(No Model.)

3 Sheets—Sheet 1.

E. C. SOOY.

FURNACE GRATE.

No. 481,596. Patented Aug. 30, 1892.

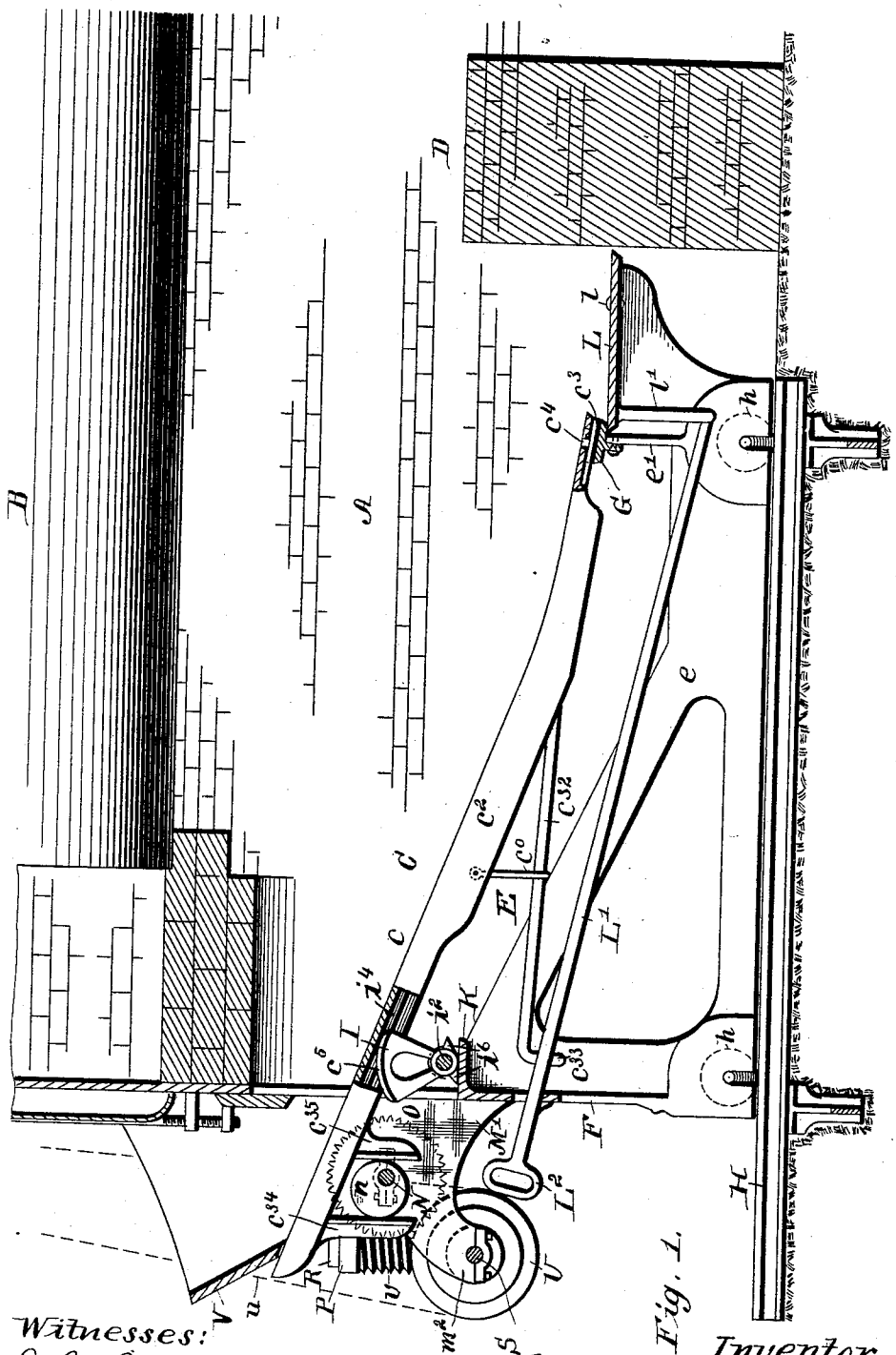


Fig. 1.

Witnesses:
F. G. Fischer
S. L. C. Hasson

Inventor
Ephraim C. Sooy.
By Richd. A. Manning Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

3 Sheets—Sheet 2.

E. C. SOOY.

FURNACE GRATE.

No. 481,596. Patented Aug. 30, 1892.

Fig. 2.

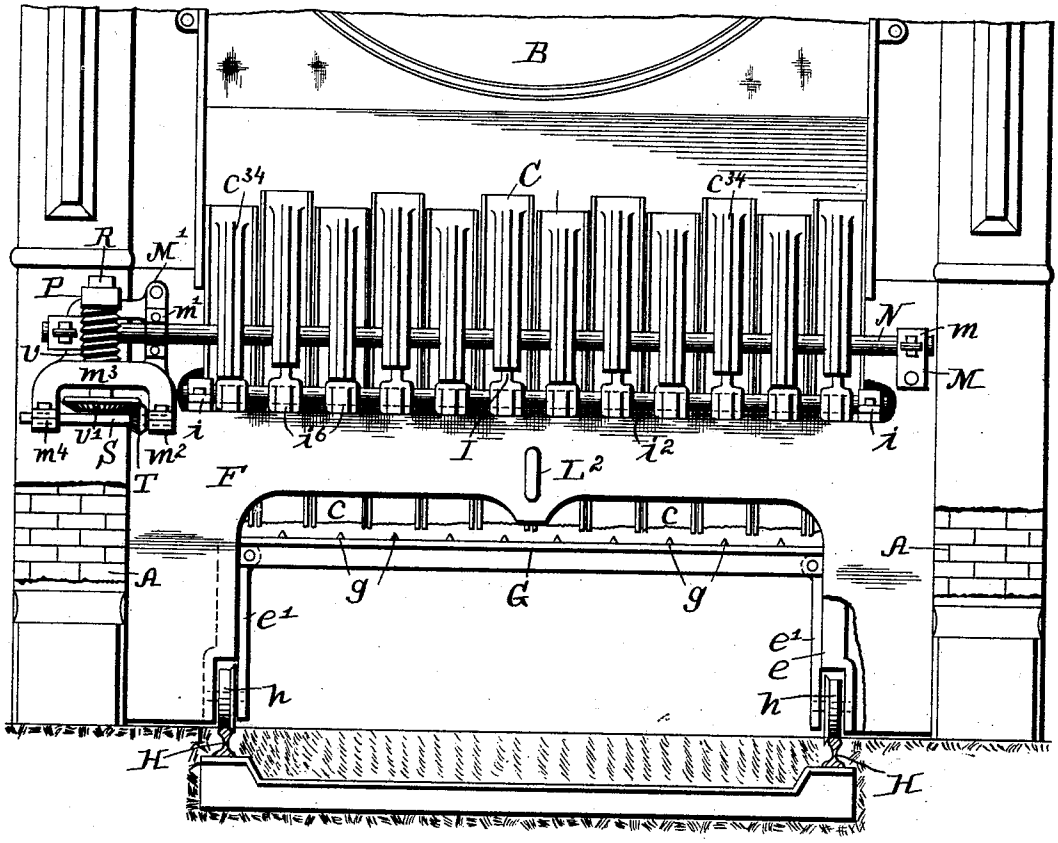


Fig. 8.

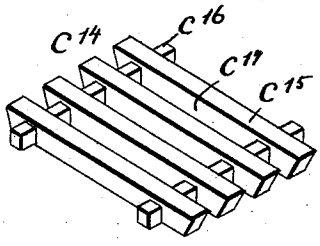
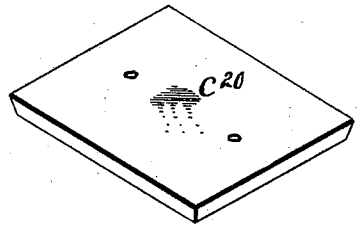


Fig. 9.



Witnesses:
F. G. Fischer
S. Y. C. Hasson

Inventor:
Ephraim C. Sooy
By
Rich'd H. Manning Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

(No Model.)

3 Sheets—Sheet 3.

E. C. SOOY.

FURNACE GRATE.

No. 481,596. Patented Aug. 30, 1892.

Fig. 3.

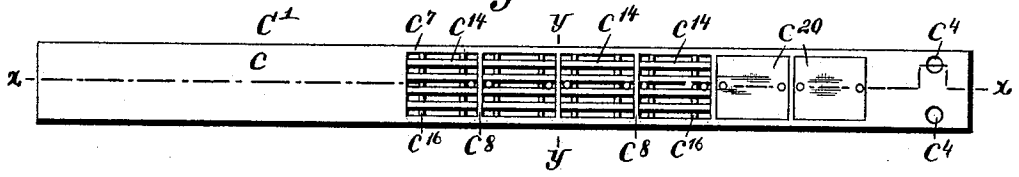


Fig. 4.

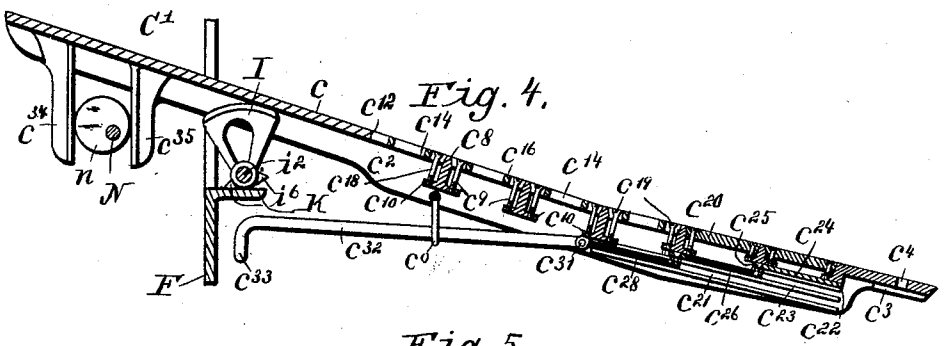


Fig. 5.

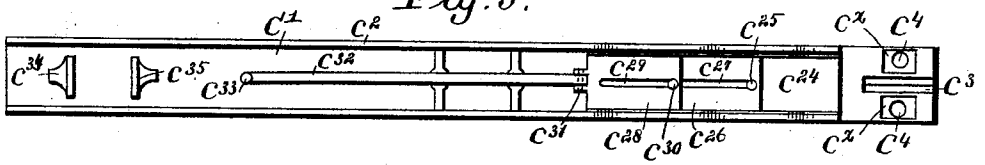


Fig. 6.

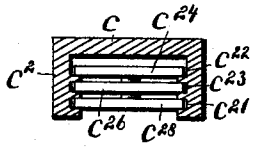
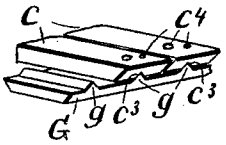


Fig. 7.



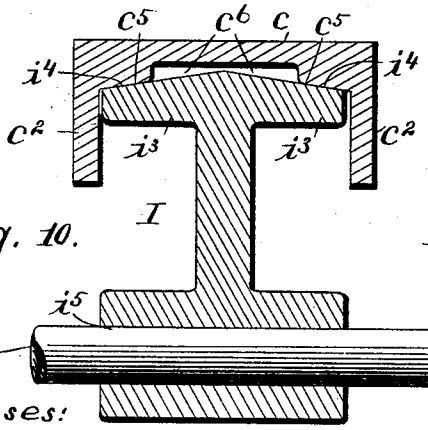


Fig. 10.

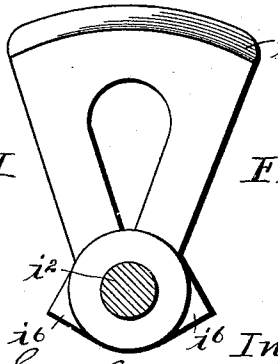


Fig. 11.

Witnesses:
F. G. Fischer
S. L. Chasson

Inventor:
Ephraim C. Sooy
By Richd. H. Manning Atty.

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EPHRAIM C. SOOY, OF KANSAS CITY, MISSOURI.

FURNACE-GRATE.

SPECIFICATION forming part of Letters Patent No. 481,596, dated August 30, 1892.

Application filed November 23, 1891. Serial No. 412,780. (No model.)

To all whom it may concern:

Be it known that I, EPHRAIM C. SOOY, a citizen of the United States, residing at Kansas City, in the county of Jackson and State of Missouri, have invented certain new and useful Improvements in Furnace-Grates; and I do hereby declare that the following is a full, clear, and exact description of the invention, such as will enable others to make and use the same, reference being had to the accompanying drawings, forming a part of this specification.

My invention has for its object, first, to confine the admission of air-currents through the grate-bar within circumscribed limits and at varying points upon the bar; second, to regulate the admission of the air through one or more sections of the bar upon the grate-bar in degrees and close the air-passages in one or more sections of the grate at will; third, to prevent the burning out of the lower end portion of the grate-bar at its supporting-point; fourth, to facilitate the reciprocal movement of the grate-bars upon their antifriction support and prevent clogging; fifth, to enable the grate-bars to be reciprocated upon their antifriction support without shock.

My invention further consists in the novel construction and combination of parts, which will first be fully described, and specifically pointed out in the claims.

In the drawings, Figure 1 is a longitudinal view in vertical section of the improved steam-boiler furnace. Fig. 2 is a front view in detail of the furnace with a portion of the front plate removed, showing the transverse bearing-shaft and the segments supporting the grate-bars thereon, also showing the lower end of the grate-bars broken away, the transverse plate supporting the lower end of the grate-bars, the transverse shaft operating the series of grate-bars, the yokes on the upper ends of the grate-bars, and the mechanism operating the transverse shaft. Fig. 3 is a plan view in detail of one of the grate-bars, showing the removable or interchangeable grates and plates, also showing the ash-feeding cavity in the lower end of the grate-bar. Fig. 4 is a vertical sectional view taken upon the line $x\ x$ of Fig. 3, showing the telescopic plates closing the grate-apertures and the operating-lever, also showing a portion of the furnace-front plate, the locking-shoe supporting the upper end of the grate-bar, the yoke on the bar, and the bar-operating cam in the yoke. Fig. 5 is an inverted plan view of Fig. 3. Fig. 6 is a vertical sectional view of the grate-bar, taken on the line $y\ y$ of Fig. 3. Fig. 7 is a detail view in perspective of a portion of the transverse bars supporting the lower end of the grate-bars, showing the broken lower ends of said bars, the aperture for the ashes in said bars, and the ribs for the bars on the transverse plate. Fig. 8 is a detail view in perspective of one of the removable plates. Fig. 9 is a detail view in perspective of one of the removable plates for the grate-bar. Fig. 10 is a vertical sectional view of the grate-bar and the rocking shoe, showing a portion of the transverse shaft supporting the said shoe. Fig. 11 is a side view of the rocking shoe.

Similar letters of reference indicate corresponding parts in all the figures.

Referring to the drawings, A A represent the vertical ash-retaining walls upon each side of the furnace, between the upper portions of which is located the steam-boiler B, and beneath said boiler my improved furnace-grate C. At the rear end of the furnace and beneath the boiler B is a transverse bridge-wall D. The grate C is supported upon a movable frame E, the sides or walls $e\ e$ of which frame consist of separate castings or plates extending in length from the furnace-front to a point within a short distance of the bridge-wall D. The ends of the sides $e\ e$ near the furnace front extend in height nearly one-half the distance from the floor of the furnace to the boiler, and the upper edge of said sides $e\ e$ incline downwardly in the direction of the bridge-wall. The side walls $e\ e$ are bound together by a furnace-front plate F, which extends from the front end of one of the walls e to the corresponding end of the other wall or side e, and upwardly a short distance above said portions of the said sides. The rear ends of the sides $e\ e$ are bound together by a transverse plate G, which serves to support the lower ends of the grate-bars. The plate G is attached at each end to a rib e' on the inner side and rear end of the side e, which ribs extend upwardly a suitable distance above the upper edge of said sides and at an equal height.

Beneath the sides $e\ e$ of the frame E on the

floor of the furnace are laid the track-rails H H, and in the lower edge and at both ends of each side are journaled the traction-wheels *h h*, which rest upon said rails, so that the entire frame E may be drawn outwardly from beneath the boiler B.

The grate C consists of a series of alternately-reciprocating grate-bars C′, arranged in a parallel position. The upper end of each grate-bar is mounted upon a rocking shoe I. Upon the inner side of the front plate F, at the height described by the upper edges of the sides *e* of the frame E, is cast a transverse plate K, which extends at right angles from said plate and from one side *e* of the frame E to the other. Upon the upper side and at each end of the plate K is attached a journal-box *i*. In one journal-box, near one side *e*, is fitted snugly one end of a shaft i^2, which shaft extends in length to the other side *e* of said frame E and is fitted in the journal *i* on the other end of the plate K. On the shaft i^2 is mounted loosely a series of rocking shoes I, corresponding to the number of grate-bars employed in the grate. Each shoe I consists of a flat plate which is cast or made in the form of a sector. The outer portion forming the arc is composed of flanges i^3 i^3, extending laterally from the sides of said sector. The outer bearing-surfaces of the flanges i^3 i^3 are inclined downwardly at an angle to the other, as at i^4, for the purpose hereinafter described. The lower end of the sector extends nearly to plate K and is perforated transversely at i^5 to receive the shaft i^2, and upon said end at right angles to said shaft are cast the lugs i^6 i^6, the under surface of each lug being inclined outwardly and upwardly in like degree.

Each grate-bar C′ is made comparatively narrow in width and consists of a fire surface or plate *c*, the lower end of which plate at a point one-third the length of the bar from said lower end is bent upwardly at an angle to the upper portion of the bar. Upon the outer longitudinal edge of the plate *c* and extending nearly the length of the bar is cast a flange c^2, which extends a short distance downwardly and at right angles to said plate *c*. Upon the other edge of the plate *c* is cast a similar flange c^2. In the under surface of the plate *c*, at the lower end of the bar which rests upon the transverse supporting-bar G and at equal distance from the flanges c^2, is made a longitudinal V-shaped groove c^3.

Upon the upper inclined surface of the supporting-plate G, directly beneath the groove c^3, is cast or formed a transverse rib *g*, the sides of which incline at the same angle as the bar G, and also inclined upwardly to a single edge, so as to admit the V-shaped groove in the under side of the plate *c* of the bar C′. Similar ribs are cast upon the plate G, parallel with the rib *g*, to register with corresponding grooves in the other grate-bars.

Through the plate *c*, on each side of the grooves c^3, is made in a vertical direction a perforation c^4. In the under side surface of the said plate beneath the perforation c^4 is made a cavity or depression $c^\times$, which communicates with said perforation c^4. The upper end of the bar C′ rests upon a rocking shoe I, the under side of the plate *c* resting upon the arc of the sector composing said shoe.

Upon the under side of the plate *c* of the bar C′ and extending from the inner side flange c^2 is cast a tread-plate c^5, the inner side of which plate extends inwardly a short distance and is inclined upwardly at an angle corresponding in degree to the angle of the upper surface of the flange i^3 of the shoe I, upon which it rides. A similar tread-plate extends from the other flange of the bar C′, and between the inner ends of the tread-plate is formed the longitudinal opening c^6. The upper ends of the grate-bars extend outwardly a considerable distance beyond the outer side of the furnace-frame plate F, and from said upper end to a point in the direction of the other end past the upper bearing-shoes the plate *c* of bar C′ is made solid. The remaining portion of the bar to the extreme lower end in that portion of plate *c* composing the fire-surface is made an opening c^7, extending from one flange c^2 across the bar to the other flange and in a longitudinal direction to within a suitable distance of the end of said bar.

In a transverse direction to the bar C′ and a short distance from the inner edge of the plate *c* and at the upper end of the opening c^7 is a rib c^8, which is cast integral with the inner side of flange c^2 on one side of bar C′ at one end, and also with the other flange c^2 on the other side of the bar at the other end. The rib c^8 extends a short distance downwardly and at right angles to the plate *c*, and upon the lower edge of the rib are cast the lateral flanges c^9 c^9, which extend outwardly at right angles to and from each side of said rib. Through the flanges c^9 are made the screw-threaded perforations c^{10}.

At the upper end of the opening c^7 in plate *c* the inner edge of said plate in said opening is cut upon a bevel or inclined outwardly, as at c^{12}. The upper edge of the rib c^8, directly opposite said edge, is beveled in a corresponding manner. In like manner similar ribs c^8 are extended across the opening c^7 in the bar C′, which are placed at distances apart corresponding to the distance described by the first rib from the inner edge of plate in the opening c^7, the upper edges of the ribs being beveled in a corresponding manner.

Within the opening formed between the ribs c^8 and the inner edge of plate *c* is placed a short grate c^{14}, composed of short parallel bars c^{15}, which are arranged in the longitudinal direction of the bar C′. The bars c^{15} are connected in the usual manner with lugs c^{16}, so as to afford the apertures c^{17} between each bar. The ends of the respective bars c^{15} are beveled or inclined downwardly and inwardly and the ends of the bars at one end of the grate rest upon the inclined inner edge of the plate *c*, and the other ends of the bars c^{15} of

the grate extend to and fit the inner inclined edge of the rib c^8, and in a similar manner the grates are placed in position between the other and adjacent ribs. The grates are held in place by means of the bolts c^{18}, which are provided with a head c^{19} at one end and screw-threaded at the other. The bolt is inserted through one of the apertures c^7 in the grate and the screw-threaded end passed through the screw-threaded perforation c^{10} in the flange c^9 on the rib c^8, the head of the bolt engaging with the upper edges of the bars c^{15}. I also make an imperforate flat plate c^{20} similar in width and length to the grate c^{14} and with the ends beveled in the same manner as the ends of bars c^{15}. This imperforate plate is used interchangeably with the grate c^{14}, as hereinafter described.

At the lower end of the grate-bar C′ on the inner side of the flange near its lower edge is made a longitudinal groove c^{21}, which extends from a point a short distance forward of the extreme lower end of said flange c^2 and in the direction of the upper end of said bar to the point at which the lower end of said bar is deflected upwardly at an angle. Upon the inner side of the other flange c^2 is made a similar groove c^{21}, both of which grooves are parallel with the upper surface of the said lower end of the grate-bar. The rib c^8, extending across the bar C′ at the extreme lower end of said bar, is made to extend but a slight distance below the under side of the said plate c and directly beneath the flange c^9 on said rib, and in the inner side of the flange c^2 is made a groove c^{22}, which is parallel with the groove c^{21}. In the inner side of flange c^2 on the other side of the bar is made a similar groove c^{22}.

Between the grooves c^{21} c^{22} is made in the inner side of each flange a groove c^{23}, which is parallel with said grooves and extends in distance from the extreme end of the flange c^2 on each side of the bar to the ribs c^8, adjoining the lower rib on said bar C′. In the grooves c^{22} c^{22} is fitted a sliding plate or valve c^{24}, in the under side of which plate, near the end in the direction g of the upper end of the grate-bar, is cast a short pin c^{25}. In the grooves c^{23} c^{23} is fitted a plate c^{26}, which is similar to the plate c^{24}, in which is made a longitudinal groove c^{27}, which extends in opposite directions nearly to the respective ends of said plate. In the grooves c^{21} c^{21} is fitted a sliding plate c^{28}, which is similar to the plate c^{26} and is provided with a longitudinal groove c^{29} of the same length as the register in groove c^{27} in plate c^{26}. In the grooves c^{27} of plate c^{26} and groove c^{29} of the plate c^{28} is a pin c^{30}, which is provided with a head at both ends, so that the plates c^{24} c^{26} c^{28} telescope one with another in the respective grooves in the flanges c^2 of the grate-bar. To the upper end portion of the plate c^{28} is hinged at c^{31} the lower end of the rod c^{32}, the upper end of which rod extends nearly to the inner side of the front plate F and is bent downwardly at said end to form the handle c^{33}. To the inner side of the flange c^2 is attached the upper end of a loop c^9, in which is supported the lever c^{32}. Each of the other grate-bars C′ is constructed in precisely the same manner as the one above described and provided with sliding plates and operating-rods in like manner.

To the under side of the grate-bar C′, at the extreme upper end and near the outer side of the front furnace-plate E, is cast or formed a bar c^{34}, which extends in a downward direction a short distance. Upon the same side of said grate-bar toward the furnace-front is cast a similar bar c^{35}, which also extends downwardly a like distance, and both form a yoke, for the purpose hereinafter described. Upon the other grate-bars C′ and in a corresponding position are cast or formed similar yoke-bars. The series of grate-bars are then placed in position upon their upper and lower supports, with the yokes in position in a transverse direction opposite each other.

Upon the outer side of the furnace-front near one of the yokes on one of the grate-bars adjacent to one of the side frames e of the frame E is rigidly attached a bracket M, in which is a journal-bearing m, and in which is journaled one end of a rotary shaft N, which shaft is extended in a transverse direction to the grate-bars between the yoke-bars c^{34} c^{35} in each bar. Upon the outer side of the furnace-plate and at the other end of said plate and slightly beyond the line of the other side wall e of the frame E is attached a bracket M′, similar to the bracket M, and having a journal-bearing m', in which is journaled the other end of shaft N. Upon the shaft N, between the yoke-bars c^{34} c^{35} on the grate-bar C′, is rigidly attached a cam n. Between each of the yoke-bars on the other grate-bars is placed a similar cam n. The cam n between the yoke-bars on one grate-bar is given a half-turn in one direction and secured in said position. Between the yoke-bars on the adjoining bar the cam is given a half-turn in the other direction, so as to throw the bar C′ rearwardly, the other cams being arranged in the same manner between the yoke-bars on alternate grate-bars. The shaft N is made to extend beyond the outer side of the bracket M′, and upon said end of said shaft is placed a gear O.

Above the shaft N and extending outwardly from the wall A of the furnace is a bar P, in the outer end of which bar is a journal-bearing for the upper end of a vertical shaft R. Upon the shaft R is a worm-gear u, which meshes with the gear O on the shaft N. Upon the lower end of shaft R is a bevel-gear u'. The bracket M′ extends outwardly and downwardly a short distance below the bearing for the shaft N, as at m^2, and in the side of said extended portion of the bracket is journaled one end of a horizontal shaft S, upon which shaft near said portion of the bracket is a bevel-gear T, which gear meshes with the gear u' on the shaft R. From the side of the bracket M′ is also extended a journal-hanger m^3, which extends at right angles to the bracket

M′ and affords a bearing for the lower end of shaft R, and is then bent downwardly a short distance and upon its lower end is provided a journal-bearing m^4, in which is journaled the other end of the horizontal shaft S.

On the end of shaft S, which extends a short distance beyond the outer side of the bearing m^4 on the hanger m^3, is a speed-pulley U, which is driven by the belt u^2.

Above the upper side and ends of the grate-bars and attached to the outer side of the collar around the end of the boiler B, is the hopper V′. Between the lower transverse plate G, supporting the lower end of the series of grate-bars and the bridge-wall D, is arranged the ash-dumping plate L. This plate, which is common in other furnace-grates, is hinged at l at one end to an upright bracket l' on the extreme rear end and side of the plate e of the frame E and at the other end to a similar bracket on the extreme rear end of the other side plate e. The forward end of the plate L extends beneath the under side of the transverse plate G, and upon the under side of said plate L, near plate G, is a downwardly-extended bar l', to the lower end of which bar is pivotally attached one end of an operating-rod L′, the other end of which rod extends in the direction of and through an aperture in the front plate F and is provided with a handle L^2.

In the operation of the improved grate the fuel is fed to the hopper V′ and is deposited upon the upper side and ends of the grate-bars. The power from the driving-belt u^2 communicates motion through the gear S T to the shaft N, and the grate-bars are given an alternately-reciprocating movement, which movement feeds the fuel downwardly toward the grates in said bars, at which point the air-currents are admitted and combustion of the fuel takes place. In this movement of the grate-bars the flanges i^4 on the rocking shoe I prevent the grate-bar from tilting sidewise and affords a steadiness in the reciprocal movement of the bar. In this manner I am enabled to prevent the clogging of the ashes at the bearing-point of the bar and the removal of the bar by the accumulation of ashes from its position. In the vibratory movement of the shoe I the flanges i^6 come into contact with the upper surface of the transverse plate K, retarding the action of the shoe, and thus limiting the play of the shoe and preventing displacement. The cams, however, afford a regular movement, being nearly in contact during the greater part of their rotation with the yoke-bars c^{34} c^{35}. As the partially-consumed fuel upon the grate-bars reaches the grates the air-current passes through the openings c^{17} and the fuel is consumed, the intensity of the fire extending nearly to the lower end of the grate-bars. To limit the extent of the fire, I remove as many of the grates from the lower end of the bar and insert in place thereof the corresponding number of interchangeable plates c^{20}, and in like manner the grates are alternately removed and the plates inserted, so as to close portions of the grate-bars and direct the current of air toward the bulk of the fuel or upon its sides, and thus control the consumption of fuel.

In the ordinary use of the grates when it is desired to regulate the admission of the currents of air in degrees to the grate the end c^{33} of the rod c^{32} is seized from a position beneath the grate-bars and drawn a short distance toward the furnace front plate. This movement of the rod c^{32} draws one of the plates c^{28}, which is telescoped with the plate c^{26}, within the grooves in the sides of the flanges c^2 to a position beneath the flanges on two adjoining ribs c^8 c^8, which partially closes the opening or compartment formed between adjoining ribs and admits the air in a less quantity. To close the openings, the plate c^{28} is drawn outward so as to draw the plate c^{26} over the partially-covered opening occupied by the plate c^{28}, which plates are then made to cover two adjoining openings or compartments, and the passage of the air-currents to the grates above are effectually closed. In this manner the fire is reduced in intensity and the fuel consumed gradually. The number of the plates may be increased, if preferred, so as to cut off the air from the grates the entire length of the bar. In practice, however, the regulation of the fire is best afforded near the center and lower ends of said bars. The accumulated ashes at the lower end of the grate-bars fall upon the dumping-plate L and are then dumped to the ash-pit. The lower end of the grate-bars, which are guarded in their movement by the ribs g, are thereby prevented from lateral displacement. As the ashes pass the lower end of the bar a small quantity is admitted through the perforations c^4 c^4, and thence to the cavity or depression $c^\times$ $c^\times$ on each side of a rib g, and in the reciprocal movement of the grate-bars the fine ashes in the cavity $c^\times$, which is also a non-conductor of heat, fill the small space between the under surface of the grate-bar, which comes nearly into contact with the portions of the plate G between adjoinings ribs g g, and the air is prevented from passing through the spaces described and feeding the fire and the lower end of the grate prevented from burning out in the otherwise constant heat.

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

1. The combination, in furnace-grates with a grate-bar having separate longitudinal openings in its fire-surface and transverse ribs between adjoining openings and opposing sides to said openings provided with inwardly-beveled edges, of interchangeable perforate and imperforate plates in said openings, having the edge of each plate beveled and fitted to the respective sides of the openings in said bar, substantially as described.

2. In a furnace-grate, a grate-bar having longitudinal downwardly-extended flanges

upon its sides and longitudinal openings in the fire-surface of said bar, and sectional grates in said openings, and transverse ribs on the flanges of said bar between said grates having lateral bolt-receiving flanges, substantially as and for the purpose described.

3. In a furnace-grate having longitudinal grate-bars, the combination, with one of said bars having longitudinal downwardly-extended flanges upon its outer edges and grooves parallel with each other in the inner sides of said flanges, and longitudinal openings in the fire-surface of said bar, of sectional grates in the openings in said bar, transverse compartment-forming ribs connected with the inner side of said longitudinal flanges of said bar between said sectional grates and extending downwardly and serially below the line of adjoining ribs to the line of the respective grooves beneath the several compartments formed by said ribs, and sliding plates in said grooves linked together in a telescopic position, and means for operating said plates, substantially as and for the purpose described.

4. In a furnace-grate having longitudinal grate-bars, the combination, with one of said bars having downwardly-extended flanges upon its outer edges and grooves parallel with each other in the inner sides of said flanges, and longitudinal openings in the fire-surface of said bar, of sectional grates in the openings of said bar, transverse compartment-forming ribs connected with the inner sides of said longitudinal flanges of said bar between said sectional grates and extending downwardly and serially below the line of adjoining ribs to the line of the respective grooves beneath the several compartments formed by said adjoining ribs, and telescopic sliding plates on said grooves having longitudinal grooves, and pins in said grooves linking one plate with another, and an operating-rod hinged at one end to one of said sliding plates, for the purpose described.

5. In a furnace-grate having longitudinal reciprocating grate-bars and suitable transverse supporting-plates for the ends of said bars, the combination, with said supporting-plates, of one of said grate-bars provided with an aperture in the end of said bars directly over said supporting-plate, and a cavity in the under side of said grate-bar communicating with the said aperture, substantially as and for the purpose described.

6. In a furnace-grate having longitudinal reciprocating grate-bars and a suitable transverse supporting-plate for said bars, the combination, with one of said bars having a longitudinal V-shaped groove in the inner surface of said bar at the bearing end and an aperture in said end of said bar communicating with said groove, of serrated ribs in the upper surface of one of said transverse supporting-plates within the groove in the said grate-bar, substantially as and for the purpose described.

7. In a furnace having suitable side walls, the combination therewith of a grate having longitudinal reciprocating grate-bars, a transverse plate in said walls supporting the rear ends of the said grate-bars, a transverse shaft beneath the front ends of the said grate-bars, and a transverse plate beneath and supporting the ends of said shaft, a rocking shoe on said shaft, having its bearing-surface in the arc of a circle supporting the forward end of one of said grate-bars, and lugs on said rocking shoe on each side of said shaft, adapted to contact with the said transverse plate, substantially as and for the purpose described.

8. In antifriction grate-bar supports, a rocking shoe or plate consisting of a sector having its bearing-surface in the arc of a circle, and lateral flanges having their outer bearing-surfaces inclined in opposite directions, substantially as and for the purpose described.

9. The combination, with a longitudinal grate-bar having longitudinal downwardly-extending flanges upon its outer edges and a tread-plate on the inner side of each flange, having its lower surface inclined from said flange in an upward direction, of an antifriction support consisting of a rocking shoe or plate, each plate consisting of a sector having its bearing-surface in the arc of a circle, and lateral flanges on the sides of said shoe, having the upper bearing-surface of said flanges inclined in downward and opposite directions and adapted to fit the tread upon the said grate-bar, substantially as and for the purpose described.

10. In a furnace-grate having suitable upper and lower transverse supports for the upper and lower ends of the grate-bars and rocking shoes upon said upper support, having a bearing-surface describing an arc of a circle, the combination of an inclined grate-bar having a plate extending the length of the fire-surface of said bar and the lower end of said plate bent upwardly at an angle to the upper portion of said plate, and means for reciprocating said bar, substantially as and for the purpose described.

EPHRAIM C. SOOY.

Witnesses:
DANIEL S. BENTLEY,
H. R. TOMLINSON.