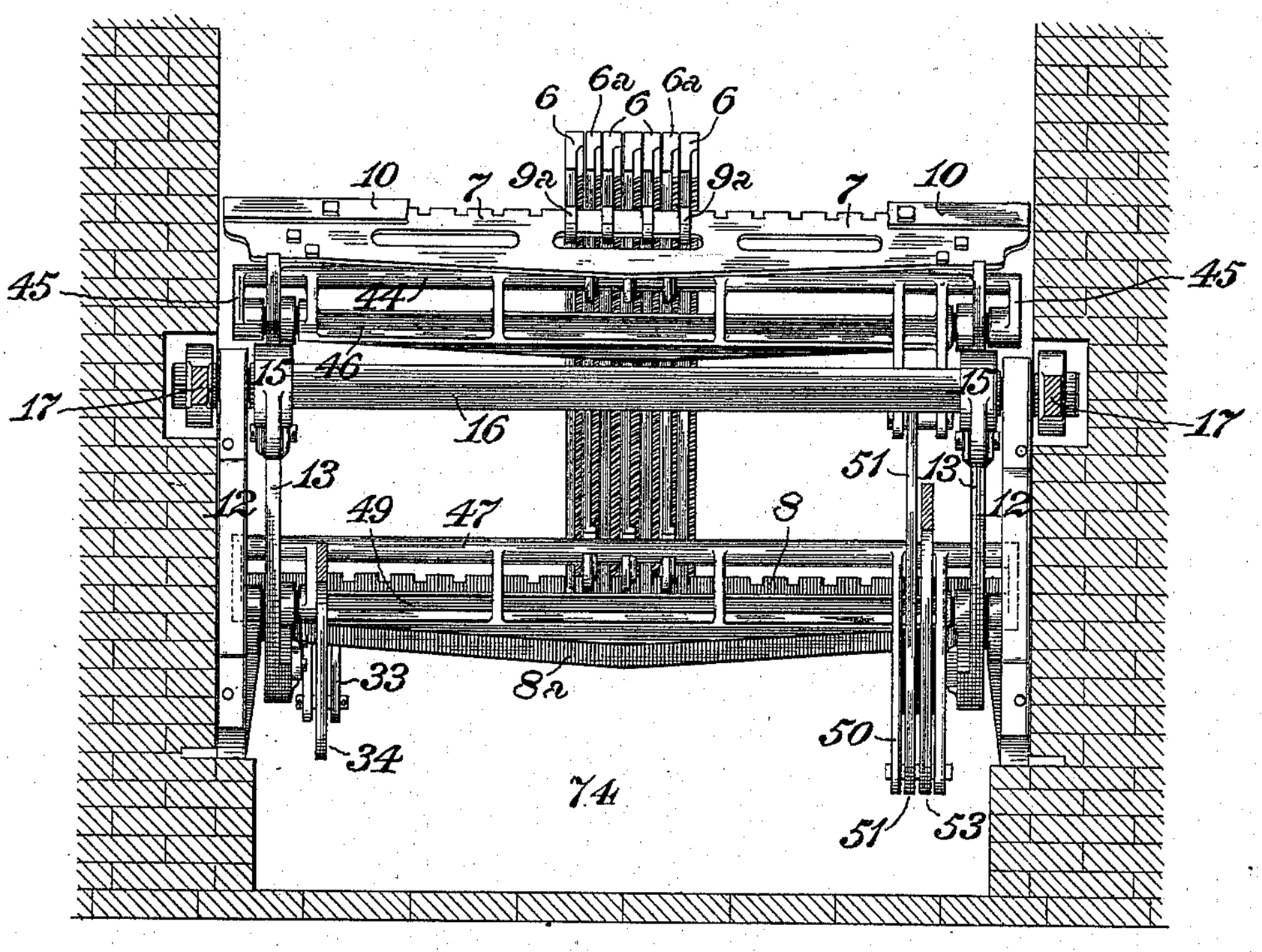
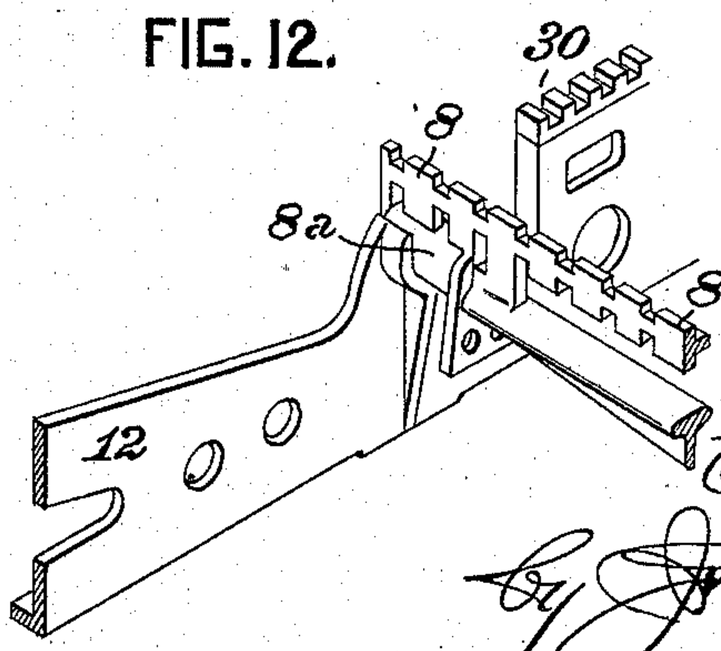


FIG. 12.



WITNESSES:

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Chas. F. Miller.

INVENTOR

Chas. R. Greuter.

by J. Howden & Co.

ATTORNEY.

UNITED STATES PATENT OFFICE.

CHARLES R. GREUTER, OF SALEM, OHIO, ASSIGNOR TO THE BUCKEYE ENGINE COMPANY, OF SAME PLACE.

FURNACE-GRATE.

SPECIFICATION forming part of Letters Patent No. 567,974, dated September 22, 1896.

Application filed July 17, 1895. Serial No. 556,285. (No model.)

To all whom it may concern:

Be it known that I, CHARLES R. GREUTER, of Salem, in the county of Columbiana and State of Ohio, have invented a certain new and useful Improvement in Furnace-Grates, of which improvement the following is a specification.

My improvement relates to the class of vibratory grates for steam-boiler and other furnaces which are actuated and supplied with fuel by mechanism known in the art as "mechanical stokers;" and its object is to provide an apparatus which shall be simple, durable, self-contained, and of such construction that it may be fitted up and erected complete before leaving the shop, and one wherein the alternate grate-bars may be raised and lowered either automatically or by hand, irrespective of the position of the grate, for the purpose of agitating the fire, preventing the formation of clinker or clogging of the grate due to the melting and running together of the fuel or other causes, and also allowing free access of air to the fire, thereby providing an apparatus particularly adapted to the use of various classes and grades of fuel, including low-grade Western bituminous coals or the run of mines, coal which produces considerable clinker and coal which tends to become fluid and run over the grates before coking.

A further object of my invention is to provide a grate capable of being readily and quickly adjusted to any desired angle for automatic or hand-firing and cleaning or removing the entire bed of fire when it is desired to quickly stop the combustion on the grate.

The improvement claimed is hereinafter fully set forth.

In the accompanying drawings, Figure 1 is a front view in elevation of a steam-boiler furnace in which my invention is applied; Fig. 2, a vertical longitudinal section through the same, showing the applied mechanism in elevation, the grate being shown in position for automatic firing; Fig. 3, a vertical longitudinal section on the line *x x* of Fig. 1, the grate being shown in position for cleaning or firing by hand; Fig. 4, a vertical transverse section at the line *y y* of Fig. 2, looking in the direction of the front of the furnace, the seven right-hand grate-bars and operating mechanism being shown in elevation; Fig. 5, a view similar to Fig. 2, the alternate grate-bars being shown in their upper or raised position when the grate is being operated automatically; Fig. 6, a vertical transverse section on the line *v v* of Fig. 5, looking in the direction of the bridge-wall or rear of the furnace; Figs. 7 and 8, side views, in elevation and on an enlarged scale, of the movable and stationary grate-bars, respectively; Figs. 9 and 10, vertical transverse sections through the grate-bars on the lines *w w* and *z z* of Figs. 7 and 8, respectively; Fig. 11, a vertical transverse section through the furnace, taken close to the inside of the fire-front and looking to the rear; and Fig. 12, a view in perspective, showing a portion of one of the side supporting-frames and of the transverse bar 8 and shaft 8^a.

My invention is herein shown as applied in connection with a steam-boiler furnace 1, which is of the ordinary construction and is provided with a fire-bridge 2 at its inner or rear end and with a fire-front 3, having openings 4, closed by firing and cleaning doors 5 at its front. A suitable ash-pit 74 is formed at the bottom of the furnace, and access thereto is afforded through an opening 75 in the fire-front below the openings 4.

In the practice of my invention I provide an adjustable main grate composed of a series of grate or fire bars 6 and 6^a, divided alternately into two sets, as shown in Figs. 4, 5, and 6. The grate-bars 6 and 6^a rest upon and are connected to a rectangular supporting-frame and are capable of being, together with said supporting-frame, adjusted to any desired angle. The alternate series of bars 6^a, in addition to being capable of angular adjustment coincidently with the supporting frame and bars 6, have a vertical and longitudinal movement imparted to them by mechanism to be presently described independently of the supporting frame and bars 6 and irrespective of the angle at which said frame and bars may have been adjusted. The bars 6 rest in notches formed in the upper edges of two transverse bars 7 and 8, located near the front and rear ends, respectively, of the furnace 1, and are firmly se-

cured to the bar 7 near their front ends by means of downwardly-projecting lugs 9, formed upon their lower edges, which bear against the rear side of said bar, and are provided with forwardly-extending shoulders 9^a, upon which rests a transverse bar 10, secured to the bar 7 by means of bolts or screws, thus holding the bars 6 firmly to the transverse bar 7, as illustrated in Fig. 8. The grate-bars 6 are connected near their lower or rear ends to the transverse bar 8 by means of downwardly and rearwardly projecting lugs 11, formed upon their lower edges, said rearwardly-projecting portions of the lugs 11 bearing against the under face of the transverse bar 8 and being of a length greater than the width of said bar, so as to hold the grate-bars 6 firmly as against any vertical movement, while at the same time allowing them to expand longitudinally without any tendency to warp and twist, as would be the case were they rigidly secured at their ends to the transverse bars 7 and 8.

Below the transverse bar 8 and formed integral therewith is located a transverse shaft 8^a, supported at its ends in bearings formed upon the upper edges of two supporting-frames 12, set in opposite sides of the furnace 1. The transverse bar 7 and transverse shaft 8^a are rigidly connected by means of two side bars 13, the whole forming the rectangular supporting-frame hereinbefore referred to for the support of the main-grate bars 6 and 6^a.

The two side bars 13 are coupled near their forward ends by links 14 to arms 15 on a transverse shaft 16, journaled in bearings formed in the supporting-frames 12 near the front of the furnace and a short distance below the openings 4 in the fire-front 3, and having two arms 17, extending outwardly therefrom through the fire-front 3, said arms 17 being provided with suitable counterbalances 18. The counterbalances 18 are formed of two sections, each fitting upon the arms 17 and secured thereto by means of bolts. One of said sections of one of the counterbalances is slotted for the admission of a pawl 19, which slides through an opening in a collar formed upon the arm 17 and engages ratchet-teeth 20 in a segment 21, secured to the outside of the fire-front 3, whereby the adjustable rectangular frame, carrying the main-grate bars 6 and 6^a, may be held at any desired angle to which it is desired to adjust it. The pawl 19 is held in engagement with the teeth 20 by means of a spring 19^a, secured at one end to the counterbalance 18 and at the other to the handle of the pawl 19, which projects at right angles from said pawl, and through a slot formed in the counterbalance 18 a sufficient distance to afford a handle for raising and lowering the arm 17. A fuel-feed-supply passage or opening 22, formed in the fire-front 3, near its top, establishes communication between the furnace and a fuel-hopper 23, which is secured to the fire-front and is provided with a vibratory fuel-feeder 24, to be presently described. The bottom or feed plate 25 of the fuel-hopper extends a short distance into the furnace, and an auxiliary or coking grate, composed of a series of curved grate-bars 26, formed as arms upon hubs or bosses and having lateral fuel-supporting plates 27, is interposed between the bottom plate 25 and the forward end of the main-grate bars 6 and 6^a. The auxiliary or coking grate 26 is supported upon a transverse rocker-bar 28, journaled in bearings secured to the inside of the fire-front 3 adjacent to the ends of the bottom or feed plate 25. The grate-bars 26 of the auxiliary grate are fitted freely on the transverse rocker-bar 28, so as to rock thereon independently one of the other, and are connected detachably to the upper portion of the rocker-bar, which is of substantially cylindrical form in cross-section, by means of open sockets formed in their hubs or bosses and fitting thereon. As the rocker-bar 28 is of a length but slightly greater than the width of the main grate and the grate-bars 26 extend its entire length it is not necessary to secure said grate-bars as against lateral displacement, as each bar bears against the next adjoining one with sufficient force to hold it in place. The free ends of the auxiliary-grate bars 26 rest freely when the main grate is in position for use in mechanical firing on the upper ends of the main-grate bars 6 and 6^a, and being free to move upon the rocker-bar 28 are moved correspondingly with the movement of the bars 6^a when the fire is being agitated.

The transverse rocker-bar 28 is provided at its lower portion and in line with its bearings with an arm 29, extending outwardly therefrom through the fire-front 3 and connected by a link 29^a to the vibratory fuel-feeder 24. The rocker-bar 28, being oscillated coincidently with the movement of the vibratory fuel-feeder, causes the auxiliary-grate bars 26 to advance and recede upon the main grate, thus feeding the fuel slowly thereon. The lateral fuel-supporting plates 27 of the bars 26 are stepped or alternated in position on the respective bars, as shown in Fig. 4, so that the plates move freely past one another in the rocking movement of the bars. A dumping-grate 30 is interposed between the rear end of the main grate and the fire-bridge 2, and rests upon and is secured to a transverse shaft 31, rectangular in cross-section, and located near its rear end and journaled in bearings formed in the two side frames 12. A dead-plate 32 rests upon the two side frames 12 between the dumping-grate 30 and fire-bridge 2, and is provided with short grate-bars upon its edge adjacent to the dumping-grate, said short grate-bars being alternated with the bars of the dumping-grate. The dead-plate 32 prevents the access of clinkers or other obstructions to the space in the rear of the dumping-grate, while the short grate-

bars serve to break up any clinkers that may accumulate upon the rear end of said dumping-grate.

The lowering and raising of the dumping-grate 30 from and into its normal position are effected by means of a downwardly-projecting arm or bracket 33, formed integral with its lower side and connected by means of a link or bar 34, extending beneath the main grate and through the fire-front 3 to the lower arm of a rocker 35, of substantially bell-crank form, journaled in bearings secured to the outside of the fire-front. A socket 36 is formed in the upper arm of the rocker 35 for the admission of a detachable hand-lever 37, and the dumping-grate 30 is held firmly in its raised or normal position by means of a pawl 38, pivotally secured to the rocker-arm bearing and engaging a pin 39, secured to the lower arm of said rocker. By this construction but little movement of the operating-lever 37 is required to dump and raise the grate 30, and the grate is easily moved, as the leverage is greater when the grate is in such position that the greatest force is required to lift it.

The main-grate bars 6^a, in addition to being adjustable at different angles coincidently with the supporting-frame and main-grate bar 6, have a movement which is both vertical and longitudinal, the vertical movement, which is comparatively slight at the upper or forward end, being imparted to the bars as follows: The bars 6^a rest upon the transverse bars 7 and 8 near their ends when the grate is in normal position, as illustrated in Figs. 2 and 3, and are provided with downwardly-projecting lugs 40 and 41, located near their ends, but between the bars 7 and 8. Said lugs are provided with longitudinal slots 42 and 43, respectively, which are open at their inner ends, the lug 41 and slot 43 being somewhat longer than the lug 40 and slot 42, for a reason which will presently be seen. A transverse shaft 44 is fitted to slide in the slots 42 and is connected by short arms 45 to a transverse shaft 46, journaled in bearings formed upon the two side bars 13. The shaft 46 is located nearer the center of the grate-bars 6^a than the shaft 44. A transverse shaft 47, corresponding to the shaft 44, is fitted to slide in the slots 43 of the lugs 41, and is connected by arms 48, which are short, but longer than the arms 45, to a transverse shaft 49, journaled in bearings formed upon the two side bars 13 adjacent to the transverse shaft 8^a. The shaft 49 is located nearer the ends of the bars 6^a than the shaft 47, allowing the arms 48 to assume a position nearly parallel with the grate-bars 6^a when the same are at rest or in line with the bars 6.

The shaft 49 is provided with a downwardly-projecting arm or bracket 50, connected at its lower end by a long link or bar 51 to the lower end of a downwardly-projecting arm or bracket 52, formed upon the shaft 46. The link 51 is connected to the arm 52 by means of a pin 52^a, which slides in a longitudinal slot 51^a, formed in said link 51, the slot being of such a length as to permit of considerable movement of the arms 50 before the arm 52 is affected. The arm 50 is also connected by a long link or bar 53, which passes beneath the main grate and through the fire-front 3 to operating mechanism upon the outside of the furnace to be presently described.

When movement is imparted to the shaft 49 through the medium of the operating mechanism, the link 53, and the arm 50, an upward movement is imparted to the lower end of the grate-bars 6^a by means of the arms 48 and shaft 47. When the bars 6^a have moved up into the fire for about two inches, the link 51 will have moved the length of its slot 51^a, thereby bringing the end of said slot in contact with pin 52^a on the arms 52. The further movement of the shaft 49 and corresponding parts will cause the upper ends of the grate-bars 6^a to move slightly upward and then longitudinally in the direction of the lower or rear end of the grate. The slot 43 in the lug 41 allows the bars 6^a to slide forward a short distance without becoming detached from the shaft 44. In the reverse movement the grate-bars will first move downwardly from the fuel and then longitudinally in the direction of the fire-front or upper end of the main grate.

The grate-bars being supported intermediately instead of at their ends, as heretofore, are free to expand without any tendency to warping, which tendency exists, to a greater or less degree, in constructions in which grate-bars are confined in bearings at their ends. The vertical and longitudinal movement of the bars 6^a tends to loosen and prevent the coking of coal thereon, as well as to maintain proper air-spaces in the body of coal, at the same time gradually feeding the fuel in the direction of the dumping-grate 30, instead of packing it, which is an objectionable feature in grates heretofore employed having oscillatory or rocking movement in service.

While I do not limit myself to any particular form or design of grate-bars, that illustrated in Figs. 7, 8, 9, and 10 I have found to be particularly adapted to use with mechanical stokers, said bars being of the usual form as regards the body or main portion, but being provided with a series of teeth on their upper faces, which are narrow but wider than the body of the bar. By reference to Fig. 7 it will be seen that the teeth on the lower end of the bars 6^a have a longer bearing-surface at the point where the greater movement takes place, thus preventing too great an opening between the bars when the bars 6^a are raised, which would allow the fuel to fall through to the ash-pit before becoming entirely consumed. This form of bar, while providing ample surface for the support of the fuel, has the advantage of allowing a free

and equal distribution of air to all parts of the fire, thereby greatly aiding the combustion thereof.

By the employment of the slotted link 51 and intermediate shafts and arms forming connections to the bars 6^a and operating mechanism, said bars are automatically brought into proper position for operation in any position of inclination to which the main grate may be adjusted.

The link 53 is coupled at its outer end to the lower arm of a rocker 54 of substantially bell-crank form, which is journaled in bearings 55 on the outside of the fire-front, and the upper arm of said rocker 54 is pivotally connected to a vertical sleeve 56, through which passes a connecting-rod 57, coupled at its upper end to a crank 58 on a transverse operating-shaft 59, journaled in bearings 60, secured to the outside of the fire-front, rotation being imparted to said shaft 60 either by a small special engine or motor or by a belt from a shaft rotated by any suitable prime mover. The connecting-rod 57 has its lower end threaded for the reception of an adjusting-nut 61, which bears against the lower end of the vertical sleeve 56, and is held at any point on the connecting-rod to which it is adjusted by means of a locking-arm 62, engaging notches in its periphery, said arm 62 being pivotally connected to the lower end of the sleeve 56. The movement of the grate-bars 6^a is regulated by moving the nut 61 toward or from the sleeve 56, thereby permitting a greater or less degree of lost motion of said nut prior to movement of the sleeve 56 and connected parts. A socket 63 is formed in the rocker 54 for the admission of a detachable hand-lever 64, by means of which the grate-bars 6^a may be operated when it is desired to work the device by hand.

Fuel is supplied from the fuel-hopper 23 to the auxiliary and main grates through the fuel-feed-supply passage 22 and over the feed-plate 25 by a vibratory fuel-feeder 24, which is provided with end journals 65, fitting in bearings in the ends of the fuel-hopper, and a hinged pusher-plate 24^a, which rests upon the feed-plate 25 and slides backward and forward thereon coincidently with the movement of said vibratory fuel-feeder. The fuel-feeder 24 oscillates in and normally closes a longitudinal opening in the front of the hopper and is actuated by a downwardly-projecting arm or bracket 66, pivotally connected to a block 67, which slides in a yoke 68, the lower end of which is connected to a crank 69 on the operating-shaft 59. A nut 70, through which passes an adjusting-screw 71, slides in the yoke 68, said screw passing through the block 67 and having a bearing in the lower end of the yoke and being held in position by means of a collar 72 bearing against the upper end of the yoke. The screw 71 is operated by means of a hand-wheel 73, secured to its outer end and abutting against the top of yoke. The traverse of the fuel-feeder 24 and fuel-feeder plate 24^a is regulated by revolving the screw 71, which moves the nut 70 to or from the block 67, thus permitting a greater or less degree of lost motion to ensue before said block is affected.

In operation, the fuel-hopper having been supplied with fuel and the driving-shaft 59 rotated, the fuel is gradually and continuously fed through the fuel-feed-supply passage 22 to and over the auxiliary or coking grate 26 and main-grate bars 6 and 6^a, which grates have been previously adjusted to such degree of inclination as may be best suited to the characteristics of the class of fuel which may be employed. The fuel is partially coked, if of coking character, upon the auxiliary grate 26 and is consumed in its passage over the main grate 6 6^a, the cinder and ash being delivered to the dumping-grate 31, from which it may be dropped at proper intervals into the ash-pit of the furnace. The vertical and longitudinal movement of the bars 6^a effectually prevents the caking or running together of the body of fuel thereon by continually breaking it up and creating air-spaces through its entire extent, at the same time gradually feeding the body of fuel in the direction of the dumping-grate. If, for any reason, it becomes desirable to resort to hand-firing, this may be readily done by lowering the main grate to the lower level of, and supplying fuel through, the openings 4 in the fire-front controlled by the doors 5. The bars 6^a can then be agitated by hand by means of the hand-lever 64, and it will be seen that when in this position the grate-bars are supported with their front ends entirely above the opening 75 in the fire-front, which communicates with the ash-pit 74. The capability of such adjustment of the main grate also materially facilitates the cleaning of the fire. The rate of feed and of agitation of the fuel on the grates may be varied as desired, or these operations may be suspended by suitable manipulation of the connections of the fuel-feeder and the agitator with the driving-shaft 59.

I claim as my invention and desire to secure by Letters Patent—

1. The combination, substantially as set forth, of a supporting-frame, a series of grate-bars fixed to said frame, a series of movable grate-bars supported between their middle portions and their ends on shafts having an oscillatory movement in the frame, and means for imparting movement to said shafts with a greater traverse of one than the other.

2. The combination, substantially as set forth, of a supporting-frame, a series of grate-bars fixed to said frame, two rock-shafts journaled in bearings adjacent to the ends of said frame, two supporting-shafts fixed to arms on the rock-shafts, a series of movable grate-bars having lower recesses between their middle portions and their ends, which engage the supporting-shafts, a link coupled at one end to a pin on an arm of one of the rock-

shafts and having a longitudinal slot adjacent to its opposite end engaging a pin on an arm of the other rock-shaft, and operating mechanism for vibrating the rock-shafts in their bearings.

3. The combination, substantially as set forth, of a series of fixed grate-bars and an alternated series of movable grate-bars, each having a series of teeth or projections on its top, of greater width than its body, the teeth of the movable bars being made of greater depth at and adjacent to one end than those of the fixed bars.

4. The combination, substantially as set forth, of a main grate having the capacity of adjustment at different degrees of inclination, a fuel-feed-supply passage, an opening and door in a fire-front below said fuel-feed-supply passage, an opening in the front below said door, leading to an ash-pit, means for moving the main grate into and out of position in which it may be fired, in regular operation, through the fuel-feed-supply passage or through the fire-front opening next below said passage, respectively, as desired, and means for supporting the front ends of the main-grate bars entirely above the passage leading to the ash-pit and between the same and the door-controlled opening above it.

5. The combination, substantially as set forth, of a main grate supported with the capacity of adjustment at different angles of inclination, a fuel-feed-supply passage, and an auxiliary or coking grate mounted in bearings between the supply-passage and the main grate, and resting freely on the main grate so as to maintain its operative relation thereto in different angular adjustments thereof.

6. The combination, substantially as set forth, of a main grate, a fuel-feed-supply passage, an auxiliary or coking grate, interposed between the supply-passage and the main grate, and composed of a series of armed hubs having lateral projections in relatively alternated planes, and a transverse rocker-bar on which said armed hubs are detachably and independently supported.

7. The combination, substantially as set forth, of a main grate, a fuel-feed-supply passage, an auxiliary or coking grate interposed between the supply-passage and the main grate and resting freely on the main grate, means for moving the adjacent ends of the main and auxiliary grates in opposite directions so as to afford a clear fuel-space between said grates, and a firing opening and door located below the auxiliary grate and in position to admit of fuel-supply to the main grate when moved away from the auxiliary grate.

8. The combination, substantially as set forth, of an inclined main grate, a fuel-feed-supply passage, an auxiliary or coking grate interposed between the supply-passage and the main grate and resting freely on the main grate, and power-actuated mechanism for reciprocating the ends of the auxiliary-grate bars upon those of the main grate.

9. The combination, substantially as set forth, of an inclined main grate, a fuel-feed-supply passage, an auxiliary or coking grate interposed between the supply-passage and the main grate, power-actuated mechanism for reciprocating the ends of the auxiliary-grate bars above those of the main grate, and power-actuated mechanism for agitating alternate bars of the main grate.

CHARLES R. GREUTER.

Witnesses:
FLORENCE A. HARRIS,
HENRY C. JONES.