

Feb. 20, 1934.

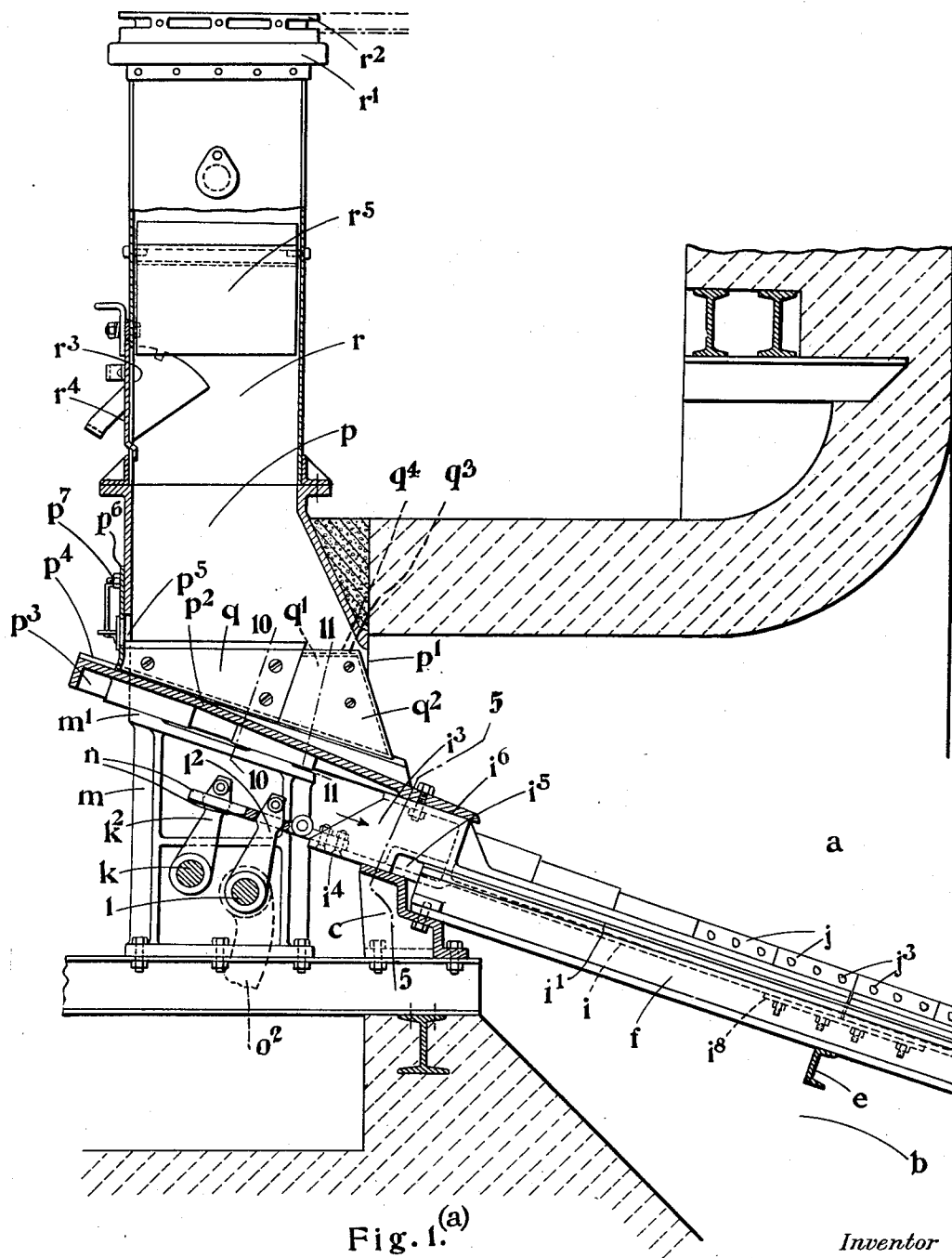
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1,947,831

FURNACE GRATE

Filed May 27, 1931

7 Sheets-Sheet 1



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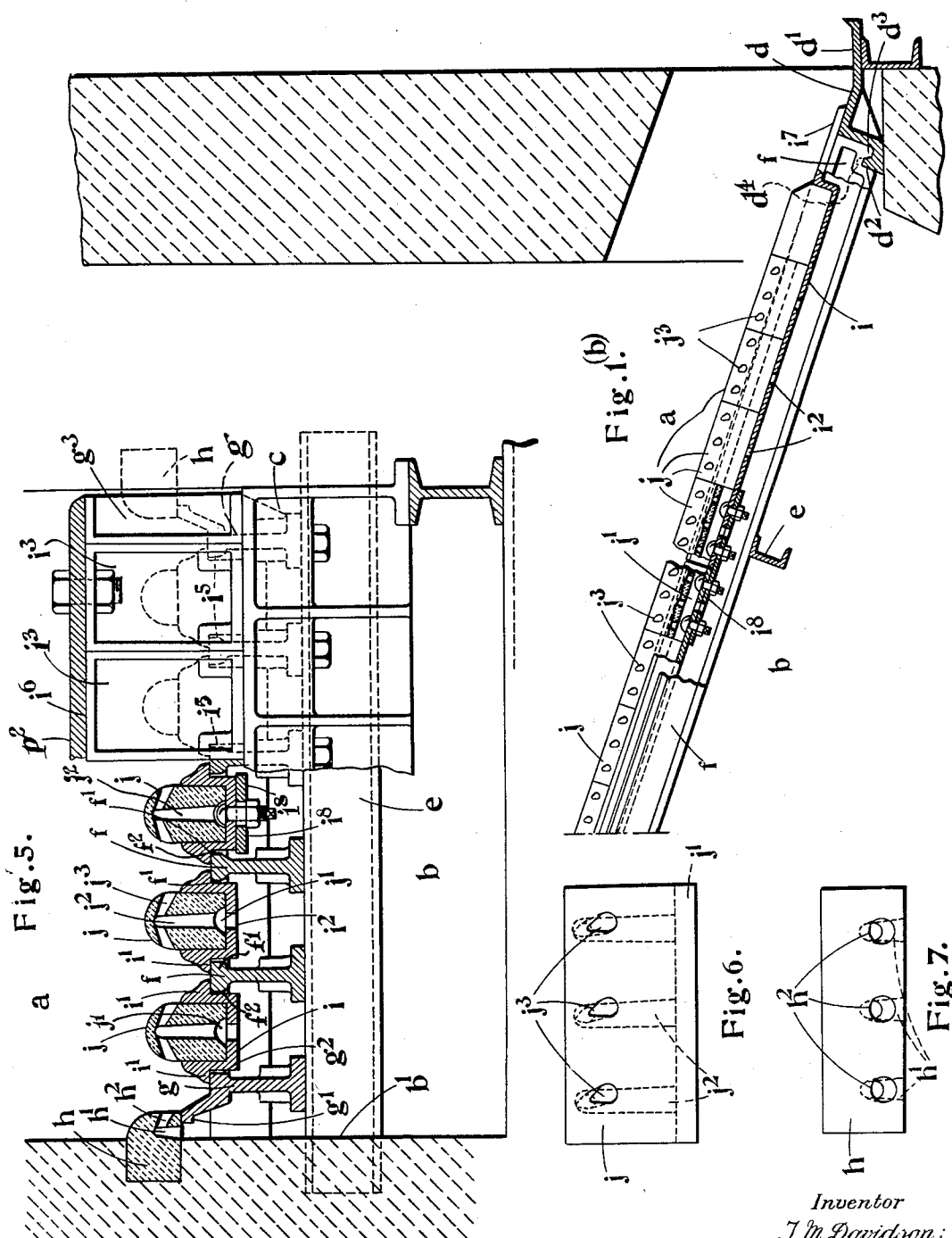
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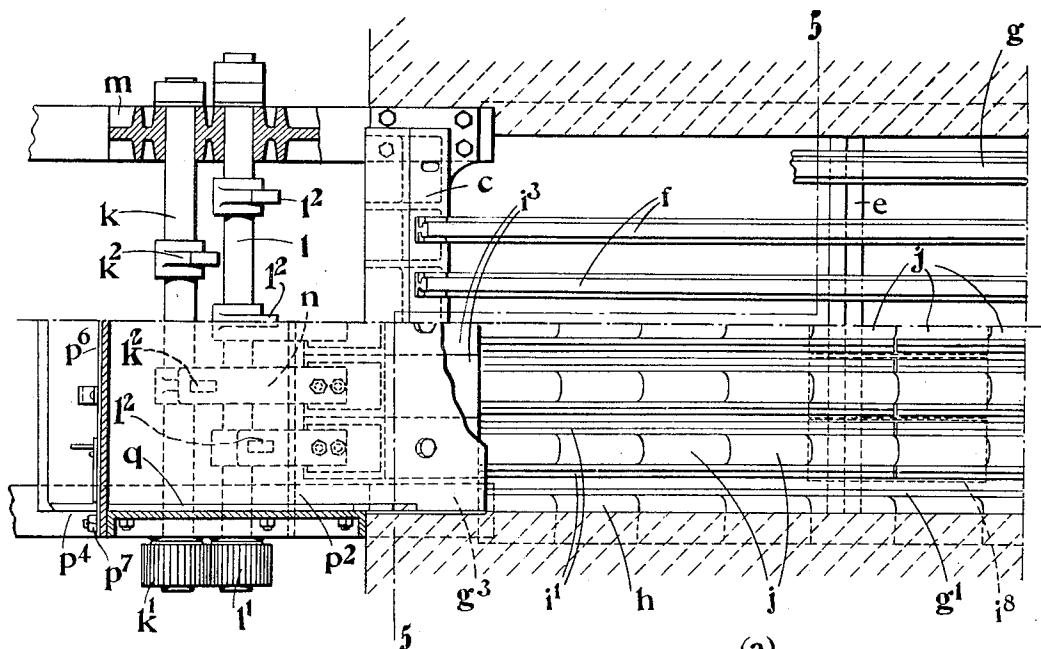


Fig. 3.(a)

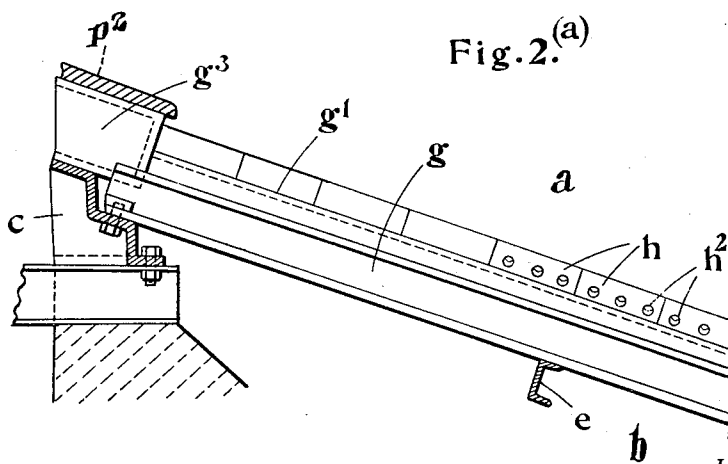


Fig. 2.(a)

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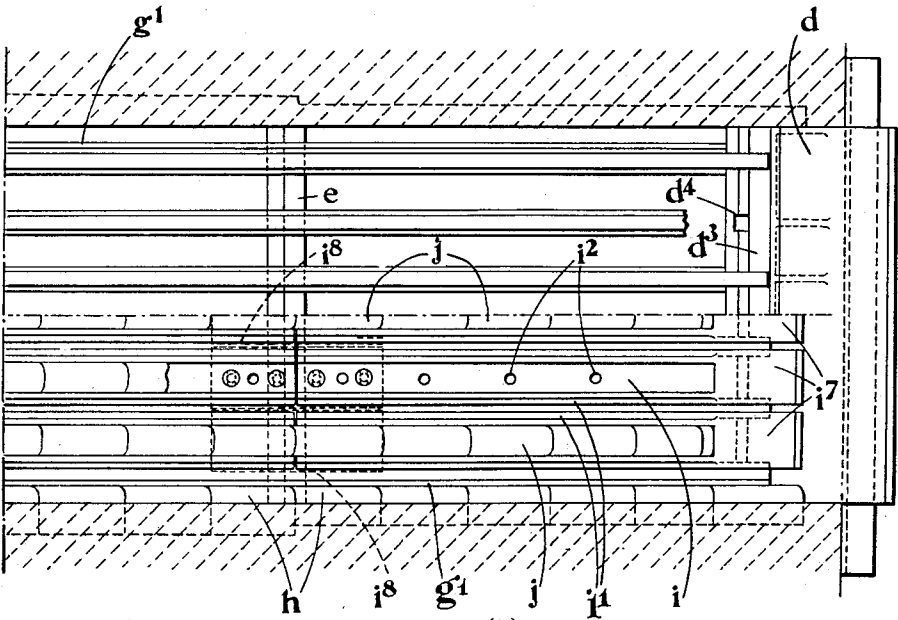


Fig. 3.(b)

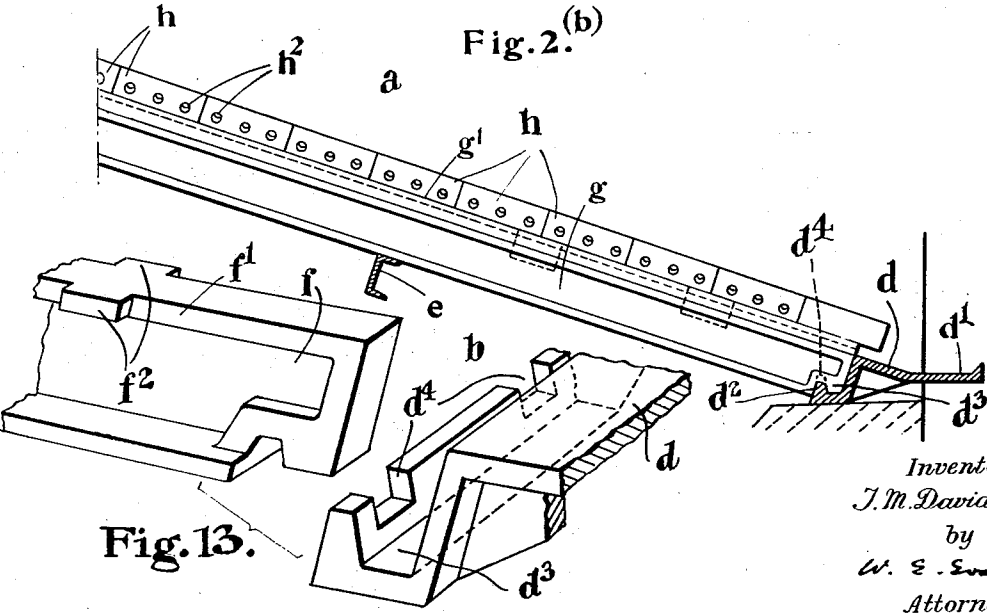


Fig. 13.

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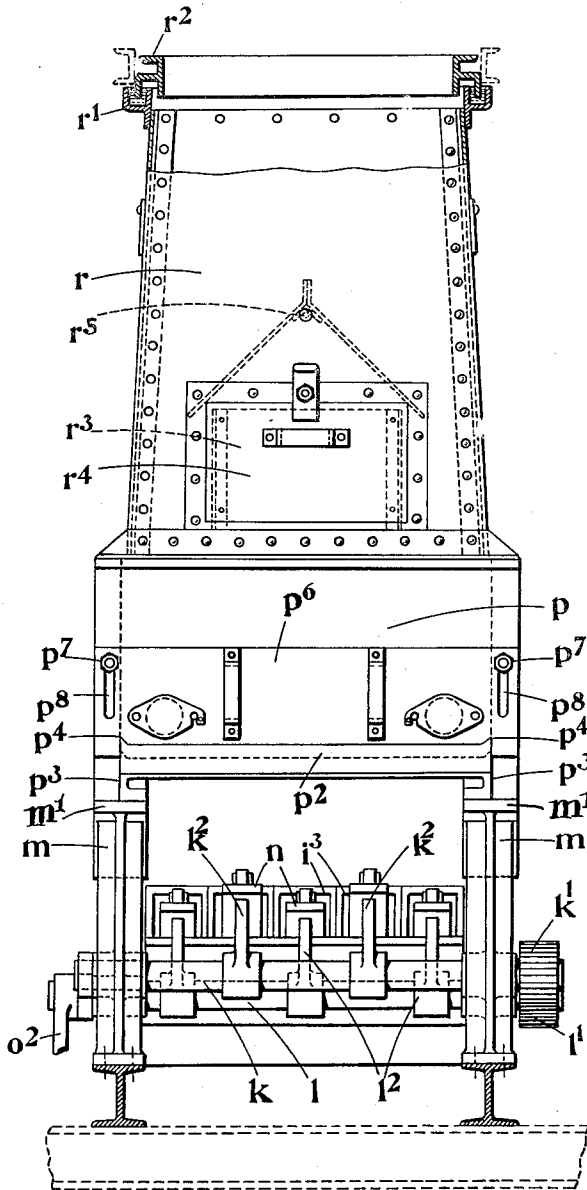


Fig. 4.

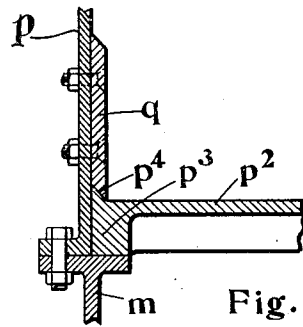


Fig. 10.

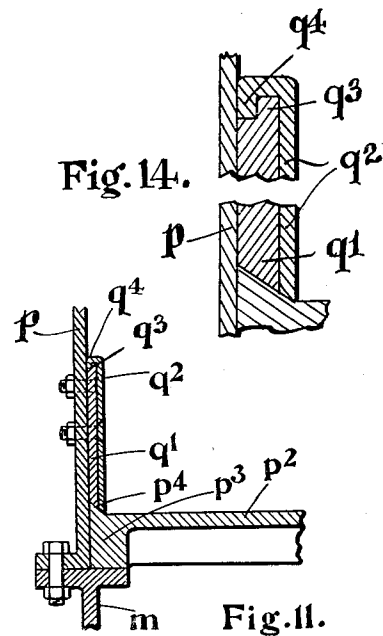


Fig. 11.

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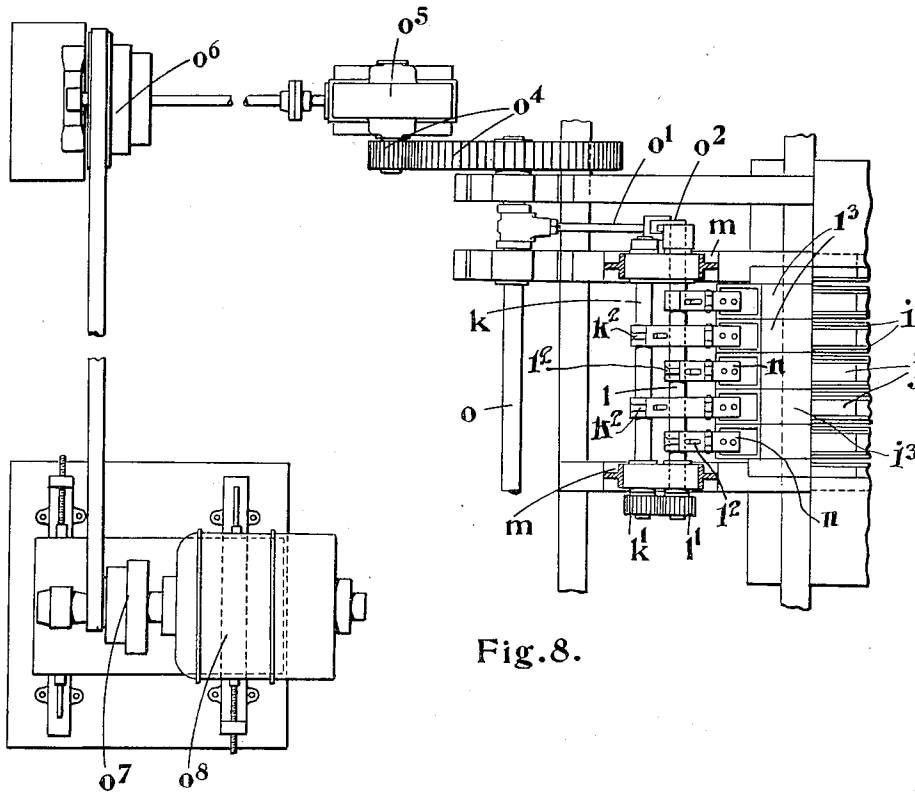


Fig. 8.

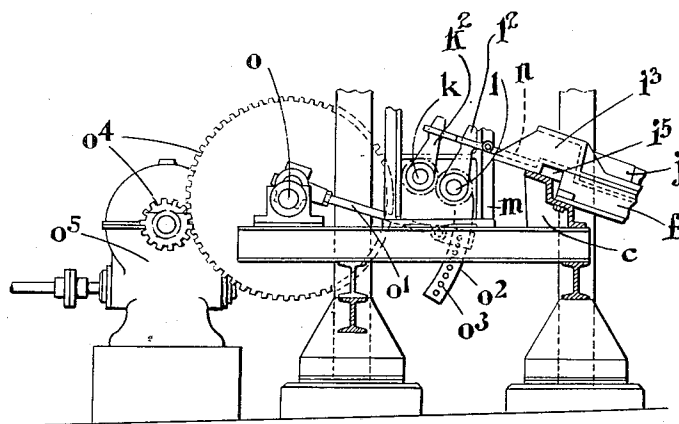


Fig. 9.

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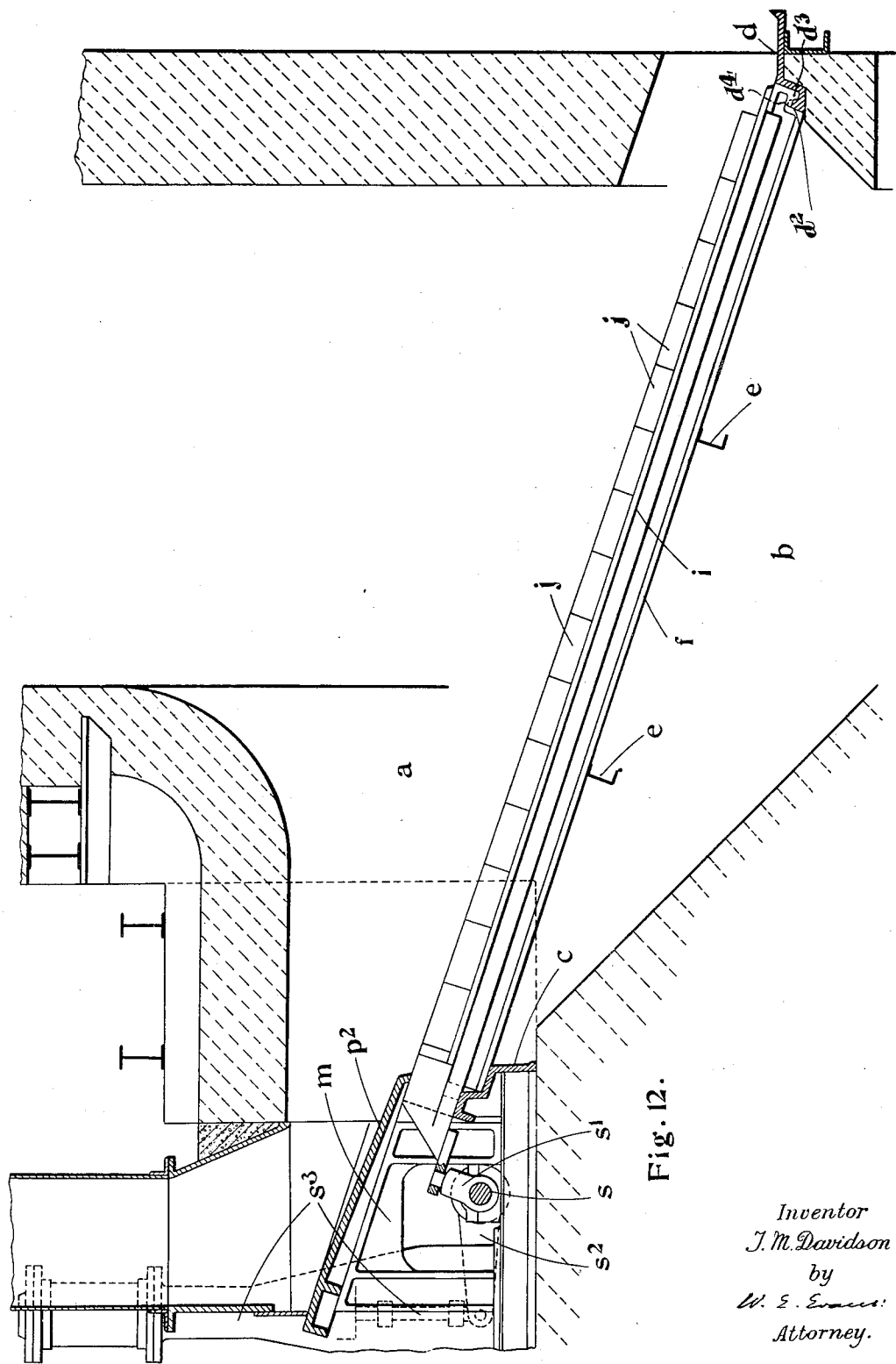
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7 Sheets-Sheet 7



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UNITED STATES PATENT OFFICE

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FURNACE GRATE

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Application May 27, 1931, Serial No. 540,431,
and in Great Britain May 28, 1930

7 Claims. (Cl. 110—38)

This invention relates to furnace grates and has for its object to provide a grate that is of universal application and adapted for effecting combustion of all kinds of fuel, and more especially fuels, such as shale, in which the carbon content is low, and fuels that are used in a finely divided condition.

In the use of furnace grates, both of the mechanical and stationary types, difficulty is experienced in maintaining the metal elements of the grate effective having regard to the severe conditions which they have to support and which result in distortion, growth, fusing or burning of the metal elements.

In the use of finely divided fuel difficulty is occasioned by the tendency of the fuel either to fall through the spaces between the elements of the grate or to become compacted and to obstruct the passage of air for combustion through the fuel bed, which, in the case of the usual type of grate embodying metal elements, must be deep enough to afford protection to the elements, that is to say, must be at least six inches in thickness.

The present invention has especially for its purpose to overcome these and other disadvantages of the usual types of grate and to facilitate the handling of the fuel, ash and clinker.

According to the invention the furnace grate is formed with base or supporting elements of metal, and an upper or fuel supporting portion or surface made from refractory material, or similar fire-resisting materials.

According to the invention, moreover, the air for combustion is directed upwardly through the furnace grate so as to enter the fuel bed at a level sufficiently far removed from the metal base elements to prevent the burning of the latter.

According to the invention, moreover, the upper or supporting surface of refractory material is advantageously formed in lengths as bricks or bars which are adapted to be received upon or into the base elements.

According to the invention, moreover, the furnace grate may be formed of longitudinally disposed units of which certain units may be given a movement relatively to the remaining units.

According to the invention, again, means may be provided for feeding fuel from a hopper or supply receptacle on to the grate, which means may comprise a movable element in the form of an apron having a movement relatively to the hopper or supply receptacle and to the fixed units of the grate.

According to the invention, also, the movement of the movable units of the grate may be effected from an oscillatory shaft receiving movement from a source of power such as a hydraulic engine, electric motor or the like, and such oscillatory

shaft may serve also to effect the movement of the feed apron before referred to.

The invention further comprises the details of construction of the particular furnace grate and setting hereinafter described by way of example.

The invention is illustrated by way of example in the accompanying diagrammatic drawings.

Figures 1(a) and 1(b) together illustrate a sectional elevation of a furnace provided with a grate according to the invention.

Figures 2(a) and 2(b) together illustrate an elevation of a lateral longitudinal bearer member and the wall bricks with which it contacts.

Figures 3(a) and 3(b) together illustrate a sectional plan view of the grate shown in Figures 1(a) and 1(b), the upper parts of the views being taken at a lower elevation than the lower parts of the views.

Figure 4 is an end elevation of the charging end of the grate with the feed chute.

Figure 5 is a cross-sectional elevation of the grate to an enlarged scale taken on the line 5—5 in Figure 1(a), in the direction of the arrow, and in Figure 3(a), the longitudinal members and bricks omitted in Figure 3(a) being shown in position.

Figure 6 is a side view to an enlarged scale of one of the bricks of the grate units.

Figure 7 is a side view to an enlarged scale of one of the wall bricks with which the lateral longitudinal bearer members contact.

Figure 8 is a partial plan view of the driving gear for the grate units.

Figure 9 is a side elevation of the reducing gear mechanism for transmitting movement to the grate units.

Figure 10 is a section to an enlarged scale of a detail of the reciprocatory apron and liner plate of the feed shoot on the charging end of the grate on the line 10—10 of Figure 1(a).

Figure 11 is a similar detail sectional view through the line 11—11 of Figure 1(a).

Figure 12 is a sectional elevation of a furnace provided with a grate according to the invention in which hydraulic driving mechanism is employed.

Figure 13 is a detail perspective view in illustration of the construction of the lower supporting frame member and the manner of engaging the longitudinal bearer members therewith.

Figure 14 is a detail sectional view to an enlarged scale of the upper and lower ends of the lining and cover plates of the lateral walls of the feed chute.

In carrying the invention into effect according to the particular construction of furnace represented in Figures 1 to 11, there is provided below the combustion chamber *a* of the furnace (Figures 1(a) and 1(b)) a recess or second chamber *b* forming a combustion air supply chamber sep-

arated from the combustion chamber by the furnace grate which is disposed at an inclination or slope of, for example, approximately eighteen degrees. Transverse supporting frame members *c*, *d* of suitable cross-sectional form are disposed respectively in positions representing the upper and lower ends of the furnace grate, while intermediate transverse bearer members *e*, which may be of channel section, extend from side to side at intervals across the air supply chamber *b*. The units of the furnace grate itself are supported upon longitudinal bearer members *f* disposed at intervals and extending from the upper to the lower supporting frame members *c*, *d*, the said members being of metal and conveniently of a form approximating to that of an H-section girder or the like. The lateral longitudinal bearer members *g* (Figures 3(a), 3(b) and 5) are advantageously provided on the outer sides with extended flanges or closure plates *g*¹ to engage beneath or contact with suitable ribs formed upon the lateral walls of the air supply chamber, conveniently by the building into the said walls of a series of refractory bricks *h* (Figures 2(a), 2(b), 5 and 7). Each unit of the grate comprises a longitudinal channel section metal member *i* (Figures 1(a), 1(b), 3(a), 3(b) and 5) having lateral flanges *i*¹ disposed towards the upper ends of the side walls of the channel section towards the discharging ends of the grate and at the lower end of the side walls of the channel section at the charging end of the grate, so that the flanges *i*¹ are inclined to the direction of the channel of the member *i* and are adapted to bear upon the upper flanges *f*¹, *g*² of the adjacent longitudinal bearer members *b* in such manner as to give through the members *i* a lifting movement to the fuel upon reciprocation of the bars. Each of the longitudinal metal members *i* of the grate serves to receive a series of bricks *j* (Figures 5 and 7) of refractory material consisting mainly of silica and alumina, carborundum, molybdenum, ganister, silicon carbide, or of mixtures of these substances or heat-resisting metals, the longitudinal metal members being of iron or steel. The lower portion of the section of each brick *j* is adapted to fit closely into the channel of the longitudinal metal member *i*, while the upper portion of each brick is advantageously formed of substantially semi-circular cross-section and may be of dimensions such that the lateral edges overlap the flanges *f*¹, *g*² of the longitudinal members, the lateral edges of which are advantageously bevelled or chamfered throughout their length.

The bricks *j* of the series of bricks carried by a single unit are for the greater part of the unit of uniform height. At the upper end certain bricks, for example, the first two are provided of greater height than the remainder, that is to say, the second brick is of greater height than the uniform height of the remaining bricks and the first brick is of greater height than the second brick. This step formation may be extended or decreased so as to apply to more or less or all or none of the bricks according to the nature of the fuel. By this means, on the forward movement of the units, the bricks which extend above the adjacent bricks serve to facilitate the feed movement of the fuel along the grate. For the same purpose the flanges *f*¹ of the longitudinal members supporting the bricks, as shown in Figure 1 of the drawings, may be provided to be of decreasing thickness from the upper end to the lower end of the grate.

The supply of combustion air to the furnace grate is effected through air holes or slots *k*² provided in the bottom of the longitudinal metal members *i* of the grate units and passes into longitudinal channels or passages *j*¹ formed in the lower surfaces of certain of the bricks, that is to say, the intermediate bricks between, for example, the last brick at the lower end and the first three bricks at the upper end of the unit. Each of the said bricks is provided with a number of upwardly directed passages *j*² leading from the longitudinal channels or passages *j*¹ and extending short of the upper surface of the brick (Figures 5 and 6). The said passages serve to connect the longitudinal channels or passages with lateral outlets formed in the side faces of the bricks as passages or openings *j*³, which outlets are disposed so that they have a downward inclination and also a slight inclination in the direction of the lower end of the grate. The bricks *h* forming the ribs on the lateral walls of the air supply chamber *b* are correspondingly provided with upwardly directed passages *h*¹ which communicate with outlets *h*² downwardly inclined in a direction transverse to the length of the grate or inclined slightly to the lower end. The upwardly directed passages *h*¹ serve to communicate with the air supply chamber *b* below the grate through the clearance space that remains between the walls *b*¹ of the air supply chamber and the flanges *g*¹ of the lateral longitudinal bearer members *g*.

At the upper ends, the longitudinal metal members *i* of the grate are provided with open box-like extensions *i*³ having bearing surfaces *i*⁴ at the bottom to rest upon the upper surface of the upper supporting frame member *c* and to extend therebeyond, the lateral walls of the extensions being recessed inwardly, as at *i*⁵, to clear the ends of the longitudinal bearer members *f* in the reciprocation of the grate units and the upper portion of the said extensions being formed by upstanding parts, the upper surfaces *i*⁶ of which are flat or plane and are disposed at a level slightly above the upper surface of the upper bricks of the several units. At the lower ends the metal members are provided with extensions *i*⁷ of the upper lateral flanges *i*¹, (Figures 1(b) and 3(b)), which extensions form aprons adapted to rest upon the corresponding surfaces of the longitudinal bearer members *f* and the lower supporting frame member *d*. The lateral longitudinal bearer members *g* are provided at the upper ends with channel section extensions *g*³ the upper and lower flanges of which respectively align with the portions of the members *i* formed with the surface *i*⁴ and *i*⁶.

The alternate units of the grate are adapted to have a reciprocatory movement in opposite directions, the longitudinal metal members *i* of the units being adapted to slide by means of their lateral flanges *i*¹ upon the upper flanges *f*¹ of the longitudinal bearer members *f*, and by means of the apron *i*⁷ at the lower end and the extension *i*³ at the upper end respectively upon the lower and upper supporting frame members *d*, *c*. The movement of the longitudinal metal members is effected from a pair of transversely disposed oscillatory shafts *k*, *l* suitably carried in bearings mounted upon bearer frame members *m* fitted to the framework of the furnace setting. The said shafts are geared by means of interengaging pinions *k*¹, *l*¹ mounted thereon and respectively carry upstanding arms *k*², *l*² (Figures 1(a) and 4) disposed at intervals along their length, the arms

of one shaft being in staggered relation to the arms of the other shaft. The said arms serve respectively to engage connecting links n pivoted by hinge-like connections to the upper extensions i^3 of the longitudinal metal members i , the outer ends of the arms conveniently passing through slots formed in the said connecting links. The shafts are given a movement of rotary reciprocation or oscillation from a crank shaft o disposed parallel thereto and provided with a connecting rod o^1 which is engaged with a downwardly extending arm o^2 mounted upon the shaft l , the engagement being effected in such manner that the angular travel of the shafts can be adjusted. For this purpose the said arm is conveniently provided with a series of holes o^3 in any one of which may be engaged a removably mounted pivot spindle connecting the connecting rod to the said arm. The crank shaft o is conveniently rotated through reducing gear o^4 from a worm and worm wheel drive o^5 receiving a movement of rotation from a cone pulley o^6 rotated through a belt drive from a second cone pulley o^7 mounted upon the driving shaft of an electric motor o^8 . Other means of effecting the oscillation of the said shafts may, however, be employed. Thus, an arm upon one of the said shafts may be connected by a connecting rod with an arm upon a driven shaft disposed parallel with and below the said oscillatory shafts, the said driven shaft being oscillated through an arm secured thereon which is oscillated through a connecting rod from a hydraulic engine in a manner similar to that hereinafter described with reference to Figure 12.

For the feed of the fuel to the furnace grate there is provided at the upper end upon a suitable supporting framework, as upon the members m , a feed chute p in the form, for example, of a hollow fitting of rectangular cross-section, the width of which increases in the downward direction on the side adjacent the grate and which is there provided with an opening p^1 for the passage of the fuel on the grate. The bottom of the chute is formed by an apron plate p^2 the lateral edges of which are formed with downwardly extending walls p^3 which slide upon slideways m^1 provided upon a supporting framework, such as the members m , at the same inclination as the inclination of the grate, the apron plate p^2 being disposed between the lateral walls of the chute p . The forward and main part of the body of the plate advantageously is disposed at a slightly increased inclination and is so formed that at its forward end it comes to lie closely upon the upper surfaces of the extensions i^3 of the movable longitudinal members and to project beyond the said surfaces slightly above the first bricks carried by the moving longitudinal members. The apron is pinned to the said surfaces of those moving longitudinal members which have movement in the same direction so that the movement of the said members is imparted to the apron. The lateral walls of the chute adjacent the apron are lined with lining plates q , the lower edges of which engage the upper edges of the lateral walls p^3 of the apron or bevelled ridges p^4 provided thereon, the said lining plates having their upper edges also bevelled to prevent accumulation of the fuel thereon and being removable for replacement upon wear. As shown, the forward part q^1 of the lining plates is advantageously reduced in thickness and height to receive a cover or surface plate q^2 of cronite or similar material specially adapted to resist wear. The upper and forward edges of the plate q^2 are extended later-

ally to engage over the corresponding edges of the part q^1 of the plate q . The upper edge of the part q^1 is also reduced in thickness at q^3 (Figures 11 and 14) to form a recess to receive a downwardly extending portion q^4 on the upper edge of the plate q^2 . At the upper end the apron plate p^2 extends beyond the wall of the chute through an opening p^5 which is closed by a plate p^6 (Figures 1(a) and 6) which is adjustable upon the wall of the chute by means of bolts p^7 engaging slots p^8 (Figure 4) in the plate so as to lie in close proximity to the upper surface of the apron or at any desired distance therefrom. The chute receives the fuel to be fed to the grate from a superposed sheet metal fitting or hopper r having at the upper end a sealing ring r^1 for forming a sealed junction with a sealing ring r^2 on a supply hopper, conduit or the like from which the fuel is supplied. At the lower end the said fitting r may be provided at one side with an opening r^3 closed by an adjustable inspection door r^4 . The fitting may further be provided with baffle or distributing plates r^5 disposed therein for determining the distribution of the fuel into the chute p .

At the lower end of the grate the transverse supporting frame member d is advantageously extended outwardly to form a discharge plate as at d^1 upon which the ash may be received, such discharge plate extending outwardly through a door or opening in the wall of the combustion chamber. At the forward side the said member is formed with an upstanding rib d^2 forming to the rear a channel d^3 . The rib d^2 is formed with recesses d^4 at positions corresponding to the positions of the longitudinal bearer members f which are formed with hooklike ends to be received into the recesses d^4 and engage in the channel d^3 .

The upper lateral flanges f^1 of the bearer members f of the grate may be provided at intervals with projections or bosses f^2 (Figures 5 and 13) of slight thickness which serve as guides in the movement of the movable members of the grate to prevent lateral displacement. It is advantageous also that the movable longitudinal members i should be formed in connected sections in such manner as to permit freedom for expansion that is not present where the said members are formed integrally. A convenient construction consists in first forming the members integrally, then dividing them into sections by saw-cuts and joining the sections by fish plates i^8 (Figures 1(a), 1(b), 3(a), 3(b) and 5) applied below the sections and connected therewith by bolts passing through transversely elongated bolt holes. Orifices may be formed in the fish plates to correspond with the air holes i^2 of the members i . Figure 12 illustrates an example of a modification of the grate in which the bricks j are of tapering form so that the brick surface of the grate units tapers throughout the length of the grate. This figure also illustrates a construction in which the movable grate units have a like movement, all the units being operated from a single shaft s through arms s^1 thereon, the shaft s being oscillated through an arm s^2 from a hydraulic engine s^3 .

It will be understood that the invention is not limited to the particular features that are hereinbefore described. Thus, the series of bricks appertaining to a single unit may be constructed in such manner that the cross-section of the upper part is gradually reduced in height from the upper end of the grate to the lower end thereof. Alternatively, each brick may have a uniform depth throughout its length, but adjacent bricks

may be of reduced height in the direction of the lower end of the furnace so that the height of the bricks at the lower end is less than the height of the bricks at the upper end, while the intermediate bricks are stepped in height. Again, the tapered effect may be given to the metal channel in which the bricks are housed so that whilst the bricks may be uniform in size and shape their height in relation to the plane of reciprocation will be less at the lower end than at the upper end. Again, instead of each grate unit being given a reciprocatory movement in opposite directions, they may be given a movement in the same direction, but with a time interval between the reversal of direction, or alternate units of the grate only may be given a reciprocatory movement relatively to the remaining units which remain stationary.

The air introduced into the air supply chamber for passage through the grate as combustion air may be supplied under pressure, and such pressure may be generated by pumps or blowers which may be operated from the same source of power as that employed for effecting movement of the grate units or of the grate units and the feed apron.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. A furnace grate, comprising spaced longitudinal bearer members, grate bar elements of hollow section interposed between and supported upon said bearer members, and bricks of refractory material seated within the said grate bar elements, the grate bar elements, refractory bricks and bearer members together forming an unbroken surface for the support of the fuel, and the grate bar elements being provided with openings for the passage of air from below the grate to the under side of the bricks and the bricks being provided with outlet passages for the air opening laterally above the grate bar elements and connected with the under side of the bricks.

2. A furnace grate, comprising spaced longitudinal bearer members, grate bar elements of hollow section interposed between and supported upon said bearer members, and bricks of refractory material seated within the said grate bar elements, the grate bar elements, refractory bricks and bearer members together forming an unbroken surface for the support of the fuel, and the grate bar elements being provided with openings for the passage of air from below the grate to the under side of the bricks and the bricks being provided with outlet passages for the air extending outwardly and downwardly and opening laterally of the bricks above the grate bar elements and connected with the under side of the bricks.

3. A furnace grate, comprising spaced longitudinal bearer members, grate bar elements of hollow section interposed between and supported upon said bearer members, and bricks of refractory material seated within the said grate bar elements, the grate bar elements, refractory bricks and bearer members together forming an unbroken surface for the support of the fuel, and the grate bar elements being provided with openings for the passage of air from below the grate to the under side of the bricks and the bricks being provided with lateral outlets for the air posi-

tioned to prevent the entry of fuel into the bricks and connected with the under side of the bricks, and means for imparting to certain of the grate bar elements a reciprocatory movement relatively to the longitudinal bearer members.

4. Furnace grates according to claim 3, in which adjacent grate bar elements have imparted to them a movement of reciprocation in relation to the longitudinal bearer elements in opposite directions.

5. A furnace grate, comprising spaced longitudinal bearer members, grate bar elements of hollow section interposed between and supported upon said bearer members, bricks of refractory material provided in series and seated within the grate bar elements, and means for imparting to certain of the grate bar elements a reciprocatory movement relatively to the longitudinal bearer members, the grate bar elements, refractory bricks and bearer members together forming an unbroken surface for the support of the fuel, the bricks of each series of refractory bricks being formed to impart movement to the fuel along the grate upon the reciprocatory movement of the corresponding grate bar elements, and the grate bar elements being provided with openings for the passage of air from below the grate to the under side of the bricks, and the bricks being provided with lateral outlets for the air positioned to prevent the entry of fuel into the bricks and connected with the underside of the bricks.

6. A furnace grate, comprising spaced longitudinal bearer members, grate bar elements of hollow section interposed between and supported upon said bearer members, bricks of refractory material seated within the grate bar elements, and means for imparting to certain of the grate bar elements a reciprocatory movement relatively to the longitudinal bearer members, the said grate bar elements being provided of a form to facilitate the feed of fuel along the grate in their movement of reciprocation, the grate bar elements, refractory bricks and bearer members together forming an unbroken surface for the support of the fuel, and the grate bar elements being provided with openings for the passage of air from below the grate to the underside of the bricks and the bricks being provided with lateral outlets for the air positioned to prevent the entry of fuel into the bricks and connected with the underside of the bricks.

7. A furnace grate, comprising spaced longitudinal bearer members, grate bar elements of hollow section interposed between and supported upon said bearer members, a series of bricks of refractory material carried upon each of the said grate bar elements, means for imparting to certain of the grate bar elements a reciprocatory movement relatively to the longitudinal bearer members, a supply receptacle at the charging end of the grate for the feed of the fuel thereto, an apron-like element at the lower end of the said supply receptacle, the said apron-like element extending over the charging end of the grate bar elements and the refractory bricks carried thereon and having a movement relatively to the supply receptacle and the grate, and passages permitting the supply of air from the under side of the grate to the upper surface thereof, the said passages being of a form to prevent the entry of fuel therein.

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