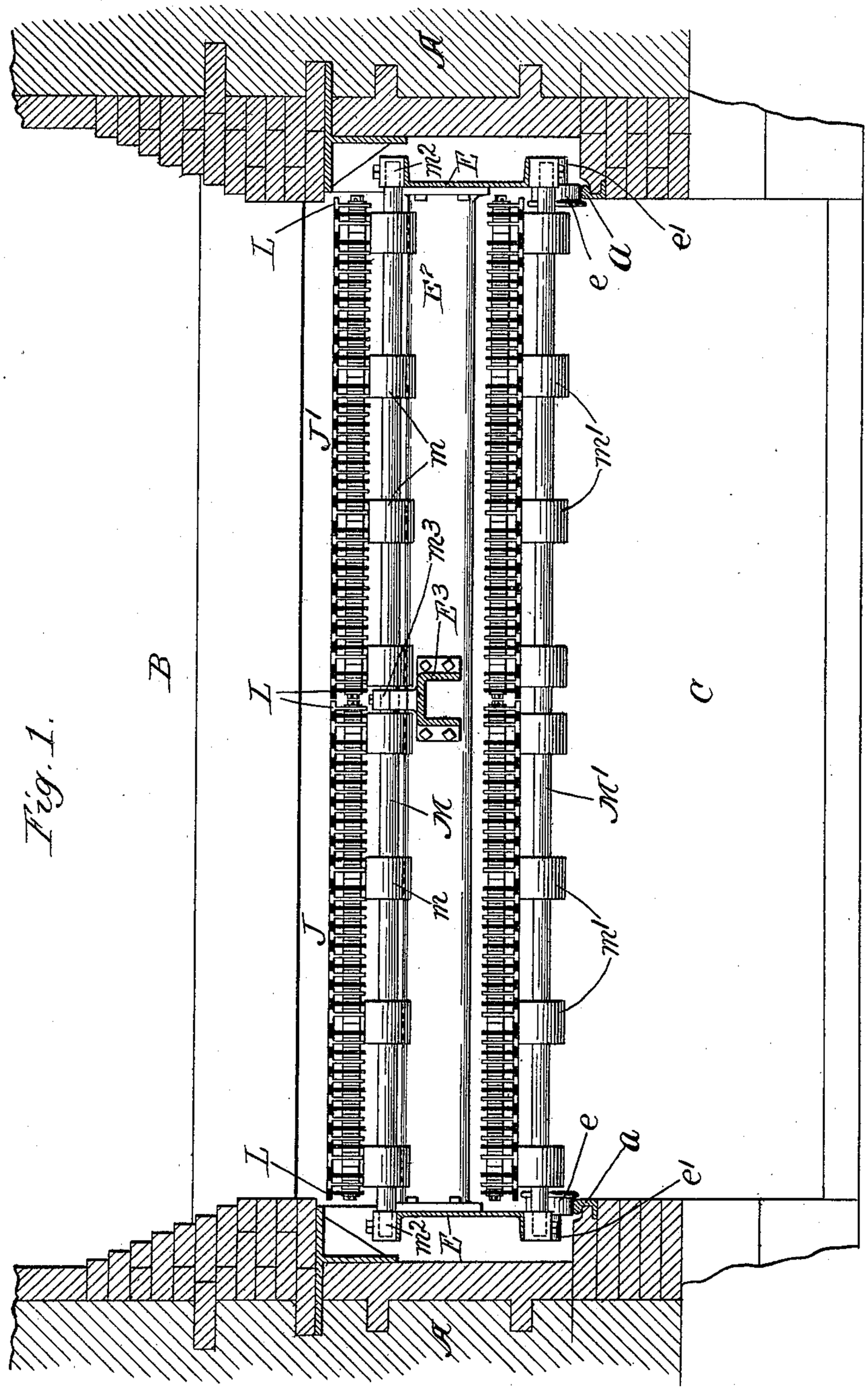
No. 685,718. Patented Oct. 29, 1901.

W. M. GREEN & J. R. GENT.

FURNACE GRATE.

(Application filed Apr. 4, 1900.)

(No Model.) 4 Sheets—Sheet 1.



Witnesses.
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C. M. Hills

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(No Model.) 4 Sheets—Sheet 2.

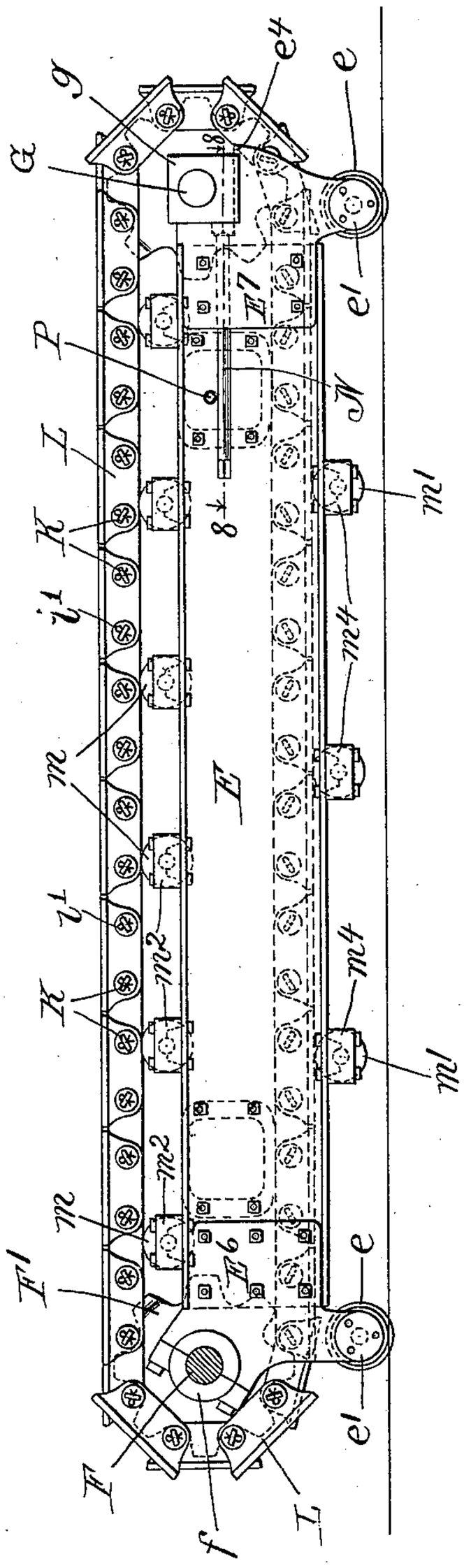

Fig. 2.

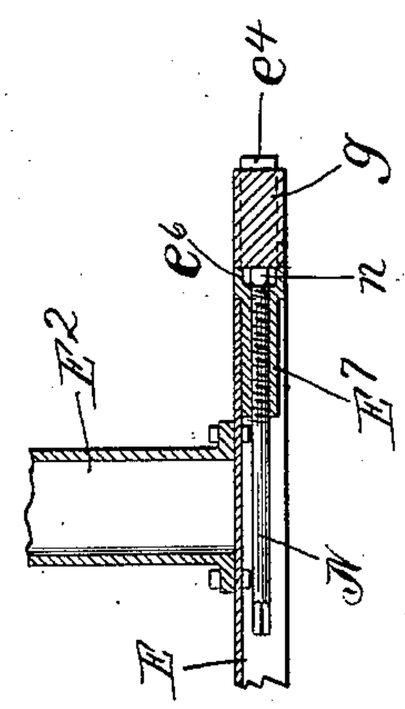

Fig. 8.

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(No Model.)

4 Sheets—Sheet 3.

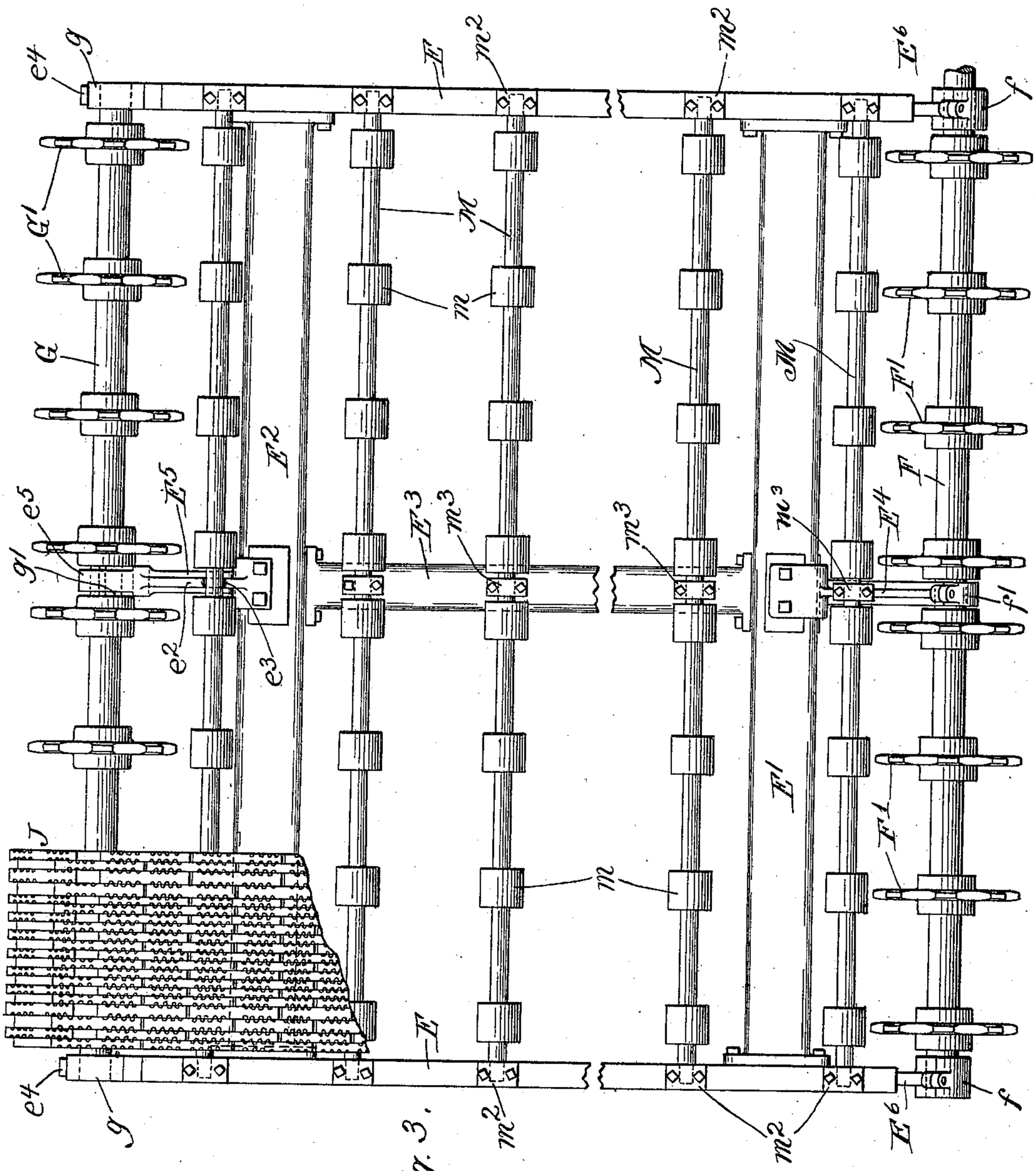

Fig. 3.

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(Application filed Apr. 4, 1900.)

(No Model.) 4 Sheets—Sheet 4.

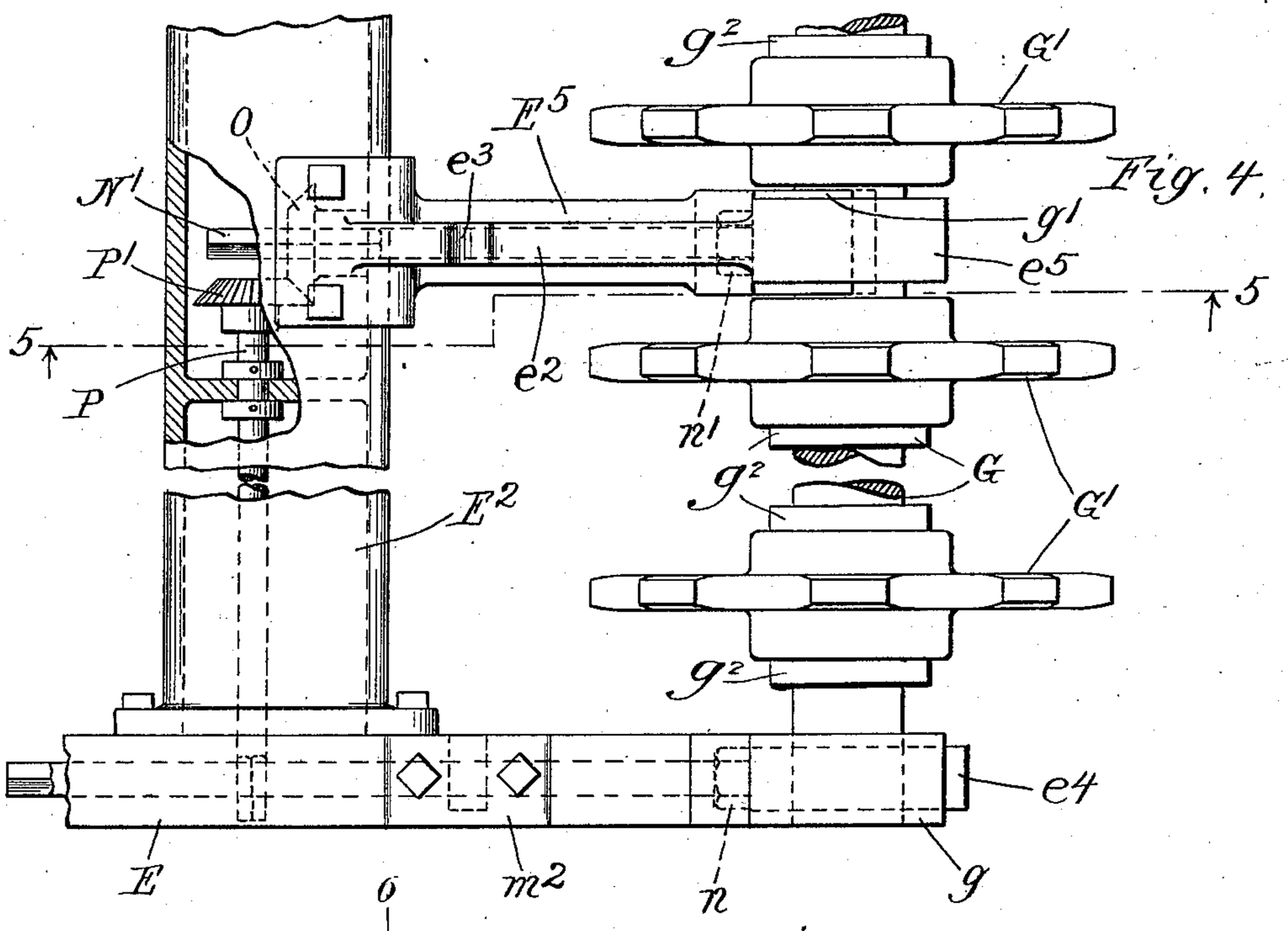

Fig. 4.

Fig. 5.

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UNITED STATES PATENT OFFICE.

WILLIAM M. GREEN, OF EVANSTON, AND JOHN R. GENT, OF CHICAGO, ILLINOIS, ASSIGNORS TO JOSEPH F. GENT, OF INDIANAPOLIS, INDIANA.

FURNACE-GRATE.

SPECIFICATION forming part of Letters Patent No. 685,718, dated October 29, 1901.

Application filed April 4, 1900. Serial No. 11,441. (No model.)

To all whom it may concern:

Be it known that we, WILLIAM M. GREEN, a resident of Evanston, and JOHN R. GENT, a resident of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Furnace-Grates; and we do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to fuel-feeding devices for furnaces of that kind having a traveling or endless-belt grate by which the fuel is delivered at the feed-opening of the furnace and is continuously fed forward or advanced while combustion is taking place, and more especially to traveling or endless-belt grates of that class in which the endless belt forming the grate is a chain belt made or built up of a plurality of short longitudinally-arranged grate-bars, which constitute the links of the chain belt and are pivotally connected with each other by transverse pivot-rods, which engage the overlapping ends of said grate-bars and in which the grate is mounted in a movable frame, which may be removed from and inserted into its place in the furnace.

The invention consists in the matters hereinafter described, and pointed out in the appended claims.

In the accompanying drawings, illustrating our invention, Figure 1 is a sectional elevation showing a boiler-furnace and traveling grate, taken on a plane parallel with the front wall of the furnace and illustrating the grate and its supporting-frame. Fig. 2 is a view in side elevation of the grate and its frame. Fig. 3 is a plan view of the supporting-frame of the grate with parts mounted thereon, together with a portion of the grate proper. Fig. 4 is a detail plan view of the grate-supporting frame and parts connected therewith at the rear end of the same. Fig. 5 is a detail section taken on line 5 5 of Fig. 4. Fig. 6 is a detail section through the links or grate-bars of the grate, showing in cross-sectional view the pivot-rods connecting the same, this section being taken on line 6 6 of Fig. 5. Fig. 7 is a view in side elevation of one of the grate-bars adjacent to the side margin of the grate. Fig. 8 is a detail section taken on the horizontal line 8 8 of Fig. 2.

In the accompanying drawings, illustrating our invention, A A indicate the side walls of a boiler-furnace, B the fire-box, and C the ash-pit thereof.

The grate illustrated is mounted on a movable frame, which is supported on wheels and is adapted for insertion into the furnace or removal from the same. The supporting-rails on which the frame of the grate is supported are indicated in the drawings by *a a*, said supporting-rails being, as shown, mounted on the side walls A A and at the lower parts of recesses formed in said side walls to receive the sides of the frame and grate. Said frame is formed by means of two longitudinal side pieces E, cross-girths E′ E², which extend between and are attached at their ends to the side pieces, and a longitudinal frame-piece or girth E³, arranged at the longitudinal center of the frame parallel with the side pieces and attached at its ends to the front and rear cross-girths. The longitudinal side pieces are shown as consisting of flanged or channel beams, while the cross-girths E′ E² are hollow or tubular in form and provided with flanges at their ends, by which they are attached by bolts to the inner faces of the side pieces. The central longitudinal frame-piece E³ is shown as similarly made of tubular form and flanged at its ends for attachment by bolts to the inner faces of the cross-girths E′ E². The frame is provided with supporting-wheels *e e*, arranged at each end of the frame and mounted in depending bearing-lugs *e′*, projecting below the lower edges of the side pieces E E. Mounted on the said carriage, at the front end thereof, is a horizontally-arranged sprocket-wheel shaft F, carrying a plurality of sprocket-wheels F′, and at the rear end of said carriage is a similar sprocket-wheel shaft G, carrying a plurality of sprocket-wheels G′. The chain grate is supported at its ends on said sprocket-wheels F′ G′ and is moved or driven by these at the front end of the frame. Said chain grate consists of a plurality of relatively short grate-bars, which extend longitudinally of the grate and are

pivotally connected with each other to form a chain or endless belt, said bars being called "link-bars." The grate illustrated is formed by means of two kinds or sets of said link-bars, of which those marked H are adapted to engage the several sprocket-wheels F' G' and may be called "driving" link-bars, while those marked I constitute the greater part of the fuel-supporting surface of the grate and are located between the driving link-bars H H. The grate is, moreover, divided into a plurality of sections or separate belts or bands, that herein illustrated consisting of two such belts or bands, (indicated in the drawings by the letters J J'.)

The several link-bars of each grate-section are pivotally joined or connected by means of pivot bars or rods K, which extend transversely of the link-bars and pass through the overlapping ends of the series of link-bars on either side of the same and are made of flattened form. Each belt or section is provided with several sets of driving link-bars H, corresponding with the sprocket-wheels in number and location. In the case of the driving link-bars the said pivot-rods pass through eyes *h* therein, said eyes consisting each of a circular part, through which the pivot-rod K passes, and a slot or opening *h'*, which opens through the bottom edge of the link-bar into the aperture *h* and is made considerably narrower than the diameter of said aperture, but of suitable width to permit the passage through it of the flattened pivot-rods in disconnecting the bars from said rods. Surrounding the said bearing-aperture *h* are hubs or flanges H', which meet or rest in contact with each other when the bars are placed together in overlapping relation. Said eyes, moreover, are made larger in diameter than the width of the pivot-rods, and cylindric bearing-blocks h^2 are inserted in the eyes *h* and are slotted for the insertion of the pivot-rods. The vertical parts or webs of said driving link-bars H H are located at a proper distance apart to leave a space between them sufficient in width to receive the teeth of the sprocket-wheels F' G', and the hubs H' on said bars are made of such length as to meet midway between the webs of the bars and to form bearing-surfaces, which enter between the teeth of the sprocket-wheel and are engaged by such teeth in the actuation of the chain.

The link-bars I, which fill the spaces between the driving link-bars H, are provided with apertures like those in said link-bars H, the same having main parts *i*, of circular form, and slots *i'*, leading from the lower edges of the link-bars into said slots or eyes. Said slots are made of proper width to receive the flattened pivot-rods and the eyes of a diameter equal to the width of the pivot-rods, so that the latter may turn in said eyes while remaining constantly in bearing engagement with the links. The link-bars are removed from the pivot-rods by turning the same into a vertical position, so that they will pass through the slots in the pivot-bars as the latter are lifted from engagement with said pivot-bars in the same manner as set forth in our prior patent, No. 637,108, dated November 14, 1899.

In order to hold the pivot-bars in angular position, and thereby prevent their withdrawal through said slots or openings in the usual operation of the grate, a set of marginal link-bars L is provided, said marginal bars being located outside of the driving link-bars H at each side of each grate-section and having in place of eyes or circular openings to receive the pivot-bars two oblique slots *l l*, Fig. 7, into which the ends of the link-bars may be inserted after the link-bars have been engaged with the pivot-bars and the latter have been turned or rotated into an angular position to prevent disengagement of the link-bars therefrom. When the pivot-bars are engaged with the said external or marginal link-bars L L, as described, they will be held from rotation and can only be turned to a position with their flat sides vertical to permit the removal of one of the link-bars by disconnecting the said marginal link-bar L from the ends of two adjacent pivot-rods. For holding the marginal link-bars in place upon the pivot-bars and at the same time holding the pivot-bars from endwise movement any suitable fastening devices may be applied to the ends of the pivot-bars, those herein shown consisting of cotter-pins *l'*, inserted through the ends of the pivot-bars which project outwardly beyond said link-bars L.

At the middle of the grate the marginal bars L L on the adjacent edges of the grate-sections are arranged close together, so as to leave only a narrow space between the same not materially wider than the space between the other link-bars forming the supporting-surface of the grate.

The sprocket-wheel shaft F, at the front end of the grate, is mounted at its ends in bearings *f f*, formed in plates or castings E^6, which are bolted to the outer faces of the side pieces E E, which project forward of the cross-girth E'. A third bearing *f'* for said sprocket-wheel shaft is provided at the middle of the grate, the same being formed in a bracket E^4, which is bolted to the cross-girth E' and extends forwardly therefrom. Similarly the rear sprocket-wheel shaft G is mounted at its ends in bearings *g g*, mounted in plates or castings E^7, bolted to the outer faces of the rear ends of the side pieces E E, and said shaft G is supported at its middle in a third bearing *g'*, mounted on a bracket E^5, which projects rearwardly from the rear cross-girth E^2 of the frame. As herein shown and preferably constructed, the lugs *e' e'*, which afford bearings for the supporting-wheels *e e*, have the form of downward integral projections on the lower edges of the said plates E^6 and E^7.

The sprocket-wheels F' and G' are arranged one at each end of the shafts F G in position

to engage the driving-links H H at the outer margins of each grate-section, and two of said sprocket-wheels are located on said shafts F and G at either side of the central bearings f' g', so as to engage the driving-links H H, which are located at the inner or adjacent margins of said sections. Other sprocket-wheels are located between the sprocket-wheels, which engage the driving link-bars at the side margins of the sections, said intermediate sprocket-wheels being adapted for engagement with intermediate sets of driving link-bars. Each lateral half or section of the grate is shown in the instance illustrated as provided at each end with two intermediate sprocket-wheels, and the grate-sections are provided with corresponding sets of driving link-bars. By employing a plurality of sprocket-wheels on each lateral half of the forward or driving shaft F, together with a plurality of sets of driving link-bars in each of the chain-sections, the pivot-rods are relieved of the strain which would be brought thereon by reason of the lagging or pulling back of the parts of the belt if the grate-sections were driven solely through their marginal driving link-bars, it being obvious that so far as the advance movement of the belt is concerned in the construction herein shown the pivot-rods will be required to move or carry forward those link-bars only which are located between the closely-spaced sets of driving link-bars.

For the purpose of supporting or sustaining the horizontal parts or runs of the grate between the sprocket-wheels the frame or carriage is provided with a plurality of transverse horizontally-arranged shafts M M', provided with bearing-rollers m m', of which the shafts M are located beneath the upper part or run of the belt and those M' are located below the lower part or run of the belt. The shafts M at the top of the carriage are mounted at their ends in bearings m^2 m^2, bolted to the top edge of the side frame-pieces E, and at their middle parts are engaged with bearings m^3, bolted to the upper surface of the central longitudinal frame-girths E^3. In the case of the shaft M nearest the front of the grate-frame the bearing m^3 is bolted to the top surfaces of the brackets E^4, while in the case of the shaft M nearest the rear of the frame a bearing is provided for the center of the shaft by means of a raised longitudinal flange e^2, Figs. 3, 4, and 5, on the bracket E^5, which flange is provided with a notch or seat e^3, in which the shaft rests. The lower set of shafts M' are mounted at their ends in bearings m^4 m^4, bolted to the lower edges of the side frame-pieces E E, these shafts being without any central supporting-bearings.

The forward sprocket-wheel shaft is immovable with respect to the frame, the bearings f f therefor being shown as formed half in the plates and half in caps bolted thereto in a familiar manner. The central bearing f' is similarly formed by a recess in and a cap attached to the bracket E^4. In the case of the rear sprocket-wheel shaft G, the bearings g g' thereof have the form of sliding bearings or boxes which engage longitudinal horizontally-arranged guides e^4 e^4 e^5, formed on the rear ends of the plates E^7 and on the bracket E^5, said bearing-boxes being arranged to slide horizontally in order that the said shaft G may be shifted backward or forward to adjust the tension of or tighten the chain-grate when necessary. Means for adjusting the said bearings are provided as follows: The bearings for the ends of said shaft G are adjusted by means of screw-shafts N N, which are inserted through longitudinal passages in the said plates E and bear at their rear ends against said boxes, said screw-shafts being engaged with nuts n n, which are square or flat-sided and are seated in flat-sided recesses e^6, formed in the vertical rear faces of the said plates E^7. Said screw-shafts are provided at their forward ends with flat-sided portions to receive a wrench or like implement by which they may be turned. In the case of the central bearing g', which is mounted to slide upon the bracket E^5, as clearly shown in Figs. 4 and 5, a special provision is made for moving the bearing E^5, the same consisting of a horizontally-arranged screw-shaft N', having screw-threaded engagement with a nut n', seated in a recess e^7 in the said bracket and bearing at its rear end against the bearing g'. The rear cross-girth E^2 is, as before stated, hollow or tubular in form, and the screw-shaft N' is extended into the hollow interior of the said girth. Mounted on said shaft N' within the said girth is a gear-pinion O, which is engaged with said shaft by means of a spline or feather engaging the groove in the shaft, so that the shaft will turn with the pinion, but will slide or move endwise through the said pinion when the shaft is moved or adjusted by being turned in the screw-threaded nut in the bracket E^5. Mounted longitudinally in said girth E^2 is a shaft P, having at its inner end a gear-pinion P', which intermeshes with the gear-pinion O on the shaft N'. The outer end of said shaft P is flat-sided and projects through an opening in the side plate E of the frame, so that a wrench or the like instrument may be easily applied to said shaft for the purpose of turning the same. The construction described obviously enables the central bearing g' to be adjusted from one side of the grate. When the shaft P is turned, the shaft N' will be correspondingly turned or rotated, thereby moving it endwise against the bearing g'. By adjusting the three screw-shafts N N and N' the shaft-bearings may be moved backwardly any extent necessary for the proper adjustment of the tension on the chain-grate. By the employment of the nuts n n', seated in recesses in the plates E^7 and bracket E^5, as described, the construction of the adjusting devices is greatly simplified and the cost thereof decreased, the necessity of providing a screw-threaded aperture in

the large castings E^7 and bracket E^5 being avoided.

All of the sprocket-wheels G′ but one on the rear shaft G are loose on the shaft, so as to turn freely thereon, one only of said wheels being affixed to the shaft, so that the latter will be turned in its bearings with the several sprocket-wheels. This construction insures that the said sprocket-wheels engaged with the two grate-sections or with different parts of the same grate-section will remain properly in engagement with the grate notwithstanding any inequalities in the driving link-bars or lagging of one belt behind the other or one part of one of the belts with regard to other parts thereof. To hold the said sprocket-wheels G′ from endwise movement on the shaft F, collars g^2 are shown as secured to the shaft on opposite sides of the hubs of each sprocket-wheel.

The driving sprocket-wheel shaft F will always be made continuous; but the shaft G need not be continuous, but may consist of two or more separate parts or sections. It is preferred, however, that one sprocket-wheel on the shaft G, or on each section thereof if the same consists of more than one section, be rigidly secured to the shaft, and thereby cause the shaft to revolve, so as to avoid the friction which would be due to the turning of the said sprocket-wheels on the shaft, it being obvious that the loose sprocket-wheels will not turn on the shaft, but will be merely shifted slightly thereon as required by irregularities in the parts of the belt or in the movement of the driving link-bars thereof.

It will of course be understood that any suitable driving means may be employed to give motion to the forward sprocket-wheel shaft for driving the grate, it being thought unnecessary to illustrate such driving means in connection with the present invention, as they constitute no part of the same.

An important part of this invention is included in the construction embracing in connection with a single wide supporting-frame a continuous sprocket-wheel shaft at the front of the frame, which is driven to give motion to the grate, and a sprocket-wheel shaft at the rear of the frame, the sprocket-wheels on which are adapted to turn or move relatively to each other, of a belt or chain grate divided longitudinally into a plurality of parts or sections and which are engaged by the sprocket-wheels on the said sprocket-wheel shafts, said belt being driven through the turning of the said forward shaft. The advantage of this construction is that a grate is thereby provided which may be much wider than would be practicable for use if the grate were made continuous from side to side of the same and which will operate properly and satisfactorily notwithstanding irregularities in the driving link-bars and yielding of the shaft to which power is applied under the torsional strain on the said shaft. If the belt be wide and in one piece, such yielding of the driving-shaft under strain usually results in one part of the belt dragging or lagging behind the other, with the effect of bending or throwing into oblique positions the several pivot-rods, thereby causing the parts to bind and preventing the proper operation of the grate. When the belt is made of two or more sections and the sprocket-wheels on the rear shaft are free to turn relatively to each other, as herein illustrated and described, the fact that one part or section lags behind the other by reason of such torsional strain on or yielding of the driving-shaft will make no difference in the operation of the grate, as each part or section will move independently and without interference with the action of the other part or parts. The importance of this feature of the invention will be better understood upon consideration of the fact that when the grate is carrying its load of fuel a very considerable amount of power is required to move the same, and if for the purpose of transmitting such power through a single driving-shaft said shaft were made heavy and strong enough to prevent any substantial yielding of the same under torsional strains it would need to be so large and heavy as to involve large expense in its construction and much trouble in handling it, especially in cases where the shaft is very long, as is the case in a wide grate such as is herein shown. By the use of the construction herein described, however, the grate may be very wide and the sprocket-wheel shaft very long, and at the same time such yielding or torsional movement which may take place in said shaft will be immaterial because having no effect upon the operation of the grate. In a very wide grate, moreover, the difficulties in the way of smooth running of the belt due to irregularities in the driving link-bars are greatly magnified, it being very difficult to construct a device of this kind so accurately that a large number of sets of driving link-bars and their associated sprocket-wheels will accurately fit or intermesh, and these difficulties are entirely obviated by our improvements, as herein described.

Another important feature of our invention is embraced in the construction in the grate-supporting frame by which the same is especially adapted for use in connection with wide grates having a plurality of grate-bar sections. It is found that the frame made up, as herein shown, of longitudinal pieces, transverse girths of tubular form connecting the same, and a central longitudinal girth which serves to rigidly connect the centers of the cross-girths and also to afford supports for the centers of the supporting-roll shafts, affords in high degree the necessary qualities of rigidity and strength combined with economy of construction.

The marginal link-bars described, which serve both as fuel-supporting bars and also as means for locking the pivot-rods from turning, also constitute a novel feature which is

herein claimed as a part of our invention. By their lateral projections from the adjacent margins of any two sections they bridge over the space which would otherwise exist between the sections and, as before described, approach each other so closely at their outer or contiguous edges as to present a practically continuous supporting-surface for the fuel. Consequently there is no clogging of the parts by cinders and no "dead" zones, but a clear even fire is maintained through the entire surface of the grate. At the outer edges of the sides of the grate moving support is given also to the fuel clear up the fire-grate, the upper surface of the moving marginal grate-bars projecting under the fire-lining in a recess formed therein, so that the usual clogging in the corners of the furnace fire-box is prevented.

We claim as our invention—

1. The combination with an endless traveling grate and shafts carrying sprocket-wheels for supporting said grate, of a frame having a hollow cross-girth, a bearing for the shafts supported on said cross-girth, a longitudinally-arranged adjusting-screw for said bearing one end of which extends into said girth, a gear-pinion on said shaft within the hollow girth and a shaft mounted in said girth and provided with a gear-pinion intermeshing with that on the adjusting-screw, said shaft extending to the side of the frame.

2. The combination with a frame and two shafts provided with a plurality of sprocket-wheels, of an endless traveling grate supported on said sprocket-wheels and consisting of a plurality of separate sections arranged side by side with their adjacent edges close together, each of said sections consisting of linked bars each provided with a fuel-supporting surface and with two bearing-apertures which open through the lower margin of the link-bar, and a plurality of pivot-rods; the side or margin link-bars of the grate being provided with fuel-supporting surfaces and having each two oblique slots which are engaged with the pivot-rods to hold the same from turning, securing means applied to the said ends of the pivot-rods outside of the said marginal link-bars, said marginal link-bars having at their upper surfaces laterally-projecting flanges which extend over the ends of the pivot-rods and securing devices thereon and which, in the case of the marginal link-bars on the adjacent edges of the grate-sections, are located close together to form a continuous bearing-surface for the fuel between the side linings of the furnaces.

In testimony that we claim the foregoing as our invention we affix our signatures, in presence of two witnesses, this 23d day of March, A. D. 1900.

WILLIAM M. GREEN.
JOHN R. GENT.

Witnesses:
C. CLARENCE POOLE,
C. W. HILLS.