No. 878,246. PATENTED FEB. 4, 1908.

H. SIEBEN & L. DANHOFF.

FURNACE GRATE.

APPLICATION FILED AUG. 12, 1903.

3 SHEETS—SHEET 1.

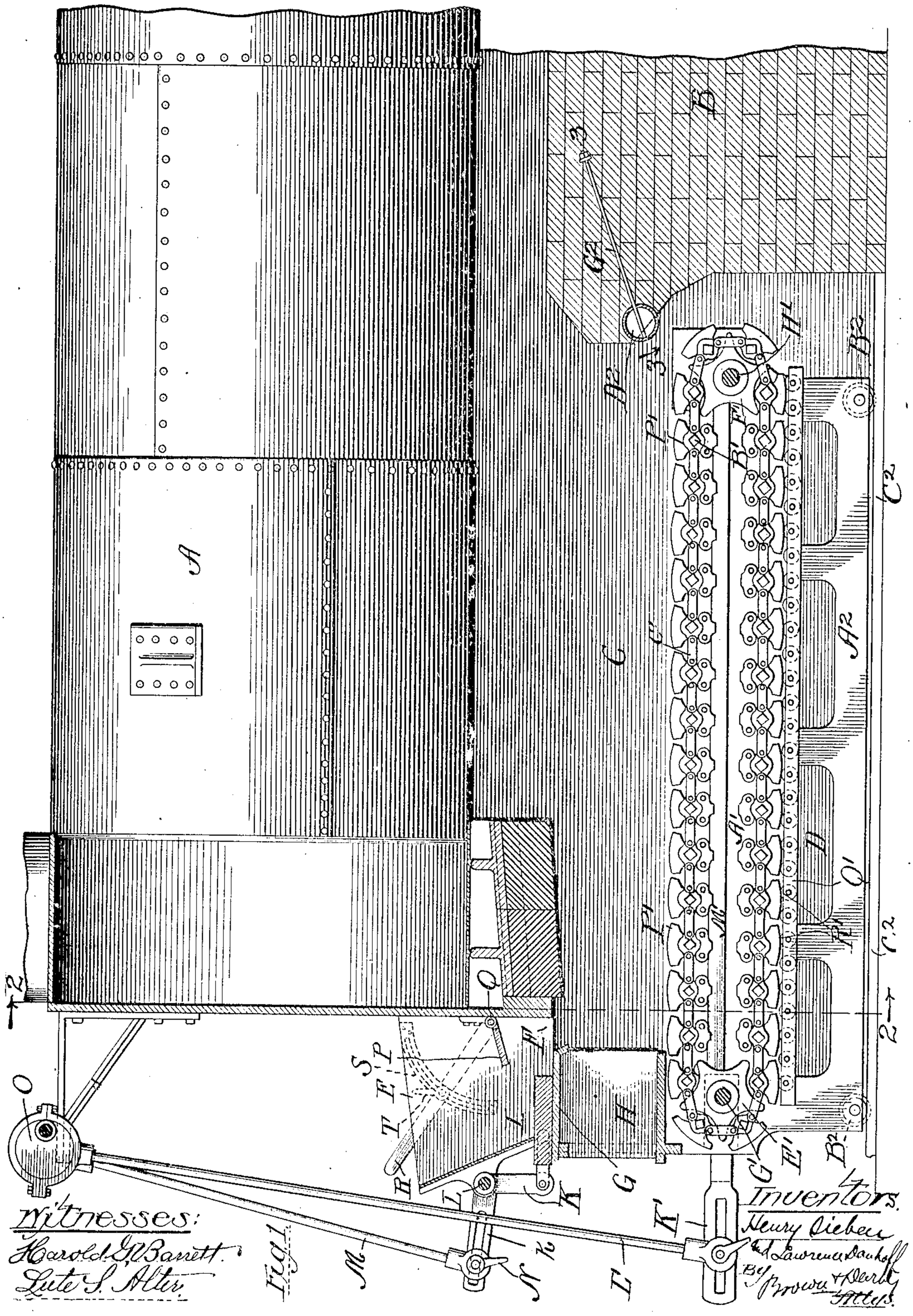

Fig. 1.

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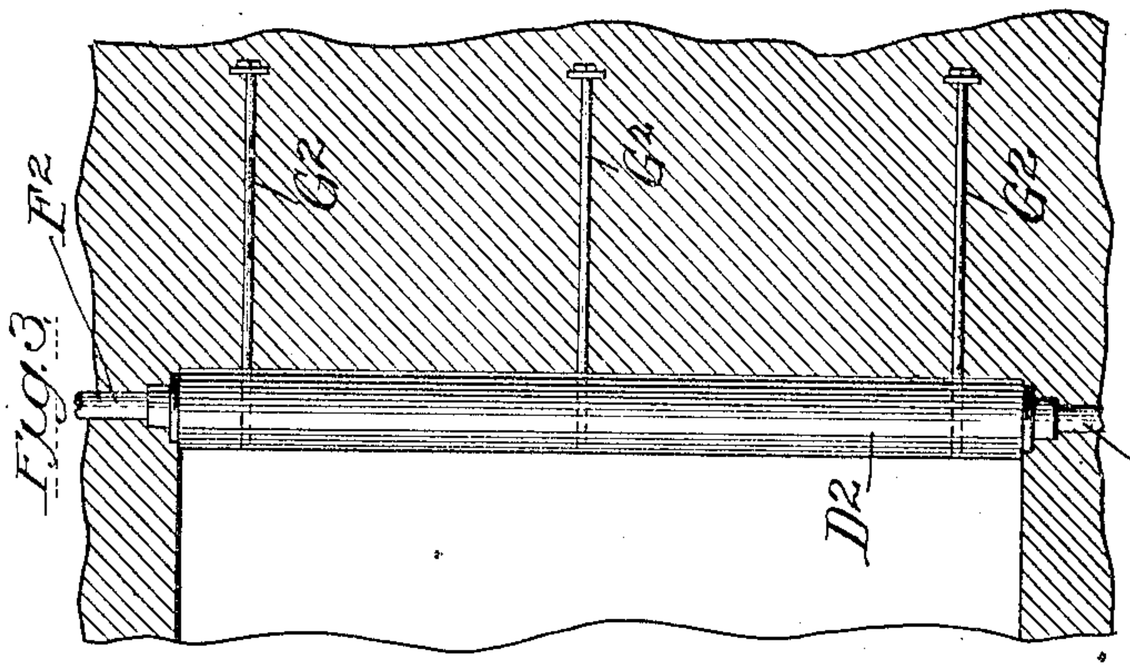

Fig. 3.

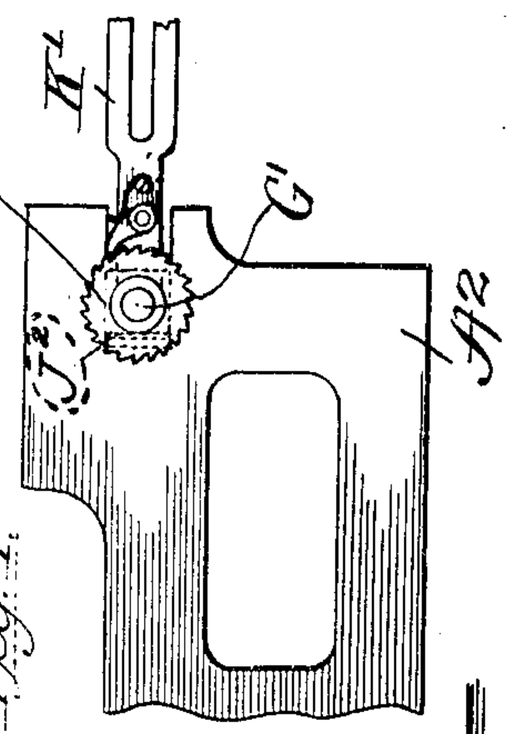

Fig. 4.

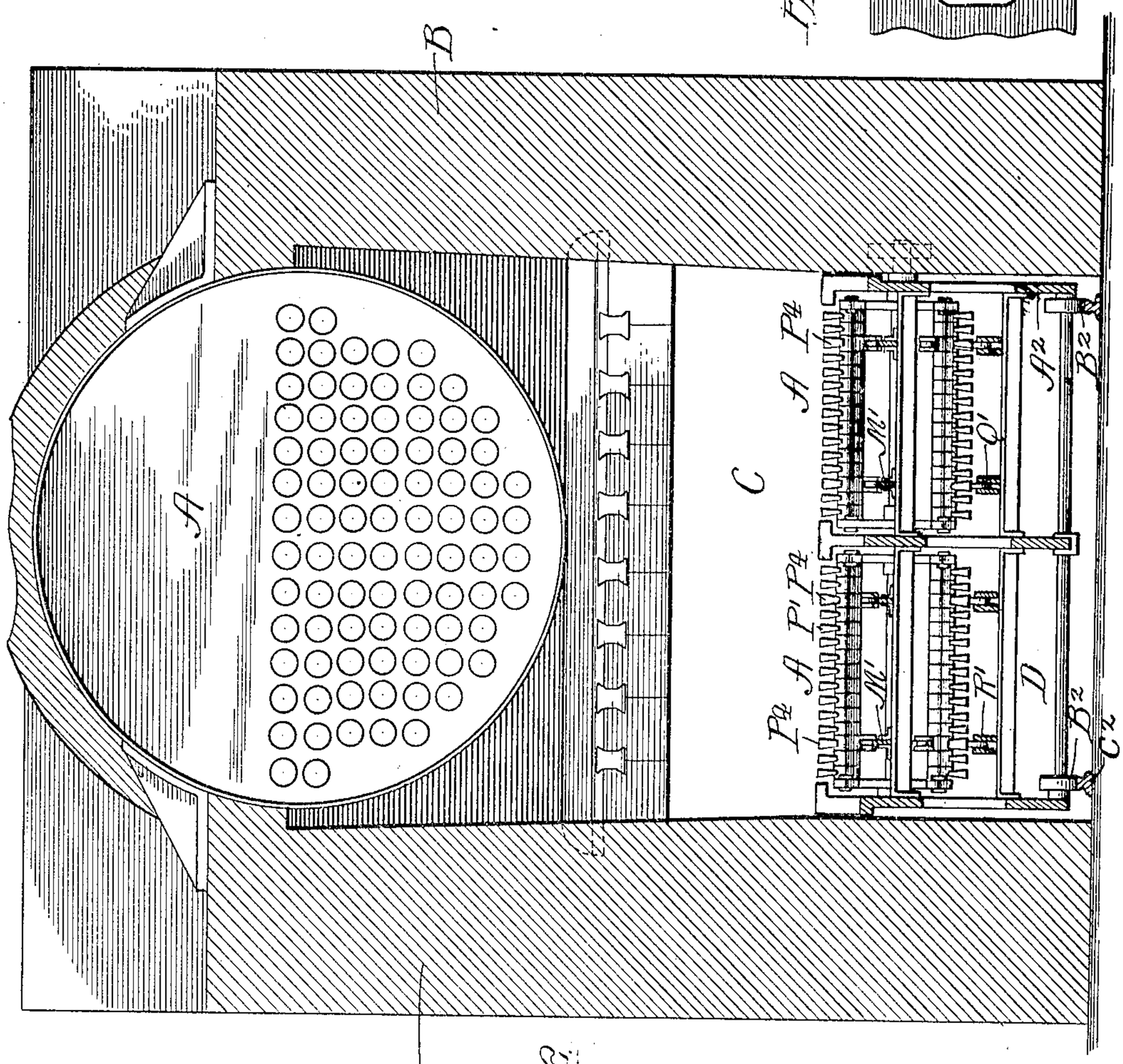

Fig. 2.

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3 SHEETS—SHEET 3.

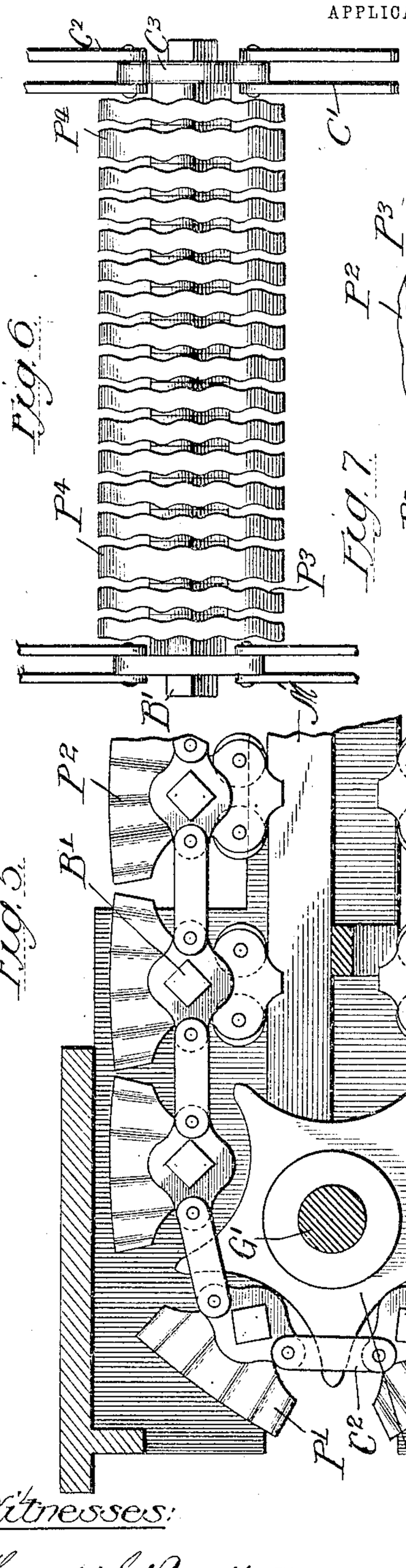


Fig. 6.

Fig. 5.

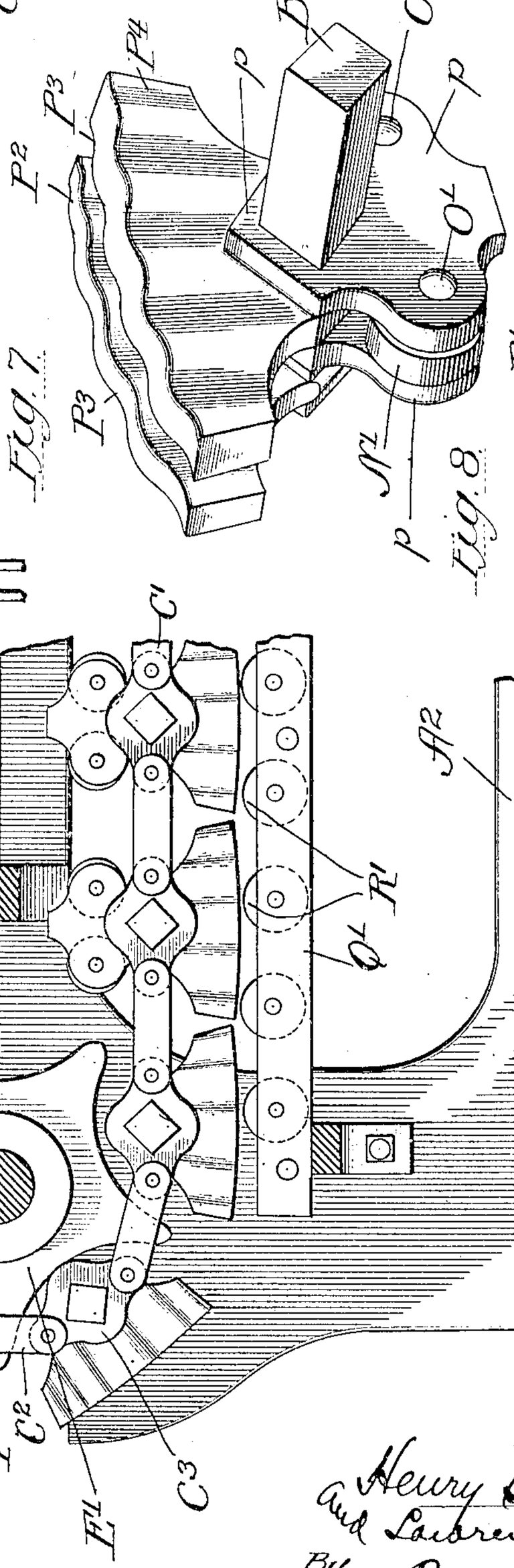
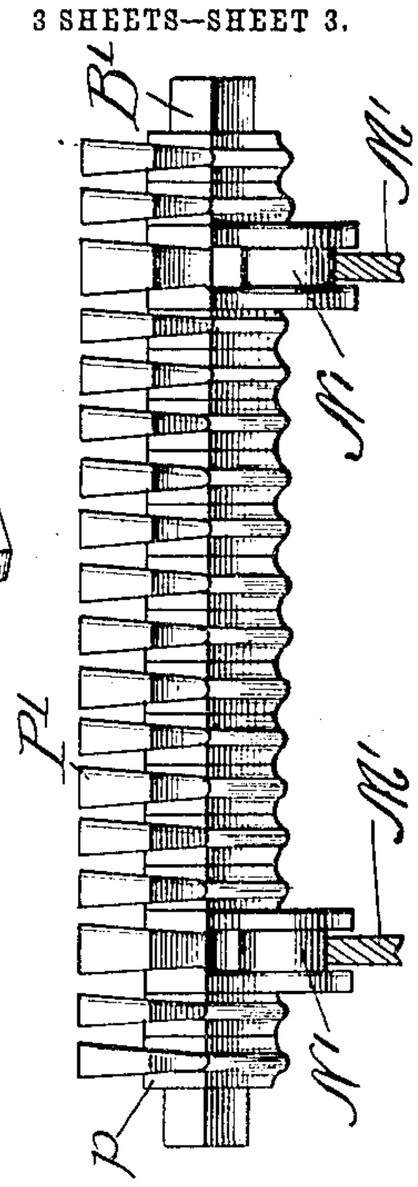


Fig. 7.

Fig. 8.



Witnesses:

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UNITED STATES PATENT OFFICE.

HENRY SIEBEN AND LAWRENCE DANHOFF, OF CHICAGO, ILLINOIS.

FURNACE-GRATE.

No. 878,246. Specification of Letters Patent. Patented Feb. 4, 1908.

Application filed August 12, 1903. Serial No. 169,236.

To all whom it may concern:

Be it known that we, HENRY SIEBEN and LAWRENCE DANHOFF, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Furnace-Grate, of which the following is a specification.

This invention relates to furnaces.

The object of the invention is to provide a furnace which is simple in construction and efficient in action and economical of manufacture.

A further object of the invention is to provide a construction of automatic stoker for furnaces which feeds smoothly and evenly with all grades of fuel, and in which the amount and manner of such feed can be regulated.

A further object of the invention is to provide an improved construction of traveling grate for furnaces.

Other objects of the invention will appear more fully hereinafter.

The invention consists substantially in the construction, combination, location and arrangement of parts, all as will be more fully hereinafter set forth, as shown in the accompanying drawings, and finally pointed out in the appended claims.

Referring to the accompanying drawings, and to the various views and reference signs appearing thereon,—Figure 1 is a view in vertical longitudinal section of a furnace chamber and showing the grate and other features embodying the principles of our invention. Fig. 2 is a transverse section of the same taken on the line 2, 2, of Fig. 1, looking in the direction of the arrows. Fig. 3 is a detail sectional view taken on the line 3, 3, of Fig. 1. Fig. 4 is a detail view in side elevation showing means for operating the parts broken off and front grate operating sprocket shaft. Fig. 5 is an enlarged detail sectional view of a portion of the grate bars and sprocket mechanism shown in Fig. 1. Fig. 6 is a detail top plan view of a single grate bar. Fig. 7 is a detail perspective view of a pair of the individual grate elements. Fig. 8 is a view in side elevation of the grate bar shown in Fig. 6.

The same part is designated by the same reference sign wherever it occurs throughout the several views.

In the operation of furnaces great difficulty has always been experienced in the proper feeding and spreading of the fuel upon moving grates and also by the fine fuel, as well as ashes, dropping through between the bars, thereby uncovering the grate, especially at the inner end thereof, whereupon an excess of air passes into the fire box, thereby interfering with the combustion of the fuel and with the heat and injuring the fire. It is desirable, therefore, to construct the fuel feeder in such a way that fuel of any sort may be fed uniformly, and provide a construction of traveling grate which shall give a proper supply of air at every point on its surface, and at the same time adequately support the finest fuel and prevent the same from falling between the grate bars. It is further desirable to construct the grate in such a way that its individual elements can be renewed when worn without the necessity of renewing the entire grate bar.

Referring to the accompanying drawings, reference sign A designates the shell or boiler proper, supported in a suitable setting B of fire brick or other material.

C designates the fire box or furnace chamber, and D the ash pit located below the grate, and into which the cinders and ashes are carried or deposited.

E designates a hopper suitably located at the front of the boiler, and having an open bottom or mouth portion F delivering into the fire box. The bottom G of the hopper is shown in the form of a shell or plate just above the usual fire door H.

I designates a plunger or push-bar. Any suitable means may be provided for operating said plunger or bar. We have shown a simple construction as illustrative of an operative arrangement, wherein the plunger or bar is connected to a bell crank lever K pivoted upon the side of the hopper at L.

M designates a link adjustably connected to the arm *k* of the bell crank lever, as, for instance, by means of an adjusting screw N operating through a slot in said arm *k*. The link M is shown connected to an operating eccentric O arranged to rotate continuously by any suitable means (not shown).

In order to regulate and control the delivery of fuel from the hopper into the furnace chamber or fire box, when the stoker above referred to is in operation, and to prevent the fuel from dropping through the hopper into the furnace chamber or fire box when such fuel is first supplied to the hopper, we arrange a plate P in the hopper, and in position to extend over the delivery mouth

of the hopper at the point where such mouth delivers into the furnace chamber or fire box, and we provide means for regulating or varying the inclination of such plate in the hopper, thereby regulating and controlling the delivery of the fuel into the furnace chamber. These results may be accomplished in any suitable manner. We have shown a simple construction for accomplishing the desired objects, wherein plate P is pivoted or otherwise adjustably mounted above the mouth of the hopper upon trunnions Q extending through the side walls of the hopper, and an adjusting handle or bar secured to one of said trunnions affords means by which the inclination of the plate P may be varied. The arm R may be locked in any suitable or convenient position, in any convenient manner, as, for instance, by means of the clamp-screw T coöperating with a locking segment S.

A′ denotes generally the traveling grate. This is composed of bars B′ extending transversely of the furnace chamber, and upon which are mounted the grate elements designated generally in Figs. 1, 2 and 8 by reference sign P′. These grate elements may be arranged and removably supported upon the bars B′, in any suitable or convenient manner by which said elements are held in position thereon. In the particular form shown, to which, however, our invention is not to be limited or restricted, the grate element supporting bar B′ is polygonal in cross-section. The grate elements P′ are each provided with a hub portion *p* arranged to be slipped onto the polygonal-shaped bars, a sufficient number of said elements being slipped onto each bar to occupy practically the entire transverse width of the space in which the traveling grate operates. Each element is provided with a segmental portion P^2, the surface of which constitutes the grate, or fuel or fire supporting surface of the grate. The hubs *p* should be of such thickness as to afford a slight offset from each other laterally of the segmental portions of the elements, thus affording passages for the air supplied to the furnace chamber through the ash pit to the fuel. In order to facilitate the supply of air to the bed of fuel from the ash pit through the space between adjacent grate elements, we prefer to groove or corrugate the sides or faces of the grate elements, as clearly indicated at P^3, thus affording grooved or channeled passages for the air in its passage from the ash pit through the grate to the fuel. We have found that the air is efficiently distributed to the fuel when passing through corrugated or fluted passages through the grate elements, and this advantage we secure in the simple manner above described.

Reference signs C′ C′ designate sprocket chains, having sprocket links C^2, and intermediate driving links C^3. The driving links of each sprocket chain are provided with openings therethrough shaped to conform to the transverse sectional shape of the grate bars, whereby such links may be slipped over the ends of such bars to afford means for connecting the sprocket chains to such bars. In practice, we propose to employ a sprocket chain or belt connection such as above described, each end of each set of grate bars composing a traveling grate. These sprocket chains operate over sprocket wheels E′ F′. The sprocket wheels E′ F′ are respectively mounted upon shafts G′ H′ suitably journaled in boxes at the front and rear of the furnace chamber, the sprocket wheels F′ being mounted to revolve loosely upon the shaft H′, while the sprocket wheels E′ are keyed or otherwise fixed to rotate with their supporting shaft G′. Rotary motion may be imparted to shaft G′, which constitutes the driving shaft for the grate, in any convenient manner. A simple arrangement is shown, wherein a ratchet wheel J′ is mounted upon to rotate with shaft G′, and an arm or lever K′ is pivotally mounted upon said shaft and carries a spring-pressed pawl arranged to coöperate with the ratchet teeth of disk J′. A rod L′, suitably actuated by an eccentric, or in any other manner, is adjustably connected to the arm or lever K′, so that upon each actuation of said rod L′ one step of rotary movement is imparted to shaft G′, thereby imparting a step of movement to the traveling grate. While we have described only one grate, it is obvious that only one or as many of such grates as may be necessary or desired may be employed in each furnace. In order to suitably support and guide the grate elements during that portion of the travel thereof in which said elements operate as a supporting surface for the bed of fuel, we provide longitudinally extending tracks or rails M′, arranged adjacent and transversely with respect to the ends of the grate bars B′. A grate element provided with a special segmental portion, indicated by reference sign P^4, is arranged adjacent to each of the grate bars, and larger than the segmental portions of the other elements arranged on the same bar therewith, in order to afford strength and rigidity, and upon the hub P of such element (see Fig. 7) we mount friction rollers N′, in any convenient manner, as, for instance, upon studs O′, said rollers being received and resting upon and guided by the bars M′. In this manner the grate bars are supported adjacent to each end thereof upon the tracks or rails M′ during that portion of the travel when the fuel or coal is supported upon the grate surface. In order to relieve the sprocket chain of any undue stretch by reason of having to support the weight of the grate bars, and the grate elements supported thereby, during

the travel of the grate, we provide means upon which the grate elements, or certain of them, are supported during the return movement of such grate. To this end, we employ bars Q′ arranged in pairs, and the members of each pair suitably spaced apart to receive a series of guide or supporting rollers R′ therebetween, and we arrange such bars or rails to extend longitudinally to the furnace chamber and underneath the traveling grate, and in position with reference to the special segmental portions P^4 for the said segmental portions P^4 to be received and to rest or to be supported upon said rollers R′, as clearly indicated in the drawings (see Figs. 1, 2 and 5).

From the foregoing description it will be observed that we provide an exceedingly simple arrangement of traveling grate, wherein the fuel when deposited upon the grate is carried inwardly through the furnace chamber, and the process of combustion progresses as the fuel is thus carried along, the shape of the grate elements promoting combustion by effecting a breaking up of the incoming air into individual jets by reason of the corrugated shape of the side surfaces or faces of the segmental portions thereof as above explained. It will also be seen that we provide efficient means for supporting the traveling grate, both in advancing movement of a portion thereof into the furnace cahmber, and also during the return movement of the other portion thereof, and with the least degree of friction and by placing the supporting bars or rails some distance from the grate bars, as above explained, the ashes and cinders are prevented from obstructing the movements of the grate bars. It will also be seen that we provide a construction in which renewals or repairs may be readily made, and wherein individual grate elements, when broken, or injured, or burned off, may be readily renewed, without the expense of renewing an entire grate bar. It will also be seen that with the construction above described a furnace grate may be placed within a space of shallow depth, which is an important advantage in many instances where the available space for the fire box is limited; and, moreover, the shallow depth of the fire box permitted by our invention is advantageous in that it enables a better control to be secured of the supply of air to the bed of fuel.

The grate construction above described may, if desired, be supported upon a frame A^2 removably arranged within the furnace chamber, whereby the entire structure may be withdrawn from the furnace chamber for inspection, repair, renewal of parts, or the like, and to this end, said frame A^2 may operate upon rollers B^2 operating on tracks C^2 arranged to extend into the furnace chamber.

It will be observed that the segmental portions of the grate elements, when in the position to form a support for the bed of fuel, are spaced in such close relation with respect to each other as to afford insufficient room therebetween for fine particles of the coal or fuel to drop down into the space between adjacent elements, while at the same time permitting a supply of air to the bed of fuel between such elements, as above explained, to secure a complete combustion of the fuel, the products of combustion, in the form of ashes, being finally carried by the grate and deposited in the ash pit at the rear end of the furnace, from which they may be removed in any suitable or convenient manner. In this manner we secure perfect and complete combustion of the fuel and the maximum amount of steam production obtainable from a given quantity of coal, and without loss or waste of fuel.

In practice there is a tendency to cause slag or other particles of fuel in a highly heated condition, when coming in contact with the fire wall at the rear of the furnace, to adhere or stick thereto, thereby clogging up the space or opening at the delivery end of the grate. In order to overcome this result we employ a pipe D^2, of comparatively large cross-sectional area, and arrange the same to extend transversely across the furnace chamber adjacent to the rear of the fire wall thereof and at a point over the delivery end of the traveling grate, said pipe forming in effect a chamber, and being supported in any suitable or convenient manner in the brick or masonry work composing the fire wall, and we maintain this enlarged pipe or chamber full of water. A convenient arrangement is shown wherein a supply pipe E^2 delivers at one end into the enlarged pipe or chamber, and an exhaust pipe F^2 communicates with the other end of said enlarged pipe or chamber.

As above indicated, the enlarged pipe or chamber D^2 may be supported in any suitable or convenient manner. We have shown a simple arrangement wherein we employ rods G^2 suitably anchored in the masonry composing the fire wall and tapped through the inner side of the pipe or chamber D^2, and at their outer ends bearing against the inner wall of said pipe or chamber.

It is believed that the operation of the construction above described will be readily understood from the foregoing description taken in connection with the accompanying drawings, and many variations and changes in the details of construction and arrangement would readily occur to persons skilled in the art and still fall within the spirit and scope of our invention. We do not desire, therefore, to be limited or restricted to the exact details of construction and arrangement shown and described. But

Having now set forth the object and nature of our invention, and a construction

embodying the principles thereof, what we claim as new and useful and of our own invention, and desire to secure by Letters Patent, is:

1. In a boiler furnace, a grate comprising grate bars, independent grate elements strung upon each of said bars, each grate element including a hub portion and a segmental portion, the hub portions being strung upon said bars and the segmental portions forming a support for the bed of fuel, the hub portion of one of the grate elements adjacent each end of each grate bar being provided with spaced depending portions, a guide roller secured between the depending portions, guide rails arranged to extend longitudinally of the furnace chamber and transverse with respect to the length of the grate bars upon which said guide rollers are arranged to rest, sprocket chains connecting said grate bars, and means for actuating said chains.

2. In a boiler furnace, a grate comprising grate bars, removable grate elements each having a hub portion and a segmental portion, the hub portions adapted to be strung upon the grate bars and the segmental portions forming a support for the fuel bed, one of said grate elements near each end of each grate bar having an enlarged segmental portion, and guide rails arranged in the path of movement of the grate elements having the enlarged segmental portions, to form a supporting guide therefor and to support the corresponding bars of the grate, a sprocket chain connecting said grate bars, and means for actuating said chain.

3. In a boiler furnace, a grate comprising grate bars, grate elements removably mounted thereon, each including a hub portion and a segmental portion, one of said grate elements near each end of each grate bar having an enlarged segmental portion, and rollers mounted upon the hub portion thereof, guide rails upon which said rollers are supported and guided during one portion of the travel of said grate bars, guiding rails for supporting and guiding the enlarged segmental portions of said elements during another portion of the travel of the grate bars, said segmental portions and guiding rails forming a support for the corresponding grate bars, sprocket chains connecting said grate bars, and means for actuating said chains.

4. In a boiler furnace, a movable grate comprising grate bars polygonal shaped in cross section, grate elements each having a hub portion and a segmental portion, the hub portions having openings therethrough corresponding in shape to the cross sectional shape of the grate bars and adapted to be strung upon the grate bars, each grate bar carrying a series of said elements, driving links strung upon the ends of the grate bars, connecting links for the driving links at adjacent ends of the grate bars, thereby forming actuating chains for the grate bars, and means for actuating said chains.

In witness whereof, we have hereunto set our hands this 1st day of August, 1903, in the presence of the subscribing witnesses.

HENRY SIEBEN.
LAWRENCE DANHOFF.

Witnesses:
E. C. SEMPLE,
S. E. DARBY.