No. 824,534. PATENTED JUNE 26, 1906.

E. EINFELDT.

FURNACE GRATE.

APPLICATION FILED MAY 3, 1904.

4 SHEETS—SHEET 1.

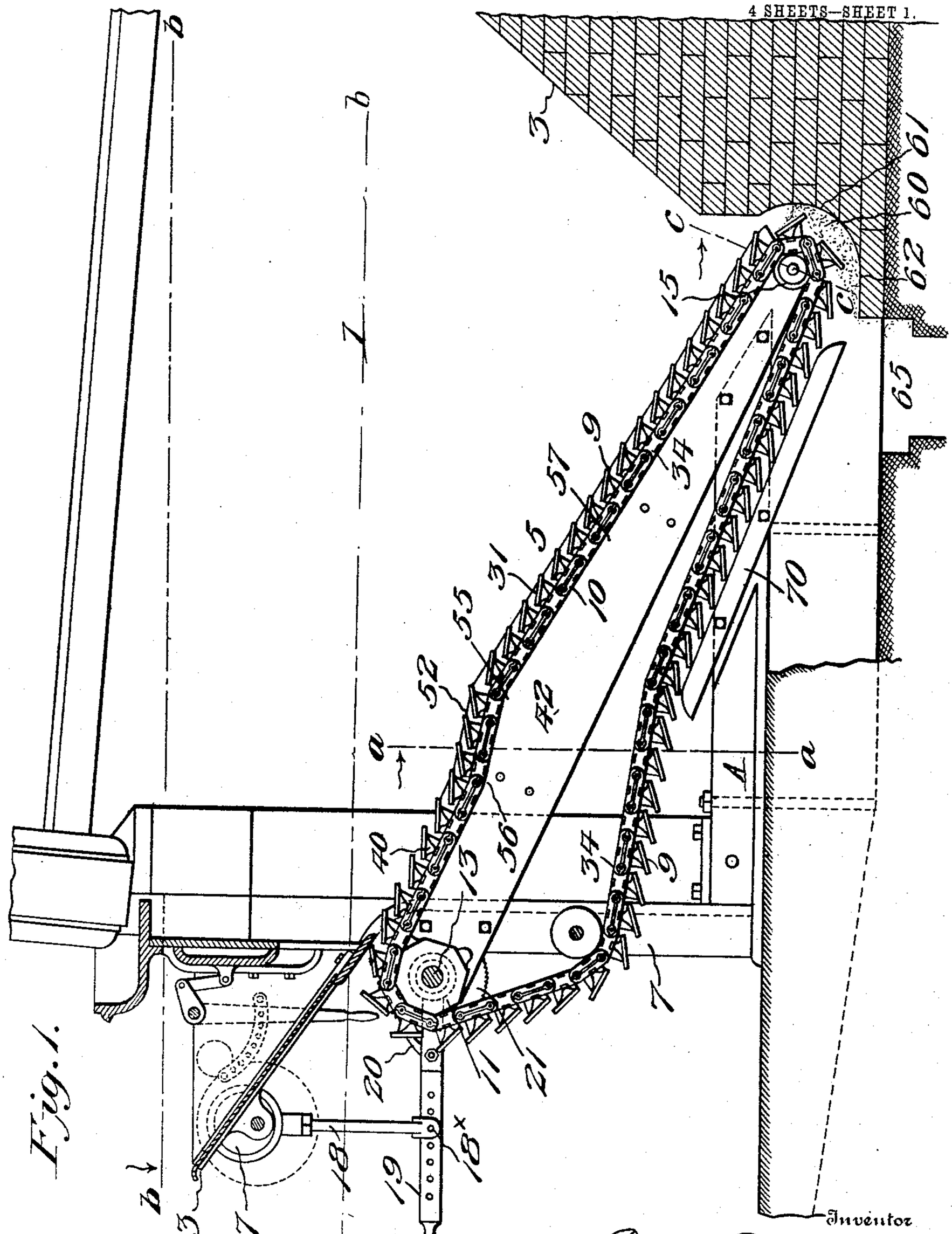

Fig. 1.

Witnesses

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4 SHEETS—SHEET 2

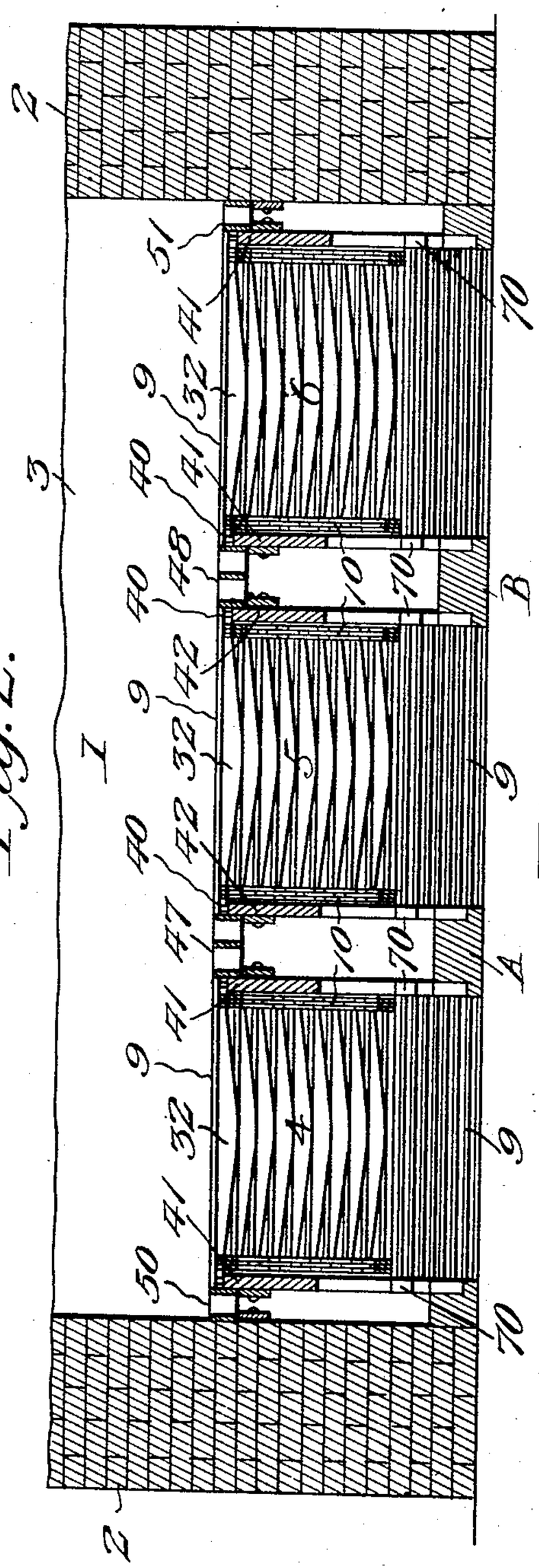

Fig. 2.

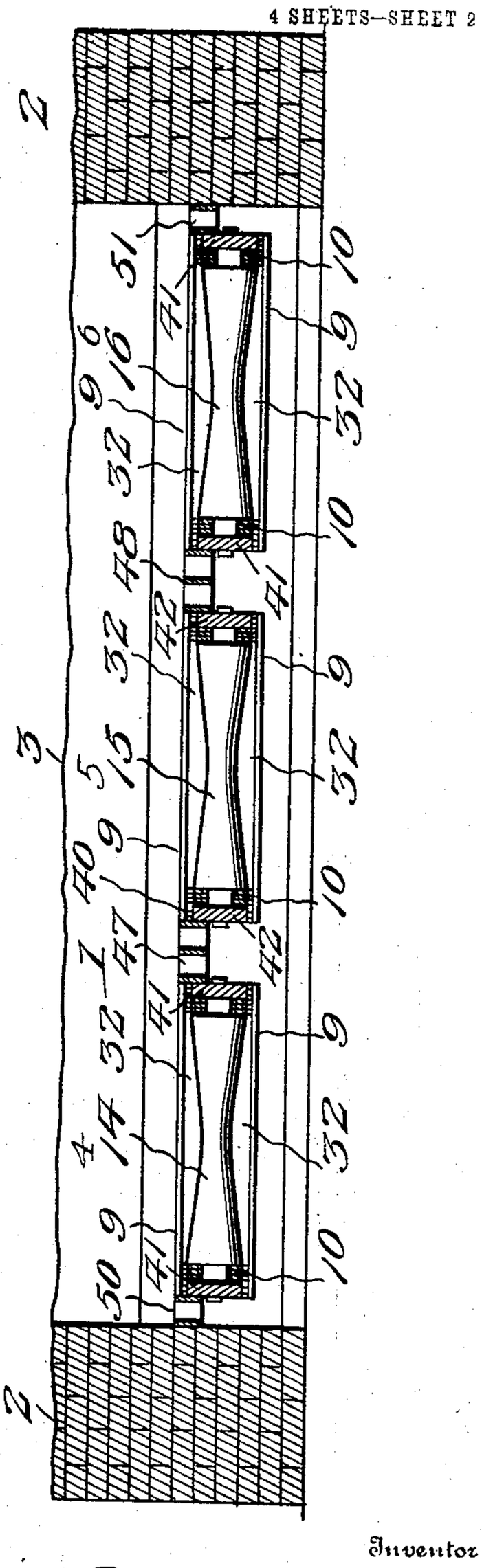

Fig. 4.

Witnesses

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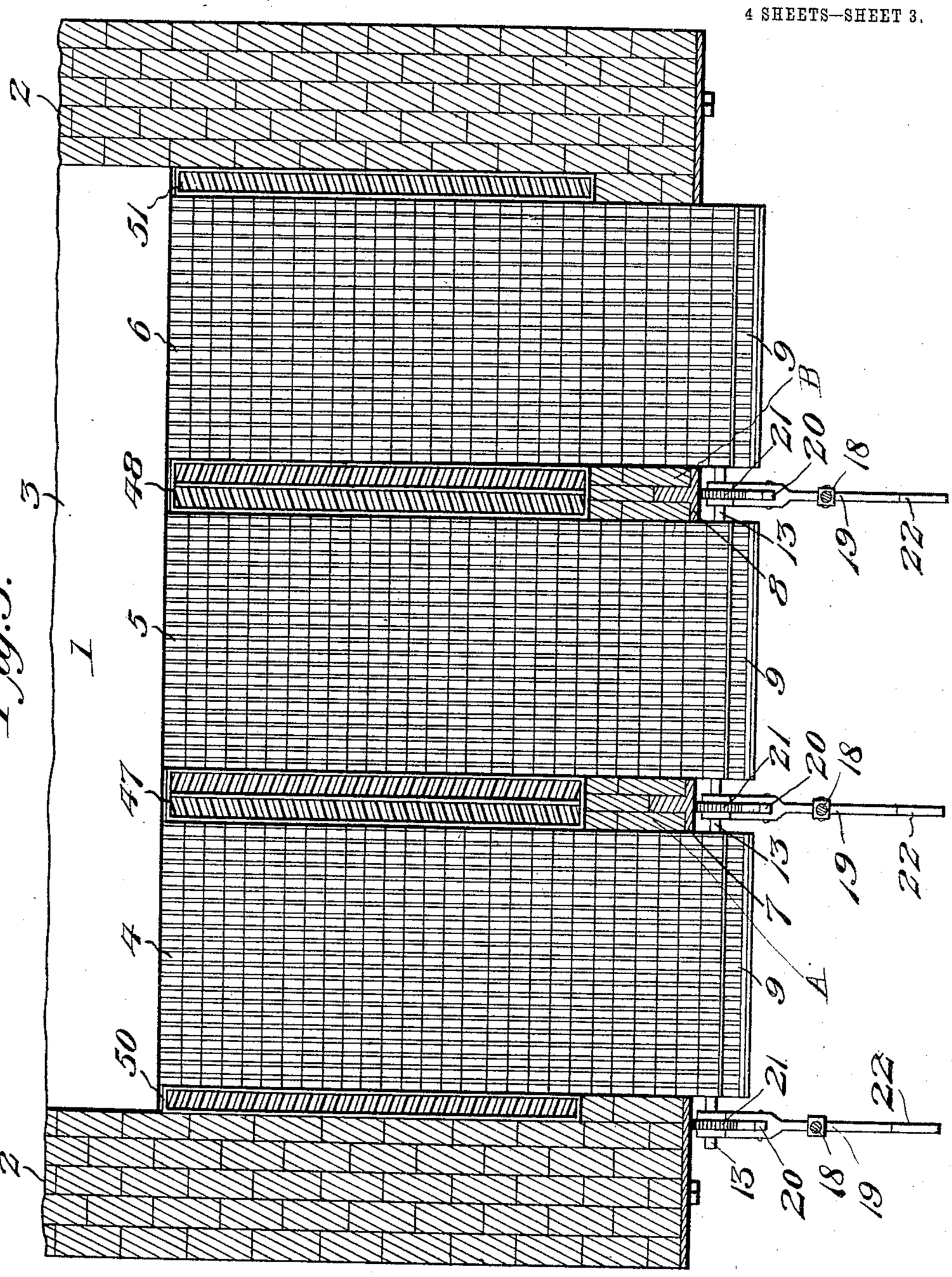
4 SHEETS—SHEET 3.

Fig. 3.



Witnesses

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4 SHEETS—SHEET 4.

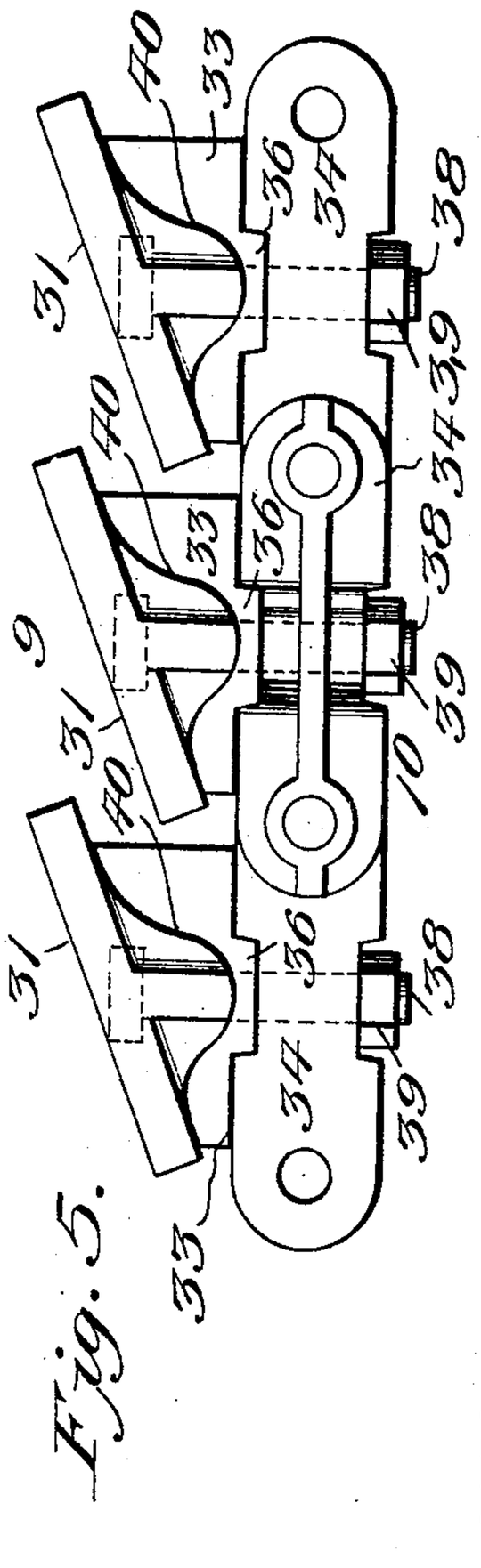

Fig. 5.

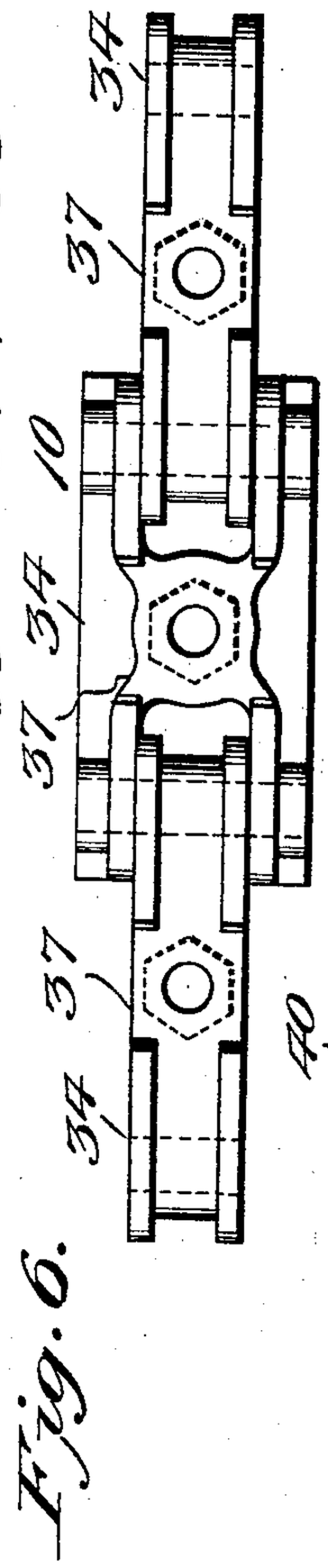

Fig. 6.

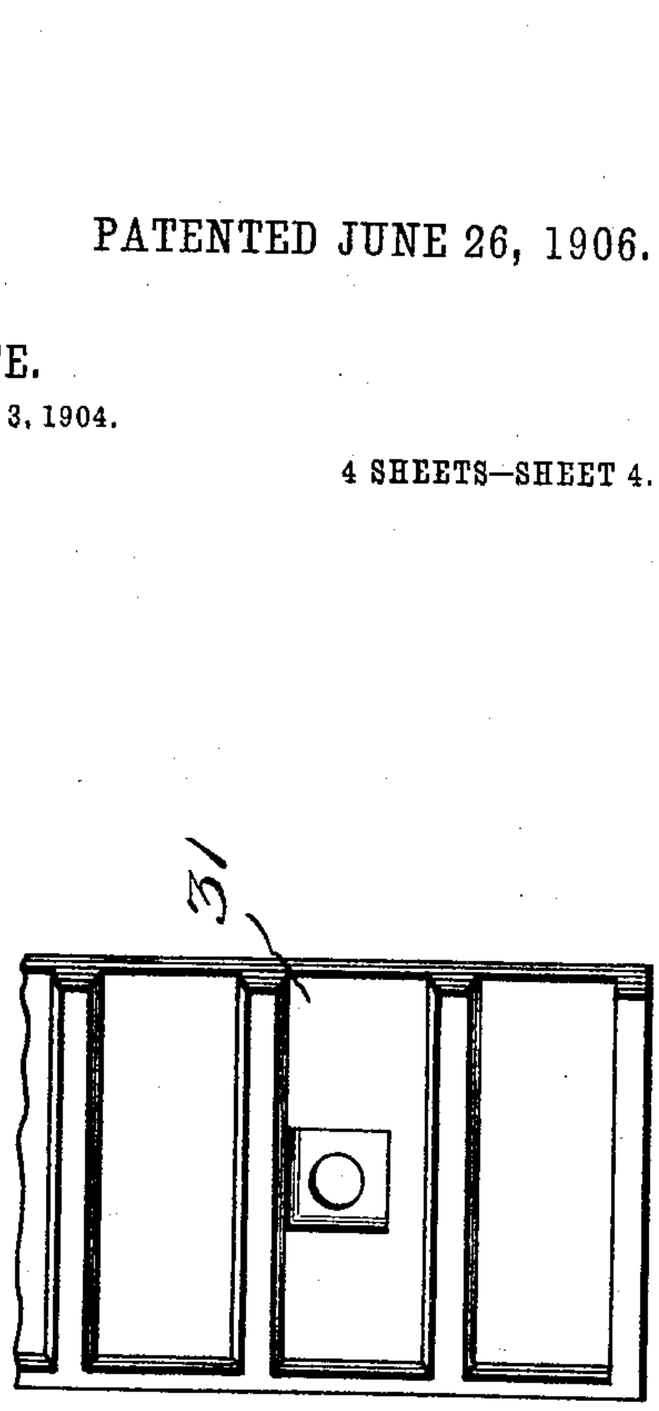

Fig. 8.

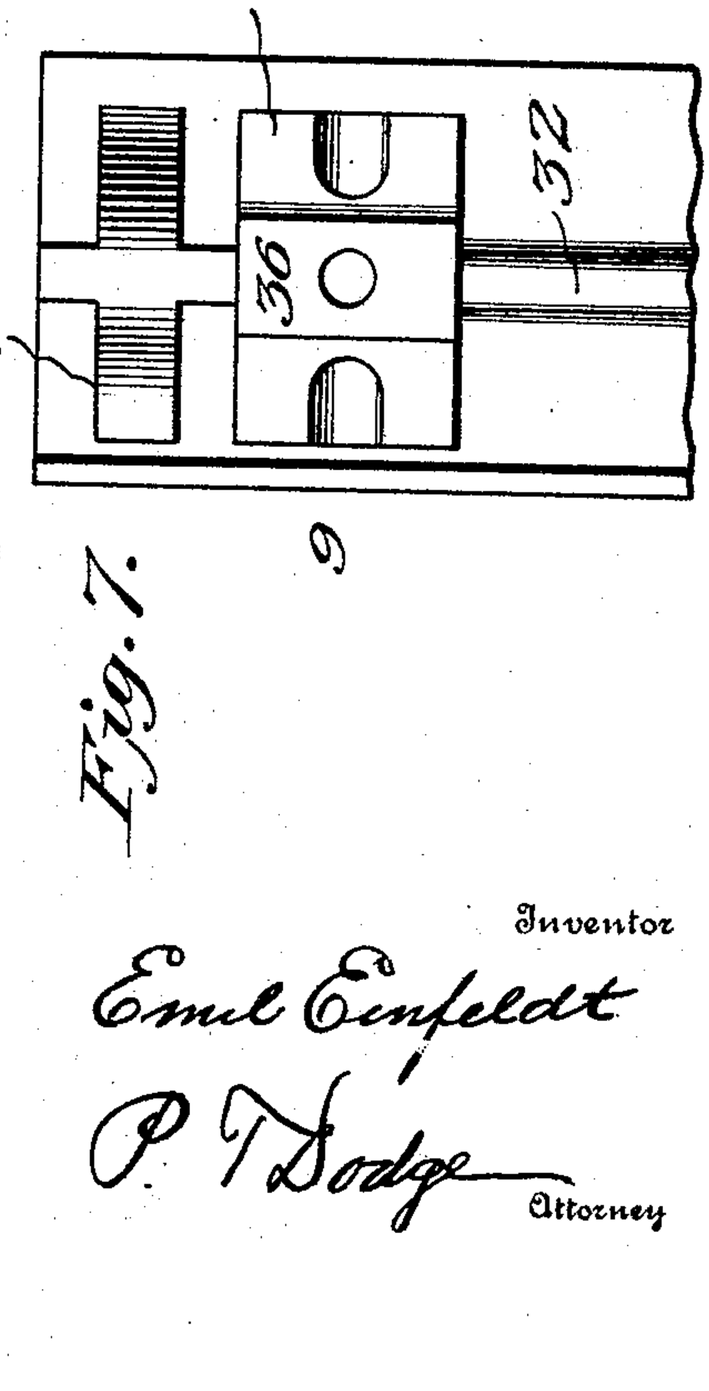

Fig. 7.

Witnesses

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UNITED STATES PATENT OFFICE.

EMIL EINFELDT, OF DAVENPORT, IOWA, ASSIGNOR TO BETTENDORF METAL WHEEL COMPANY, A CORPORATION OF IOWA.

FURNACE-GRATE.

No. 824,534. Specification of Letters Patent. Patented June 26, 1906.

Application filed May 3, 1904. Serial No. 206,151.

To all whom it may concern:

Be it known that I, EMIL EINFELDT, of Davenport, county of Scott, and State of Iowa, have invented a new and useful Improvement in Furnace-Grates, of which the following is a specification.

This invention relates to furnace-grates of the type wherein the grate-bars are carried by endless traveling chains, which grates are used for burning fuel in a finely-divided condition; and the invention consists in various improvements designed with a view of obtaining the most efficient consumption of the fuel and gases, the uniform and proper feeding of the fuel, and the effective operation of the mechanism generally.

In the accompanying drawings, Figure 1 is a longitudinal section through a furnace equipped with grates embodying my invention. Fig. 2 is a vertical transverse sectional elevation on the line *a a* of Fig. 1. Fig. 3 is a horizontal sectional plan view on the line *b b* of Fig. 1. Fig. 4 is a transverse section on the line *c c* of Fig. 1. Fig. 5 is an end elevation, on an enlarged scale, of a section of the carrying-chains and a number of the grate-bars, showing how the latter are detachably connected with the links of the chain. Fig. 6 is a top plan view of a portion of one of the carrying-chains with the grate-bars removed. Fig. 7 is a bottom plan view of one end of one of the grate-bars. Fig. 8 is a top plan view of the same.

Referring to the drawings, 1 represents the furnace-chamber, inclosed at the side by side walls 2 and at the rear by rear walls 3, in which chamber are arranged traveling grates, in the present instance three in number 4, 5, and 6, extending side by side through the front of the chamber between vertical piers or columns 7 and 8, which latter give support to the arches of the masonry on which the boiler is mounted.

The traveling grates comprise each a series of transversely-arranged grate-bars 9, supported at their opposite ends on chains 10, which chains at the front pass over sprocket-wheels 11 and 12, mounted on horizontal transverse shafts 13, arranged end to end and journaled in bearings on the front of the furnace. At the rear the chains pass around and are guided by imperforate guiding-drums 14, 15, and 16, around which drums the chains have a slip or free movement, while they are positively driven by the front sprocket-wheels, the result of this arrangement being that the weight of the fuel on the downwardly-traveling part of the chain of bars will act by gravity to pull them in the direction of travel, and thus materially aid their feeding movement.

The rotation of the sprocket-wheels to effect the feeding movement of the grates is accomplished in the present instance by eccentrics 17, driven in a suitable manner, to which are connected rods 18, jointed at their lower ends by removable pins $18^{\times}$ to levers 19 which levers are mounted at their inner ends loosely on the respective shafts 13 and each of which is provided with a driving-pawl 20, engaging ratchet-wheels 21 on the shafts, the arrangement being such that the vibratory motion given to the levers by the eccentrics will advance the shafts intermittently and feed the grates forward step by step.

By the removal of the pins $18^{\times}$, which connect the rods 18 with the levers 19, the latter may be operated manually in case it is necessary to effect quick movements of the grates independently of the actuating mechanism, the levers being provided with a handle 22 for this purpose. It will be noted that by the arrangement described the several grates are driven independently of each other from a common source of power, and either may be operated by hand by the means described without disturbing the operation of the others by the common driving means.

As a result of the construction described, the fuel stored in hoppers 23 at the front of the furnace and discharged from said hoppers onto the front of the traveling grates is carried by them slowly and uniformly from the front to the rear of the furnace-chamber, being subjected to the action of combustion in its passage therethrough.

The grate-bars are each formed on its upper side with an active supporting-surface 31 for the fuel and on its under side with a convex rib or web 32, which latter conforms to the surface of the guiding-drums, which are concave between their ends, so that in passing around the drums the bars are given proper support and effectively guided. Near their opposite ends the grate-bars are formed with flat surfaces 33, which bear against the faces of links 34 of the carrying-chains 10, and these bearing-surfaces have projecting from them

each a lug 36, which is seated in a depression or socket 37 in the link, the said parts being firmly but detachably connected together by a through-bolt 38, passing through holes in the link and grate-bar and held by a nut 39, applied to the bolt at the under side of the link. By reason of this manner of connecting the bars with the links of the chains their individual removal may be expeditiously effected with little trouble while the chains are in motion when it is desired to replace a burned or injured bar with a new one, the bar being under these circumstances removed while passing up at the front of the furnace, at which point the under sides of the bars are uppermost and exposed and the fastening-nuts readily accessible. The extreme ends of the grate-bars beyond the point of connection with the chains are formed on the under sides with bearing-surfaces 40, which slide on and are supported by the upper edges of guide-plates 41 and 42, extending longitudinally within the furnace-chamber, the spaces between the adjacent guiding-plates being spanned or bridged over by fixed grates or plates 47 and 48, respectively. There are two sets of these guiding-plates, one of which is situated between grates 4 and 5 and gives guiding support, respectively, to the adjacent ends of said grates, while the other set is situated between grates 5 and 6 and gives support to the adjacent ends, respectively, of said grates. The plates of the first set are supported at their front ends by the column 7, and at their rear ends they are fastened to and sustained by the rear end of a horizontal bar A, extending rearwardly longitudinally within the furnace-chamber from the base of the column 7. The plates of the second set are sustained at their forward ends by column 8 and have their rear ends secured to and supported by the rear end of a horizontal longitudinal bar B, extending longitudinally into the furnace-chamber at the base of the same from the base of column 8. The stationary grate 47, which spans the space between movable grates 4 and 5, is secured to and sustained by the guide-plates extending between these grates, while the other stationary grate 48 is secured to and sustained by the second set of guiding-plates between the movable grates 5 and 6.

I propose to interpose between the outer ends of the two outer traveling grates 4 and 6 and the side walls of the furnace stationary grates 50 and 51, respectively, in order to prevent the extreme heat of the walls from injuriously affecting the ends of the grate-bars, which action would result if the ends of the bars travel in contact with or in close proximity to the walls, in which case the fuel in a high degree of combustion would heat the bricks of the wall to an intense degree and burn out the ends of the grate-bars traveling closely thereto. By the provision of the two stationary grates 50 and 51 this over or intense heating of the wall is prevented, so that the grate-bars are effectively protected from injury.

The stationary grate 50, before alluded to, is firmly secured to the side wall of the furnace, as shown in Fig. 2, and it gives support to the guiding-plate at this point, which guiding-plate is bolted to the side of the stationary plate. In like manner the other stationary grate 51 at the opposite side of the furnace-chamber is firmly secured to the side wall of the furnace and gives support to the guiding-plate at this point, which latter is bolted to the grate, as in the first instance described.

It will be observed as a result of the construction described and illustrated with respect to the relation of the movable and stationary grates that the three movable grates are of the usual width and conjointly they present a practically continuous extended surface for the fuel, and the stationary grates are very narrow in proportion to the width of the movable grates, their function being to bridge over the narrow spaces between the movable grates. As a result the fixed grates in their relations, as described, to the relatively wide traveling grates serve as a means of bridging over the space between the edges of the traveling grates immediately in rear of the vertical piers 7 and 8, between which the traveling grates extend at the front. The width of the sationary grates being very much less than the movable grates they will offer practically no obstruction to the advance of the body of fuel as a whole, supported conjointly by all of the grates, so that the movable grates are enabled to carry a fuel-bed of a width corresponding to the effective width of the furnace-chamber and as a practically continuous mass.

The relative positions of the sprocket-wheels at the front, the guiding-drums at the rear, and the guiding-plates over which the chains slide are such that the fuel-supporting bed formed conjointly by the grate-bars will have a general inclination downward from the front, and during the greater part of their feeding movement the vertical space 52 between the front edge of one bar and the rear edge of the next bar in advance will be contracted. I have found in the practical operation of the mechanism that if these conditions are preserved throughout the length of the fuel-bed the formation of clinkers will result and the fuel will become packed and the combustion of the same will be interfered with. In order to overcome these objections, I propose to provide for the further separation of the bars at a single predetermined point in their travel, so as to increase the vertical space between them at this point, and thus break up the fuel in the process of

coking and allow more draft to pass through, thereby greatly promoting combustion and preventing the formation of clinkers. Beyond this point the grate-bars resume their relative positions and throughout the remainder oi their travel to the guiding-drums. I find that the best results are obtained if the bars are opened at a point in the furnace-chamber about one-third the length of the chamber from its front, although of course good results may be obtained if this point of opening is varied within reasonable limits. The opening of the bars at this point may be conveniently effected by having the guiding edges of the plates approach more nearly the horizontal, the result being that as the grate-bars pass onto these relatively sloping portions ot the plates the grate-bars will each be tipped upward at its rear edge, and in this way the space between the rear edge of each bar and the rear edge of the next bar behind will be widened.

On reference to Fig. 1 it will be observed that the upper edge of the guide-plates extends in a straight line at a downward inclination to the point 56, at which point its inclination changes and extends in a nearly horizontal line to the point 55, whence it again extends at a downward inclination in a straight line for the remainder of its length. As a result of this construction the grate-bars pursue a straight path with the spaces between them contracted until they arrive at the point 55, whereupon in passing onto the portion of the plates between the point 55 and 56 the spaces between the bars are suddenly widened, after which they pursue a straight path downward to the guiding-drums with the spaces between them again contracted. By this means the combustion of the fuel is promoted and greatly aided at a point in the travel of the bed where such increased combustion is most effective At the same time clinkers which may have formed are broken. After passing this point of greatest combustion the consumption of the fuel continues active, so that by the time it arrives at the guiding-drums it is converted into ashes, which are discharged, as will be more fully described hereinafter.

In order that air may be prevented from passing from beneath the grates around the rear ends of the same, and thus retard the proper draft through the fuel-bed, I form the rear wall of the furnace so that it will conform closely to the path of the bars as they pass around the guiding-drums, thus forming, in effect, a contracted space 60, having a curved rear surface 61 and terminating in a horizontal ledge 62 just beneath the drums at a point where the bars begin their return movements after passing around the drums. As the bars laden with the ashes resulting from the combustion of the fuel pass around the drum they are suddenly tipped and the ashes ace dumped and accumulate in the contracted space 60, forming a pile on the ledge 62 and banked up against the curved surface 61, thus constituting, in effect, a seal which closes communication through this space between the under and upper sides of the grates. As the mass of ashes increases in height and extends in the path of the bars the latter push them forward and act to direct them into the pit 65, from which they may be conveyed in any suitable manner. It will be observed, therefore, that by reason of the accumulation of ashes in the contracted space at the rear of the grates and, further, by reason of the provision of the imperforate guide-drums all communication between the under and upper sides of the grates at the rear is effectually closed, so that all the air and draft must pass upward through the bed of fuel and between the bars, and thus promote effective combustion with no retarding effects.

To prevent the undue sagging of the lower part of the chains and grate-bars, in order to avoid the provision of a pit or recess to receive the sagging part, and to contract as far as possible the space occupied by the grates, I fix beneath the traveling grates inclined supporting-rails 70, which extend upward from a point just in advance of the guiding-drums to a point about midway of the length of the chamber, along which rails the bars in their return movements travel and by which they are given direct support and maintained in an elevated position.

Having thus described my invention, what I claim is—

1. In combination with a furnace-chamber, traveling grate-bars therein, and means for guiding said grate-bars, first at a downward inclination in a straight line for a portion of their rearward travel, then at a relative slope upward with reference to their first movement toward the horizontal, and finally at a downward inclination in a straight line for the remainder of their travel, substantially as described.

2. In combination with a furnace-chamber, traveling grate-bars therein, and means for guiding said bars first at a downward inclination in a straight line for about one-third the distance of the length of the grate, then for a short distance at a relative slope approaching the horizontal, and upward with reference to their first movement and finally at a downward inclination in a straight line for the remainder of their rearward travel.

3. In combination with a furnace, an endless chain grate therein comprising connected grate bars each formed on its inner side with a convex longitudinal web or rib, means for supporting the front of the grate, and a guide-drum at the rear over which the grate-bars pass, said drum having its surface con-

cave to receive the ribs of the bars; whereby the latter in their passage around the drum are given firm support and effectively guided.

4. In a furnace, the combination of a plurality of traveling grates arranged side by side with a space between adjacent grates, said space being greatly less in width than the width of the individual grates, and said grates forming conjointly an extended practically continuous moving fuel-supporting bed, and a narrow stationary grate bridging the space between the movable grates.

5. In a furnace, the combination with a plurality of movable grates arranged side by side, of guiding-plates extending longitudinally between said movable grates and giving guiding support to the same, and a stationary grate secured to said guiding-plates and bridging the space between the movable grates, said stationary grates being greatly less in width than the width of the individual grates.

6. The combination with a plurality of traveling grates arranged with a space between them, and adapted to support the bed of fuel and advance the same as a continuous mass, of a fixed grate situated in the space between the movable grates and of a relative width which, while bridging the space between the movable grates, will not afford sufficient resistance to the movement of the fuel-bed to interfere with the advance of the same as a continuous mass; whereby the movable grates are enabled to conjointly support and advance a fuel-bed of great width.

7. In a traveling grate, the combination with a supporting-chain comprising a series of jointed links formed with sockets in their upper sides and with openings extending downwardly through the links and forming continuations of the sockets, of a series of grate-bars having on their inner sides depending lugs to enter the sockets in the links, said grate-bars and lugs being formed with openings extending entirely through them in line with the downwardly-extending openings in the links, and through-bolts extending through said openings in the grate-bars, lugs and links and serving to connect the bars detachably with the links.

8. In combination with a furnace-chamber provided at its front with vertical supporting piers or columns, a boiler sustained at the front by the said columns, a plurality of traveling grates situated within the furnace-chamber and extending through the front of the same and between the supporting-piers, and relatively narrow fixed grates bridging the space between the movable grates in rear of the supporting-piers; whereby the movable grates are enabled to advance, as a continuous mass, a fuel-bed of great width.

In testimony whereof I hereunto set my hand this 25th day of April, 1904, in the presence of two attesting witnesses.

EMIL EINFELDT.

Witnesses:
J. L. HECHT,
A. NEILSON.