(No Model.) 4 Sheets—Sheet 1.

N. W. PRATT.

REVOLVING STOKER.

No. 485,223. Patented Nov. 1, 1892.

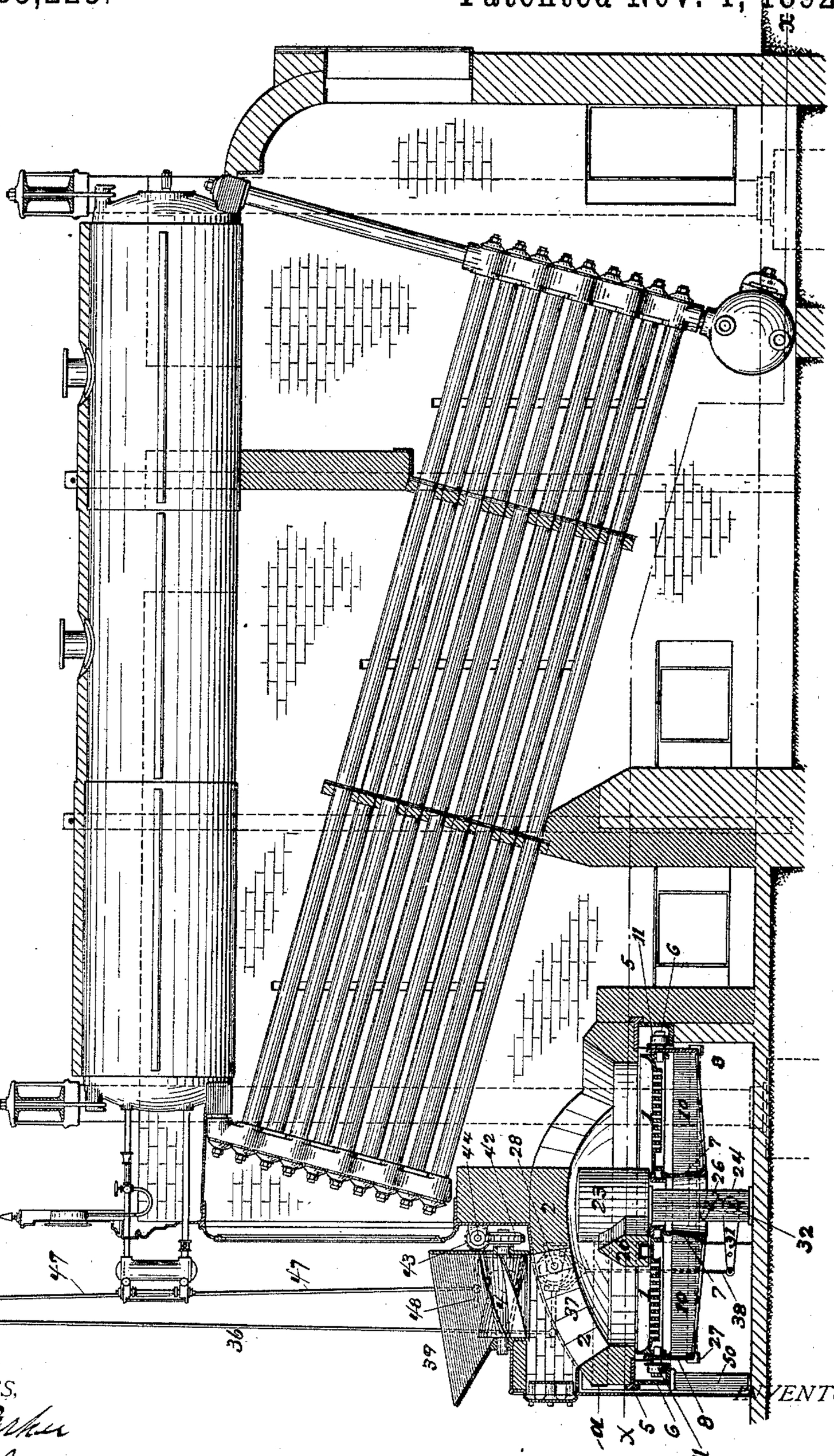

Fig. 1

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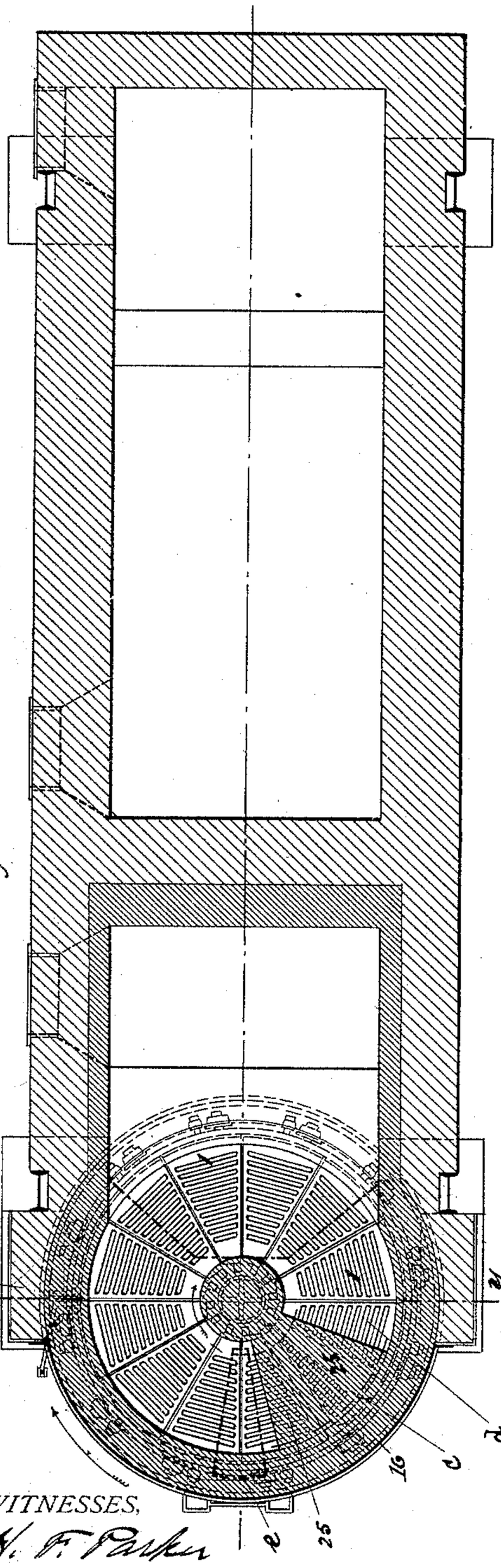

Fig. 2.

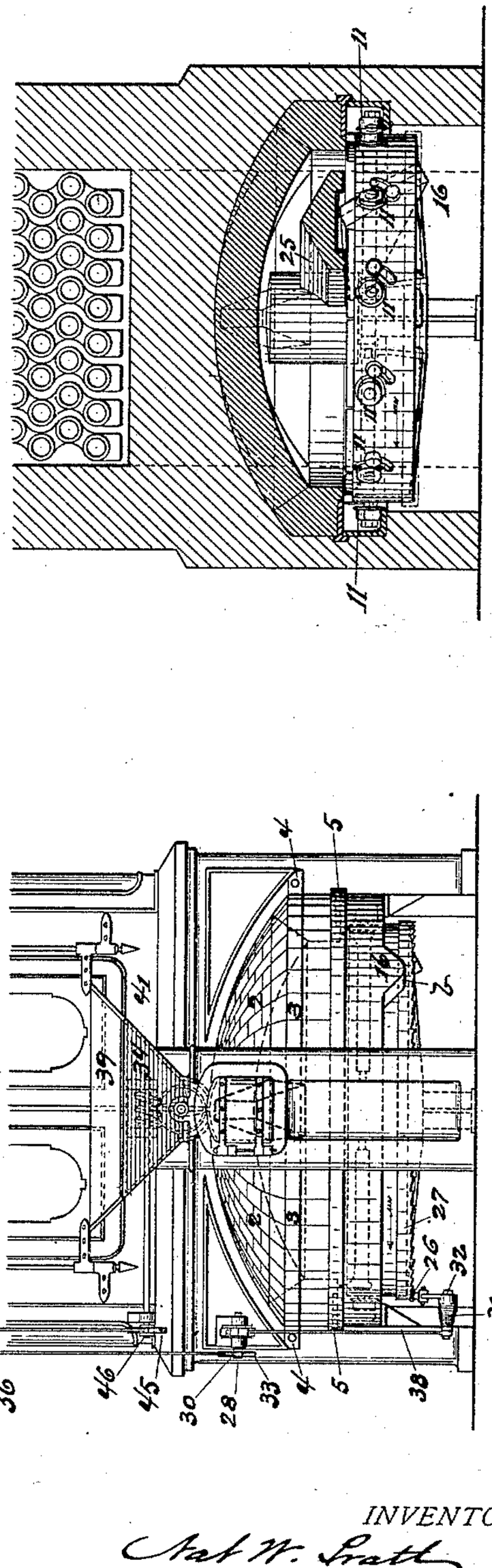

Fig. 4.

Fig. 3.

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4 Sheets—Sheet 3.

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No. 485,223. Patented Nov. 1, 1892.

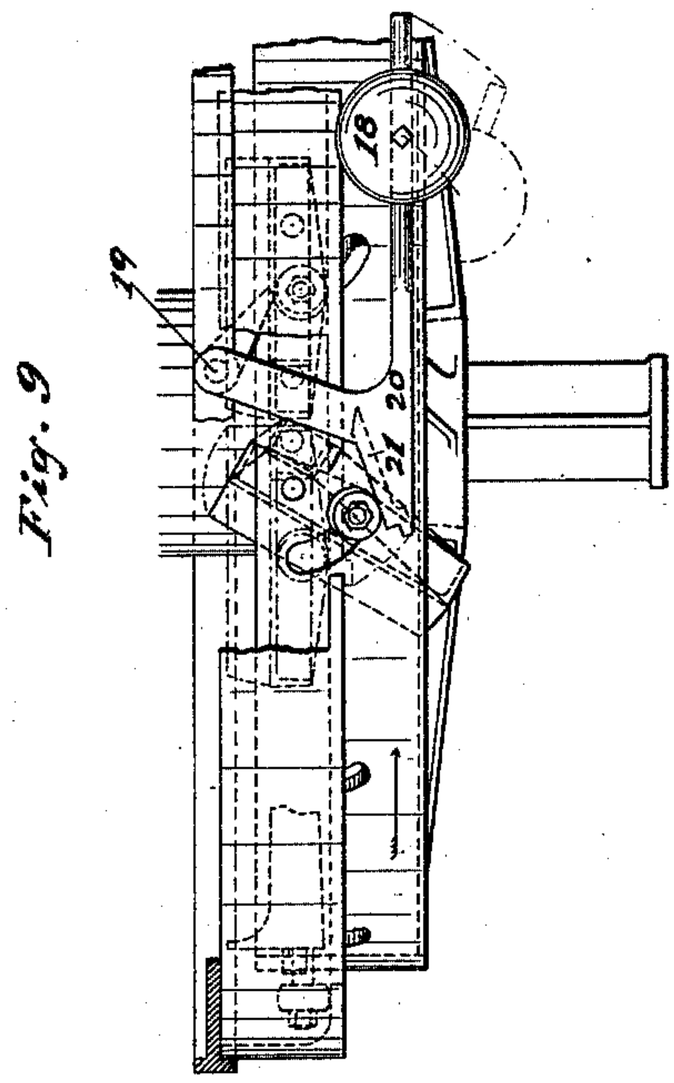

Fig. 9

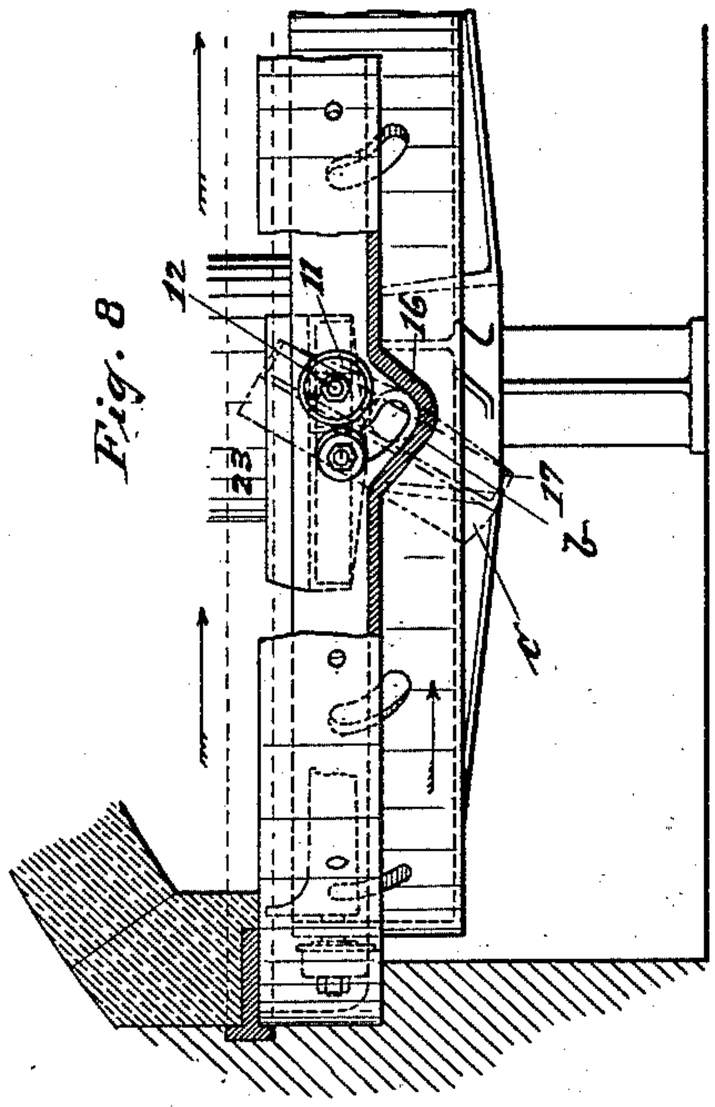

Fig. 8

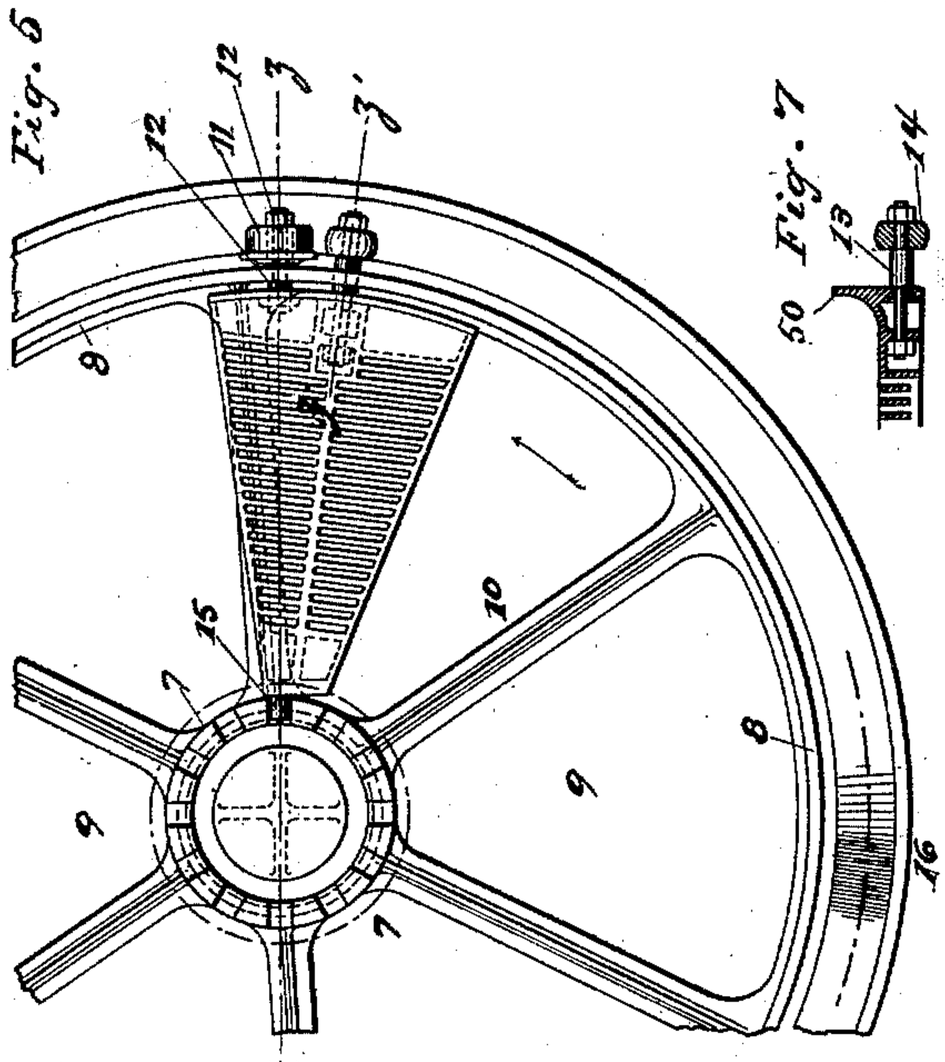

Fig. 5

Fig. 7

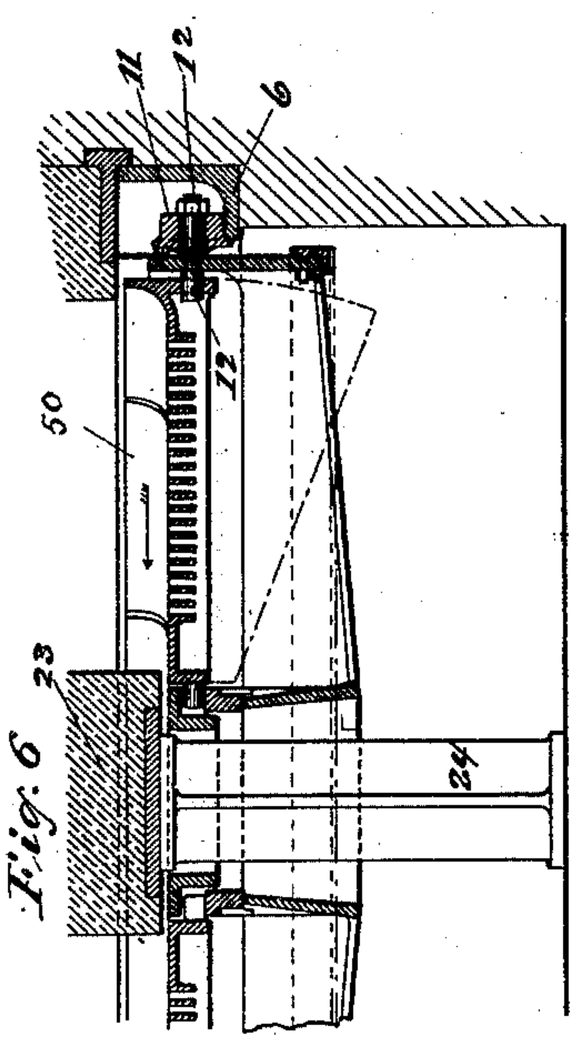

Fig. 6

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REVOLVING STOKER.

No. 485,223. Patented Nov. 1, 1892.

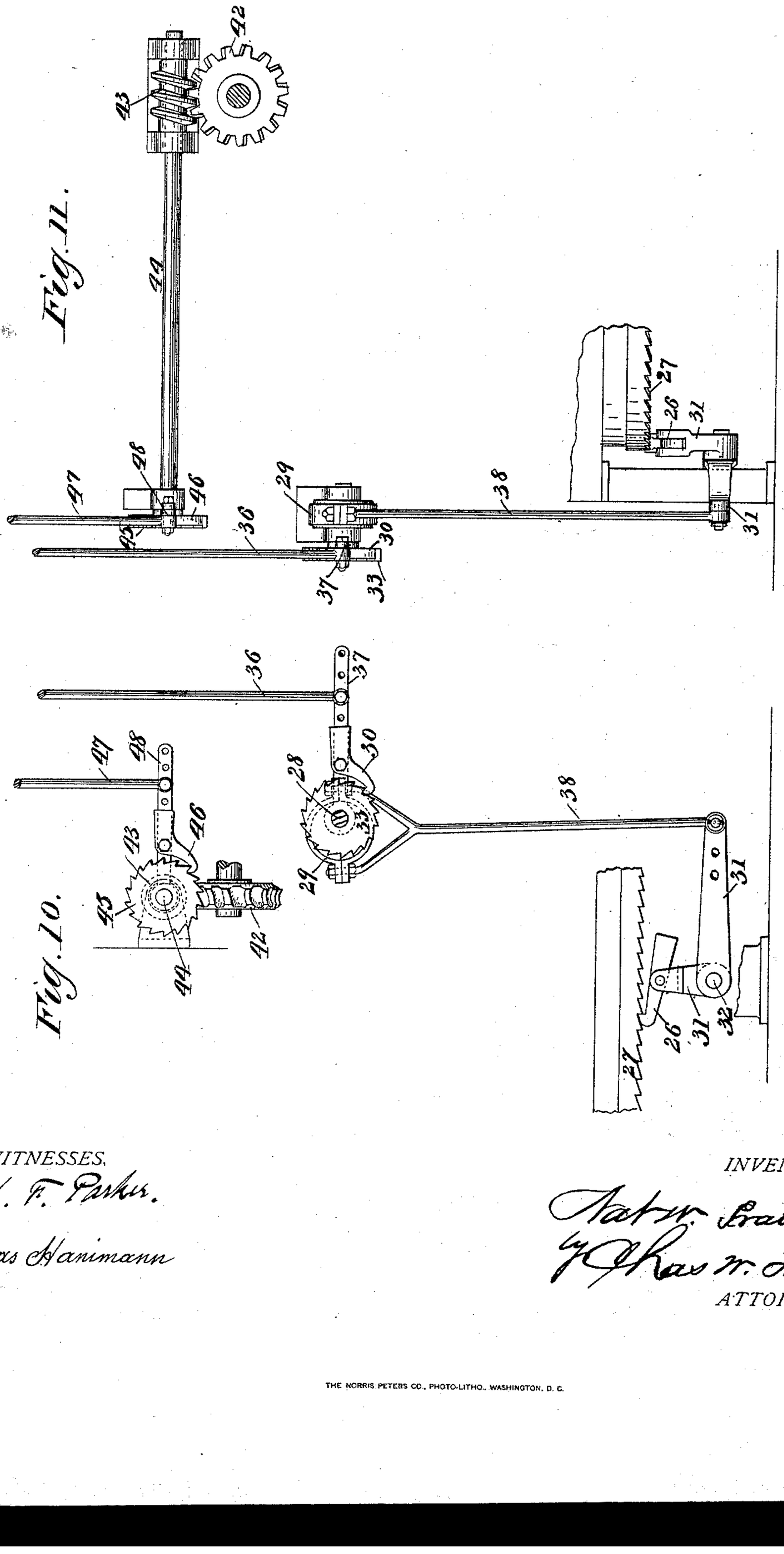

Fig. 11.

Fig. 10.

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UNITED STATES PATENT OFFICE.

NAT. W. PRATT, OF BROOKLYN, NEW YORK.

REVOLVING STOKER.

SPECIFICATION forming part of Letters Patent No. 485,223, dated November 1, 1892.

Application filed March 5, 1889. Serial No. 301,950. (No model.)

To all whom it may concern:

Be it known that I, NAT. W. PRATT, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Revolving Stokers, of which the following is a specification, reference being had to the accompanying drawings, in which similar figures of reference indicate corresponding parts throughout, and in which—

Figure 1 is a longitudinal sectional elevation of a water-tube steam-boiler, showing the invention applied thereto; Fig. 2, a longitudinal section of Fig. 1 on the line *x x;* Fig. 3, a front elevation of the lower portion of the structure; Fig. 4, a cross-section on the line *y y*, Fig. 2, looking from the front toward the back; Fig. 5, an enlarged plan view in detail of the grate-frame; Fig. 6, a cross-section of Fig. 5 on the line *z z;* Fig. 7, a cross-sectional detail at the line *z' z'*, Fig. 5; Fig. 8, a side view, partly in section, of the revolving grate shown in detail, taken opposite the dumping-point; and Fig. 9, a side elevation showing a modification. Figs. 10 and 11 are enlarged side and front views, respectively, showing in detail the propelling mechanism of the grate and feeder detached from the other parts.

My invention is applicable to a water-tube boiler, as shown in the accompanying drawings, or to any form of boiler other than the water-tube; and the object is to provide an automatic stoker having a maximum amount of grate-surface at the hottest portion of the fire and adapted, therefore, to promote perfect combustion of the fuel before the products are discharged.

The object is also to construct a traveling grate such as will require a small power to actuate it and upon which the weight of the fuel will offer little, if any, resistance to the working of the grate and of its feed mechanism.

My invention consists of a rotary grate composed of dumping-sectors journaled on radial axes aside from their centers of gravity in the carrying-frame, or, broadly stated, of dumping-sectors having a preponderence of weight upon one side of their axes, said sectors bearing on their preponderating sides upon a circular track. The track is interrupted or depressed at a portion thereof whereby the sectors are caused to drop by gravity and discharge their loads in succession at a point of rotation succeeding the fire.

My invention also consists in a novel construction of the furnace adapted to such rotary grate, and of a radial bridge covering the sectors at their dumping-point, and a certain juxtaposition of the fuel-feeder with reference to the bridge.

My invention also comprises certain novel mechanism for actuating the grate automatically in given relation to the feeder.

In order to enable others skilled in the art to which my invention appertains to understand and use the same, I will proceed to describe a machine embodying the details of its preferred construction, explain its operation, and subsequently point out in the appended claims its novel characteristics.

1 is a circular grate, which may be placed wholly or partly underneath the boiler, as the circumstances require.

In the drawings the furnace is shown placed half outside of the boiler-front, the outside portion being covered with a dome 2, the thrust of which is received by a cast ring 5, in addition to which there is a wrought-iron band 3, the ends of which are fastened at the points 4 4 to the front wall of the boiler. The wrought-iron band takes the thrust of the upper outside portion of the ring of thrust-blocks supporting the dome, and the cast ring 5, in which this ring of thrust-blocks is set, rests upon a second circular casting 6, built into the wall, which also forms the track upon which the grate is revolved and supported.

The grate 1 is composed of a series of sectors trunnioned radially in the hub 7 and periphery 8 of the circular frame 9. The hub and periphery of the frame 9 are joined together by a series of radial arms 10, composing a wheel-like frame, as separately appears in Fig. 5, the frame being built up or cast in one piece, according to its size. The frame 9 is supported by rollers 11 upon the circular track 6, built into the brickwork, and the studs 12, upon which the said rollers revolve, are firmly fixed to the periphery of the frame 9 and project inwardly also to form trunnions upon which the outer ends of the grate-sections rest. The trunnions 12 and 15 of the

grate-sections lie in an axis aside from the center of gravity, as well as from the axial center, of said sections, and each section has a stud 13, carrying a roller 14, running on the same track-casting as the rollers 11, which support the frame 9. The circular track has a depression at the dumping-point 16, as shown in Figs. 2, 3, 5, and 8.

In all parts of the revolution of the grate and its frame 9 the grate-sections are held level by means of the double supporting-points of the trunnions 12 and the rollers 14, except at the point of depression 16, and at this point the weight of the grate and the ashes thereon causes it to drop and discharge the ashes, assuming the position indicated by dotted lines at 17, Fig. 8, the roller 14 dropping and running up again on the incline of the depression as the grate rotates in the direction of the arrows, whereby the grates are replaced in a horizontal position ready to receive a fresh supply of fuel.

The entire weight of the grates and their supporting-frame 9 is sustained by the circular track 6 at the periphery of the frame, and the central portion of the grate-surface, which would otherwise be inefficient and difficult to clean, is blanked out by a central pier 23, of fire-brick, supported by an iron column 24. This central pier carried up in the middle of the furnace, is put in for the purpose of cutting out the center of the grate in order to get more room for pivoting the inner ends of the sections of the grate in the hub and to avoid subjecting that portion of the furnace to fire in which no movement could be imparted to for dumping.

A bridge-plate 25, covered with fire-brick, extends from the central supporting-pier to the outside edge of the furnace of sufficient width for a single section of the grate to pass under and be completely covered by it during that portion of the revolution of the grate in which the section is dropped for dumping off the ashes and restored to a level position to receive fresh fuel. The bridge 25 closes the opening, preventing the access of air from the ash-pit to the furnace or dropping of fuel from the furnace to the ash-pit during the operation of clearing. The coal is banked against the declining side of the bridge opposite the feeding-point, and the ashes are banked against the opposite declining side of the bridge as the grate rotates, so that the spaces between the surface of the level grate and the edges of the bridge are practically sealed to prevent ingress of draft at the dumping-point, which would result in lowering the temperature of the furnace by the introduction of cold air. The grate-bearing frame 9 is preferably revolved by means of a pawl 26 and ratchet-rack 27, attached to its lower periphery, (or a worm meshing into a worm-gear on the lower edge of the ring can be used.) The pawl 26 and its carrying-lever 31, fulcrumed at 32, are actuated from a counter-shaft 28 and eccentric 29, (or crank,) as indicated in Figs. 10 and 11, which counter-shaft is in turn operated by a pawl 30 and ratchet-wheel 33, keyed thereon, which said pawl 30 receives reciprocative motion through the rod 36 by an eccentric (or crank) 34 on a shaft 35, suitably located above the boiler, as indicated in Fig. 1. The lever 37 of the pawl 30 has the rod 36 adjustably connected thereto, so as to obtain a longer or shorter leverage to vary the stroke of the pawl 30, taking up a greater or less number of teeth on the ratchet-wheel 33, thereby varying the surface speed of the grate, carrying the coal faster or slower. Each revolution of the ratchet-wheel 33 causes the pawl 26 to travel one tooth of the ratchet 27, and the speed of the grate may be further varied by rendering the leverage of the lever 31, also adjustable according to the point of attachment of the rod 38 thereon.

The coal is fed through a hopper 39 by means of a crushing and feeding device 41, (shown in Figs. 1 and 3,) which crushes any large lumps and measures out a given amount at each revolution, showering the same through the opening 40 in the brickwork down upon the grate. The feeder 41 is composed of a spirally-bladed wheel that catches the lumps of coal between the edges of its blades and the adjacent edges of the surrounding casing, and by reason of its spiral form tends to distribute the bulk of the coal to the outer or larger surface of the grate. The speed of the feeder 41 is made variable in a corresponding manner to that employed in the grate-propelling mechanism. The feeder 41 is turned by the worm-gear 42, keyed to its shaft, the worm 43 upon the counter-shaft 44 engaging with it, and the said counter-shaft bearing a ratchet-wheel 45, that is operated by the pawl 46 and rod 47, connected to the pawl-lever 48 at variable distances from its fulcrum and reciprocated by a separate eccentric 49 on the shaft 35.

It is to be observed that I provide an upturned flange 50, to the margins of the grates that nearly fills the space above their peripheries. The space that is left, which is essential to its free rotation, is sealed by the fuel that is banked up against the said margins, and the spiral shape of the feeder 41 contributes to this feature in the manner before stated. The space at the inner margins of the grate about the central pier is likewise sealed, and the undue passage of air at any other portions than through the grates themselves is thereby prevented. The chief object of the upturned flange 50 is to cut off the draft from the portion of fuel adjacent the side wall of the furnace and prevent rapid combustion opposite the movable joint between the grate and the wall, which would cause clinkers to form and clog the movement of the rotary frame.

In operation the coal makes nearly a complete circuit of the grate-surface, being showered down upon the grate at a point adjacent

to the bridge 25, refilling the sectors as soon as they pass from under the bridge. Abundant surface is thereby given for the fire to progress through the body of coal as fast as it rotates and to thoroughly ignite it as it approaches the center of the furnace, and also to effectually complete the process of combustion as the residue is carried away in rotation toward the dumping point. It will also be observed that the coal is fed into that portion of the furnace covered by the dome for the purpose of becoming heated up to the point of incandescence and igniting on top of the fuel as it travels forward, due to the reflected heat from the dome, which heat is received from that portion of the fire which is already at its best point of combustion. The proper relative speed of the feeder and of the grate are conveniently adjusted by the levers 37 and 48, according to the required conditions of temperture or the quality of the fuel. With some fuels it may be desirable to give each section of the grate a half-revolution, so that such which receive coal in the first revolution would be underneath in the second one, and so on alternately, the grate turning completely over to dump its ashes. This, however, would take more space underneath the covering bridge and also a greater proportion of the circumference of the circle.

The modification illustrated in Fig. 9 consists in providing the circular track at the dumping-point with a depressible section that is counterbalanced by a weight of such gravity that when the roller of a loaded grate passes upon the depressible section the latter drops, so as to dump the grate about its pivot, and as the load is discharged the grate is overbalanced by the weight and the section of track restored to its normal position, restoring the grate. The depressible section of the track is borne upon an arm 21, fulcrumed at 19 upon any suitable part of the stationary framework above the track. The arm 21 has also a lever 20 projected rigidly from it, upon which the counterbalancing-weight 18 is attached, acting as a tumbling-bob, and is rendered adjustable by means of a set-screw. The depressible section of track 21 has a lip that fits under the adjacent edge of the fixed portion of the track when the section is up and serves as a stop to prevent the passage of the section above its proper level. As the grate rotates in the direction of the arrows the wheels first pass over the depressible section, but do not depress it, being fixed to the rim; but as the rollers advance upon the section the load of ashes upon the grate overcomes the weight 18, depressing the section to the position shown, the grate assuming the position represented by dotted lines. The ashes being discharged into the ash-pit beneath the weight of the grate is insufficient in itself to overbalance the tumbling-bob and is therefore restored to a level position. The entire operation, being momentary, is completed before the grate-frame has rotated sufficiently to interfere with the replacement of the roller at the level of the track. The operation is repeated similarly upon each sector of the grate as the same advances to the dumping-point and proceeds therefrom in continuous rotation.

It is to be understood that the grate-sectors are not necessarily journaled eccentrically in order to operate as herein described, but may be centrally journaled and weighted upon one side of their axes to dump by gravity, within the meaning of my invention.

No claim is herein made, broadly, for a horizontal rotary grate made up of a series of sectoral sections that are hung on radial pivots and dumped a half-revolution automatically by the movement of the grate, as the same is claimed in my application, filed May 14, 1890, Serial No. 351,773, the distinction between said broad subject-matter and the present lying in the fact that the present invention is limited to a particular species—namely, wherein the grate-sections are dumped by gravity either by pivoting at one side of their centers or by adding a weight to one side of their centers to effect the same result.

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

1. In a revolving grate, the combination of a rotary carrying-frame, a series of sectoral grate-sections journaled therein on radial axes aside from their centers of gravity, and an interrupted stationary track concentric with the axis of rotation of the frame, upon which the preponderating sides of the grate-sections bear during a part of their circuit.

2. In a revolving grate, the combination of a rotary carrying-frame, a series of sectoral grate-sections journaled therein on radial axes aside from their centers of gravity, a stationary track concentric with the axis of rotation of the said frame, upon which the preponderating sides of the grate-sections bear, a fuel-feeder at one side of the sectional grate, and a depression or interval in the surface of the track at a point in the order of rotation preceding the position of the feeder between the same and the incandescent body of fuel.

3. The combination, with a horizontally revolving grate and a vertical cylindrical side wall at its periphery, of an upturned peripheral flange on the grate, having a non-perforated surface, whereby combustion of the fuel adjacent the side wall is checked.

4. In a revolving fire-grate, the combination of a horizontal supporting-frame having a central hub and a concentric rim, grate-sections composing sectors of a circle, trunnioned in said hub and said rim upon axes that are aside from the center of gravity of the said grate-sections, a circular track concentric with said supporting-frame and upon which it rotates, a depression, substantially as shown, of the circular track at the dumping-point of the grates, and at the outer margins

of the said grates rollers that are adapted to travel upon the said circular track, to normally sustain the sections in a level position, to permit their gravitation at the point of said depression, and to restore their normal position by passage out of said depression upon an incline of the same, substantially as and for the purposes set forth.

5. In an automatic furnace-stoker, the combination, with a horizontally-revolving circular grate having movable dumping-sections, of a feeding-hopper located vertically above said grate at a point succeeding the dumping-point of said sectors in the direction of rotation and adapted to supply fuel continuously and distribute the same to the grate at a portion of the surface of the latter having a motion approaching the fire.

6. The herein-described means for driving the rotary circular grate at variable surface speeds from a source of given speed, consisting of a pawl-and-ratchet mechanism circumferential to the grate and a pawl-carrying lever engaging therewith, actuated by a pawl-and-ratchet eccentric, (or equivalent,) the eccentric-actuating pawl being connected with its carrying-lever at alterable distances from the fulcrum thereof, whereby the said eccentric-actuating pawl is caused to engage with a greater or less number of ratchet-teeth, in the manner set forth.

7. The combination, with a rotary grate, of a domed crown having an opening above one side of the grate for the exit of hot gases and an opening above the other side of the grate for the supply of fuel, said crown presenting a reflecting-surface of refractory material immediately over the fuel during a part of its circuit.

8. The combination, in a boiler-furnace, of a revolving grate, a domed crown thereof partly within and partly without the front wall of the boiler, and a flanged circular frame confining the thrust-blocks of the crown.

9. The combination, in a boiler-furnace, of a revolving grate having automatic dumping-sectors, a domed crown partly within and partly without the front wall of the boiler, a fuel-feeder and an opening therefor through the exterior part of the crown, a bridge covering the sectors at an interval of their circuit immediately preceding their passage under the feeder, and mechanism, substantially as described, whereby the sectors are dumped and restored to a horizontal position under the bridge.

10. The combination, with a rotary furnace-grate the frame whereof is cored at the center, of a central pier composed of refractory material projecting vertically through and above the said cored center, adapted to direct the fuel upon the grate and about the said pier from a feeding-point to a clearing-point, as described.

11. The combination, with the central pier and concentric side walls of a furnace and a rotary grate having dumped sectors, as described, of a bridge extending radially from said pier to said side walls above the dumping-point.

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