Oct. 25, 1932. J. J. BUCKLEY 1,884,557

FUEL GRATE

Filed Feb. 8, 1929

Fig. 1,

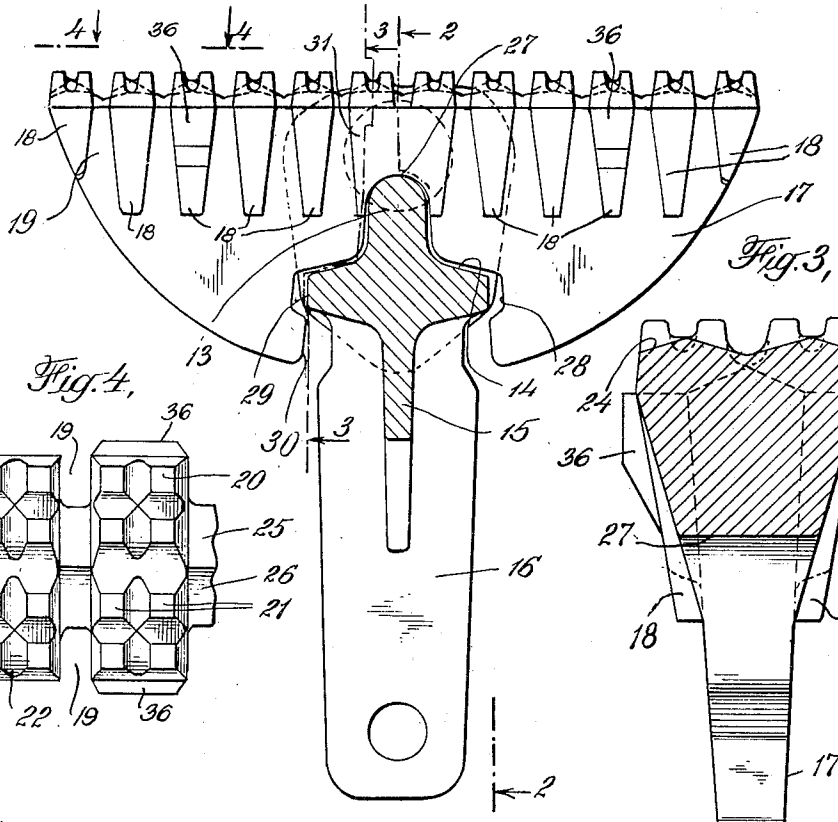
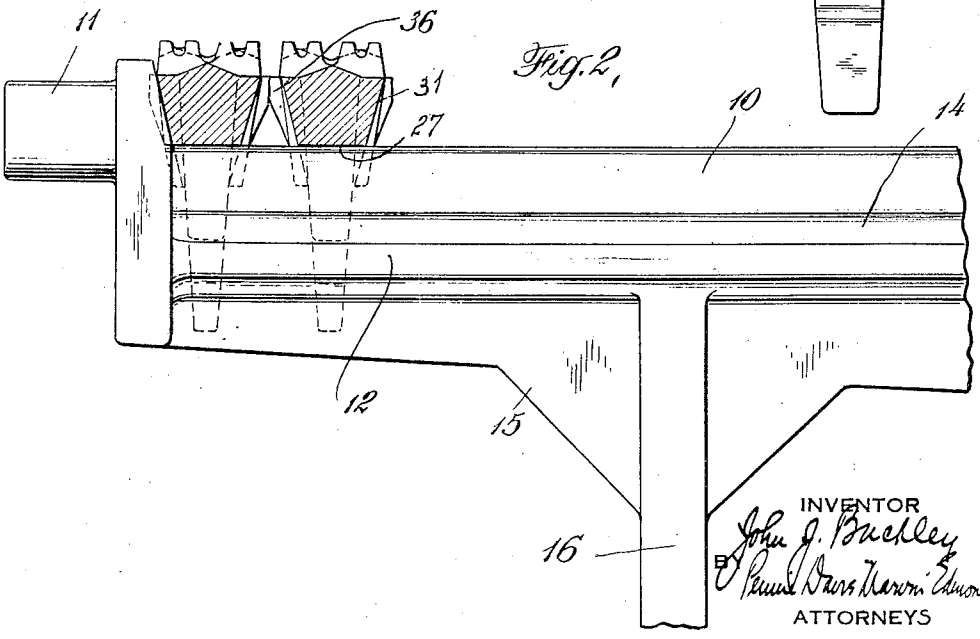


Fig. 3,

Fig. 4,

Fig. 2,



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FUEL GRATE

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This invention relates to fuel grates and is concerned more specifically with a grate bar of novel construction especially adapted for use in boiler furnaces, locomotive fire boxes, etc.

The grate bar of the invention includes numerous novel features which give it many advantages over bars of the type now in common use. It permits the fuel to be burned more efficiently by reason of a better distribution through the fuel bed of the air required for combustion, it has a longer life because of the better cooling action of the air which comes into wider contact with the parts of the bar which come in contact with the burning fuel, and it is so constructed that the parts which support the fuel are formed in units which are readily removable and replaceable without the necessity of taking the bar out of its supporting structure. In addition, a grate formed of these bars is to a considerable extent self-cleaning and the bars may be made in different forms for burning different sizes and kinds of coal, the feature of replacement permitting the grate to be changed over at a small labor charge.

The new bar comprises a central longitudinal member provided with the usual trunnions and a plurality of cross-bars extending beyond the edges of the member. These cross-bars preferably have the form of a plate with a plurality of spaced lugs on each side thereof, the adjacent lugs defining vertical passages through which air may flow from the ash pit to the bed of fuel. The fuel is not supported in the customary manner on flat surfaces of substantial area which shield portions of the bed and prevent air entering it, but, on the contrary, the plate and cross-bars are provided with groups of spaced projections which are separated by substantially horizontal air channels, the tops of the projections forming fuel supporting surfaces. In one convenient form of construction, each lug and a portion of the plate adjacent thereto is provided with a group of four of these projections, and the projections in this group are separated by air channels extending at right angles to each other, one of the channels connecting at each end with an air passage at either side of the lug so that air may flow through the channels to enter the fuel bed between the projections. Along the median line of the plate is another air channel which separates the groups of projections associated with oppositely disposed lugs and this arrangement of projections and channels brings about a wide distribution of air through the fuel bed with few dead spaces.

In the preferred construction of the new grate bar, the cross-bars are separate from the longitudinal supporting member and are single units formed by casting. The cross-bars rest loosely on the supporting member so that they are readily removable but when the member is rocked to remove ashes, the cross-bars move relatively to the member and parts of the cross-bars and the member come into locking engagement. For this purpose, the supporting member comprises a web from which projects an upright flange and the plate portion of each cross member has a recess, the shape of which corresponds generally to the cross section of the supporting member. The shape of the recess is such, however, that upon rocking of the grate bar, the cross-bar may have an angular movement relative to the supporting member or carrier. The cross-bar is also provided with a pair of locking lugs, one at each side of the axis of the carrier and so placed that when the carrier is tilted and the cross-bar moves relatively thereto, one of the lugs moves beneath a portion of the carrier and prevents the cross-bar from being dislodged therefrom. Because of the relative movement of the cross-bars with respect to the member, a grate made of these bars is self-cleaning to a substantial extent when employed, for example, in a locomotive where the structure is subjected to repeated jars.

In addition to these features, the new bar includes numerous others which will be pointed out specifically in the detailed description to follow. For a better understanding of the invention, reference may be made to the accompanying drawing in which

Fig. 1 is a transverse sectional view of the new grate bar;

Fig. 2 is a view partly in section and partly in elevation on the line 2—2 of Fig. 1;

Fig. 3 is a sectional view on the line 3—3 of Fig. 1, and

Fig. 4 is a fragmentary plan view on the line 4—4 of Fig. 1 on an enlarged scale.

Referring to the drawing, the grate bar is shown to consist of a supporting member, generally designated 10, this member being provided with trunnions 11, one at each end, so that the bar may be mounted in the usual supporting frame and rocked or tilted in that frame in order to dump the fire. The supporting member includes the horizontal web 12, from the upper face of which projects a central flange 13, this flange having a rounded top. The top surfaces 14 of the web are inclined upwardly to a slight extent toward the place where they merge with the flange 13, as illustrated more clearly in Fig. 1. Formed integral with the web on its under surface and extending from end to end is a strengthening rib 15 and at any convenient point, the bar has the usual shaker arm 16 which may be connected to a shaker rod by which all of the grate bars in a grate are connected so as to be rocked at the same time. The trunnions 11 are somewhat offset from the web 12 for a purpose presently to be described.

Mounted side by side on the supporting member 10 are cross members which support the bed of fuel. Each cross member consists of a central plate 17 somewhat semi-circular in form though other shapes may be employed. On both faces of the plate are projecting lugs 18, which are spaced apart to provide air passages 19 between them. The lugs are preferably tapered in a downward direction so that the passages decrease in size toward the top of the plate, each passage being defined by the lugs on one plate, a portion of the plate itself and similar parts on the next adjacent cross member.

Formed integrally with the lugs and projecting upwardly above the top surface of the plate are projections 20 which provide the supporting surfaces for the fuel. In the construction illustrated, four such projections are associated with each lug, each projection being square in cross section with its cross sectional area diminishing as the top of the projection is approached, so that the projection has the general shape of a truncated pyramid. As shown, the combined areas of the tops of the four projections in a group are equal to about half the area of that portion of the lug and of the plate from which the projections extend. It will be observed that the inner projections 21 of a group associated with a lug extend upwardly from a portion of the plate 17 and the spacing of the projections on opposite lugs is such that there is provided a plurality of substantially uniformly spaced supporting surfaces for the fuel. Separating the lugs of a group are channels 22 and 23 which extend at right angles to each other, the arrangement being such that air flowing up through one of the passages 19 may enter the channel 23 and pass along this channel and along the connecting channel 22 so as to enter the fuel bed over a substantial area.

The bottom surfaces of the channels are inclined as shown at 24, each half of the channel from the mid-point of the lug being inclined downwardly toward the edge of the lug as illustrated. Similarly the top of the plate 17 is formed with a pair of surfaces 25 and 26 inclined downwardly from the median line of the plate toward its opposite faces. The purpose of the inclined surfaces is to permit finely divided ash to slide off the surfaces and down through the passages into the ash pit beneath the grate.

Each cross-bar or fuel-supporting unit 17 is formed with a recess in its bottom edge having the general shape of a section of the supporting member 10, but of slightly greater dimensions so that the cross-bar may be mounted on the supporting member to rest, for example on the top of the flange 13 at 27. The side walls of the recess are cut back as at 28 and these cut-back portions have a width slightly greater than the ends 29 of the web 12 of the supporting member, the cut-back portions serving to define lugs 30 at the open end of the recess. When the cross-bar is in place on the supporting member, the lugs 30 lie below the bottom edge of the web 12 of the supporting member and the distance between the lugs is such that when the supporting member is in the upright position shown in Fig. 1, the cross member may be placed in position thereon without difficulty, the web 12 passing between the lugs 30 with a fairly close fit.

The recess in the cross member is generally similar in shape to the shape of the upper portion of the web and flange of the supporting member. When the supporting member is rocked to dump the grate bar, the cross-bar remains stationary, being temporarily held against movement by the weight of the coal upon it. The supporting member consequently moves relative to the cross member until the upper portion of the flange of the cross member bears against a corresponding part of the wall of the recess in the cross-bar. Thereafter the top of the flange 27 of the supporting member tends to move in the recess in the cross-bar in a direction opposite to that in which the rocking force is applied. There is thus a lateral shift of the supporting member with reference to the cross-bar and the combined rocking and shifting movement of the supporting member is sufficient to bring one of the edges of the web of the supporting member into position beyond one of the lugs 30 of the cross-bar. The cross-bar and supporting member are thus held in locking engagement and this locking action

prevents the several cross-bars on the supporting member from being dislodged during the shaking operation.

Since the cross-bars and supporting member have a slight freedom of relative angular movement, the shaking of the grate is made easier because the fireman can rock the several supporting members to a slight degree without causing a movement of the cross-bars, but when the supporting members and cross-bars become locked together then further movement of the shaking handle causes the cross members to tilt. The play between the supporting member and its cross-bars permits the fireman to apply a sudden shock to the cross-bars which causes them to tilt. In the ordinary grate, the fuel-supporting surface with its weight of coal is moved as soon as force is applied to the shaking handle and the firebed is not benefited by the jarring that takes place in the present grate. Also, since the cross-bars are free to rock slightly with reference to the supporting members, a grate made of the new grate bars is to some extent self-cleaning, particularly when used in a locomotive where the structure is subjected to repeated jars.

In the construction illustrated, it will be noted that I make use of the central lugs of each cross-bar for strengthening means. These lugs 31 are of double width and by their use the amount of metal in the cross-bars at the point where these bars are supported on the flange 13 is increased, thus strengthening the cross-bars at the point where they are subjected to the greatest strain.

It will be apparent that in the new grate, the provision of a plurality of projections extending above the top surface of the cross-bars provides a support for the bed of fuel in which there are a relatively small number of dead spaces where air cannot reach the fuel. By the provision of air passage defined by the lugs, the air which is drawn up through the grate by the action of the draft flows with increasing velocity toward the top of the plate and then spreads out through the channels which communicate with the passages and reaches such parts of the fuel bed as are not in contact with the tops of the projections. These projections are closely enough spaced to prevent coal from dropping between them and through the grate into the ash pit and by varying the size of the projections the grate bar may be made in forms satisfactory for different sizes of fuel. I prefer to employ the projections in groups of four, as illustrated and find that this arrangement provides a satisfactory distribution of the air and support for the fuel.

In assembling a grate made of these bars, the supporting member 10 is placed with its trunnions in the usual bearings in the grate frame and then the cross-bars set on top of the member. The distance between adjacent bars is determined by means of spacing lugs 36 which are extensions of a pair of lugs 18. Preferably each cross-bar will have a spacing lug on each face near each end so that each bar has four such lugs. By varying the size of the spacing lugs, the distance between adjacent cross-bars may be controlled and this in turn determines the amount of air that will pass up through the passages and between adjacent cross-bars to the fuel bed. while the top surface of the cross-bars lies a substantial distance above the top of the flange on the supporting member, this surface is not far above the axis of the trunnions which are offset as shown. The grate bar is therefore properly balanced and not top-heavy.

With the new grate bar, the necessity of repairs is considerably less than with bars of the present construction, since the top portions of the bar which come in contact with the fuel bed are kept cool because of the distribution of the air to substantially all parts of the fuel mass. This cooling action tends to prevent burning out of the bars but if repairs and replacements of the cross-bars should be required, it is not necessary to remove the entire bar with all its cross members. Such cross-bars as have deteriorated in use are removed one by one and new ones places on the supporting member. This operation is a simple one and can be performed with but little labor. With grate-bars as heretofore constructed, the heat to which the bars are exposed is likely to burn out a portion of the bar, whereupon the entire bar must be scrapped. With the new bar, the supporting member is in a relatively cool zone and those portions of the cross-bars which lie closest to the burning fuel are well cooled by the air currents flowing past them. If, for any reason, a cross-bar in the new grate should be burned or injured so as to be unfit for use, only that cross-bar need be removed and replaced. Accordingly, there is little metal scrapped and the labor charges for repairing are low because of the ease and simplicity with which replacements can be made.

I claim:

1. A grate bar comprising a supporting member provided with trunnions at its ends, and of substantially uniform overall width from end to end, a plurality of cross-bars mounted on the supporting member and having a limited freedom of movement with reference thereto, and parts on each cross-bar lying on opposite sides of the axis thereof and normally free of said supporting member and spaced to permit said parts to clear said member when the cross-bar is removed therefrom, said parts having projections positioned to engage the member alternately to secure the cross-bar thereto as said member is rocked in opposite directions and said

cross-bar moves relatively to said member in its rocking movement.

2. A grate bar comprising a supporting member having a longitudinal web, said member being of substantially uniform overall width from end to end, a plurality of cross-bars mounted to rest on the member and movable to a limited extent with respect to said member, and projections on each cross-bar lying one at each side of said member and below the lower edge of said web, said projections normally lying free of said member and spaced apart sufficiently to permit said projections to clear said member when the cross-bar is raised therefrom, said projections being movable alternately beneath the lower edge of said web to lock the cross-bar and member together as said member is rocked in opposite directions.

3. A grate bar comprising a supporting member having trunnions at its ends, said member being of substantially uniform overall width from end to end, and a plurality of cross-bars mounted to rest on said member, and having a substantial degree of freedom of angular movement relative to said member, each cross-bar having a pair of spaced lugs lying one at each side of the member and below a part of said member when the cross-bar is in place on the member, said lugs being spaced apart a distance greater than the width of said part of the member and normally free thereof, and said lugs being alternately engageable beneath said part to limit said relative angular movement upon rocking of the member in opposite directions.

4. A grate bar comprising a supporting member which includes a web and a flange projecting upwardly between the edges thereof, said web having a substantially uniform overall width from end to end, and a plurality of cross-bars mounted to rest on said member, said cross-bars having a substantial degree of freedom of angular movement relative to said member and each cross-bar having a pair of spaced lugs lying at either side and below the lower edge of said web when the cross-bar is in place on the member, said lugs being normally out of contact with the member but movable alternately into engagement with the web upon rocking of the member in opposite directions, the engagement of a lug with the web preventing movement of the cross-bar relative to the member.

5. A grate bar comprising a supporting member which includes a web and flange projecting upwardly between the edges of the web, said web having a substantially uniform overall width from end to end, a plurality of cross-bars mounted to rest on said member and having a limited rocking movement with respect to said member, each cross-bar having a recess in which the flange and web of the supporting member are received, the walls of the recess lying clear of the flange and web throughout the major portion of said walls, and a pair of lugs one at each side of the mouth of the recess and spaced from and below the lower edge of the web when the cross-bar is in position on the member, the relative movement of the cross-bar and member when the latter is rocked causing one lug or the other to enter into locking engagement with the web.

6. A grate bar comprising a supporting member and a plurality of cross-bars thereon, each cross-bar including a plate portion and a plurality of spaced lugs projecting from opposite faces thereof, pairs of lugs on adjacent cross-bars defining air passages, and projections arranged in groups, the projections of each group extending upwardly from and as a continuation of a lug and a part of the plate portion adjacent thereto, adjacent projections in a group being separated by air channels, one of which communicates with one of said air passages at each end.

7. A grate bar comprising a supporting member and a plurality of cross-bars thereon, each cross-bar including a plate portion, and a plurality of spaced lugs projecting from opposite faces of the plate, the space between adjacent lugs providing a passage for air, and projections arranged in groups, the projections of each group extending upwardly from and as a continuation of a lug and a part of the plate portion adjacent thereto and separated from each other by air channels, and an air channel extending lengthwise along the top of the plate portion between groups of projections.

8. In a grate bar, a central longitudinal member and a plurality of cross-bars supported on and projecting beyond each side edge thereof, each cross-bar including a plate, spaced lugs on opposite faces thereof, adjacent lugs partly defining upward passages for air between them, and a pair of spaced projections extending upwardly from the top of each lug above the top of the plate, the said projections being integral continuations from the lug and the space between serving as a channel receiving air flowing up along the outer face of said lug.

9. In a grate bar, a central longitudinal member and a plurality of cross-bars supported on and projecting beyond each side edge thereof, each cross-bar including a plate, spaced lugs on opposite faces thereof, adjacent lugs partially defining a vertical passage for air, and integral projections extending upwardly from the top of each cross-bar, said projections being arranged in groups with the projections of each group lying above a lug and a part of the plate adjacent thereto, adjacent projections being separated by an air channel, certain of said channels receiving air from said passage and leading it over the top of the lugs and the top of the plate.

10. In a grate bar, a central longitudinal member and a plurality of cross-bars supported thereon and projecting beyond each side edge thereof, each cross-bar including a plate, spaced lugs on opposite faces thereof, adjacent lugs partially defining a passage for air, and projections extending upwardly from the top of the cross-bar and formed integrally therewith, said projections being arranged in groups with each group disposed between a pair of said air passages, the projections of each group being separated by intersecting air channels, one of which communicates at each end with an air passage.

11. In a grate bar, a central longitudinal member and a plurality of cross-bars supported thereon and projecting beyond each side edge thereof, each cross-bar including a plate, spaced lugs on opposite faces thereof, adjacent lugs partially defining a passage for air, the projections extending upwardly from said cross-bar and as continuations thereof, said projections being arranged in groups between said passages for air, the projections of each group being separated by intersecting air channels, one of which communicates at each end with an air passage, and an air channel along the top of the plate between oppositely disposed groups of projections.

12. In a grate bar, a central longitudinal member and a plurality of cross-bars supported thereon and projecting beyond each side edge thereof, each cross-bar comprising a plate, spaced lugs on opposite faces thereof, a group of projections extending upwardly from the top of each lug and a part of the plate adjacent thereto, the tops of all the projections lying in a plane, and air channels separating adjacent projections, and intersecting at the center of each group, said air channels inclining downwardly from said central point.

13. In a grate bar, a longitudinal member, a plurality of cross-bars supported thereon and projecting beyond the side edges of said member, and a plurality of groups of spaced projections extending upward as continuations from the upper surface of each cross-bar, the area of the top of each projection being less than the area of its base, and said groups and the individual projections of each group being separated from one another by substantially horizontal air channels, all of which receive air flowing upwardly along the sides and ends of said cross-bar.

14. A grate bar comprising a supporting member having a relatively wide portion and a relatively narrow portion lying above said wide portion, said member being of substantially uniform overall width from end to end, a plurality of cross-bars mounted on said supporting member and normally free of said wide portion, said cross-bars having a limited rocking movement relative to said member, and spaced projections on each cross-bar normally free of said supporting member, said projections alternately engaging the member upon occurrence of said relative rocking movement of the cross-bar and member in opposite directions, said engagement stopping said relative movement.

15. A grate bar comprising a supporting member of substantially uniform overall width from end to end, and a plurality of cross-bars resting thereon and free to swing on said member as an axis to a limited extent, each cross-bar having a pair of projections spaced to permit said cross-bar to be freely removed from said member, said projections normally lying clear of said member but alternately cooperable therewith to hold the member and cross-bar together as the member is rocked in opposite directions.

16. A grate bar which comprises a supporting member having a narrow portion at its top and a relatively wider portion below said top, a plurality of cross-bars mounted on said member and free to rock relative thereto to a limited extent, and a pair of spaced lugs on each cross-bar separated a distance greater than the greatest width of said relativly wide portion, said lugs normally lying free of said wide portion but alternately engaging the latter to lock the cross-bar and member together when said cross-bar and member are moved relatively in opposite directions.

17. In a grate bar, a longitudinal member, and a plurality of cross-bars supported thereon and projecting beyond the side edges of said member, each cross-bar having a plurality of spaced lugs on opposite sides thereof, and a plurality of projections extending upwardly from said cross-bar as continuations thereof and providing a fuel-supporting surface, said projections being arranged in groups of four with a pair of projections of each group lying above a lug and another pair lying above said cross-bar adjacent to said lug, said projections being spaced apart to permit the flow of air between them, and said projections of each group lying at the corners of a square.

18. A grate bar comprising a longitudinal carrier having trunnions at its ends for supporting the grate bar for rocking movement, the carrier being of substantially uniform overall width between said trunnions, and fuel-supporting units mounted transversely on the carrier and extending substantially equal distances on both sides of a vertical plane passing through the axis of the trunnions, each unit being capable of a substantial degree of angular movement relative to the carrier and having spaced locking parts normally lying completely out of contact with the carrier and on opposite sides of said plane, said parts being alternately engageable with a portion of said carrier to lock the cross-bar

thereto upon occurrence of said relative angular movement in opposite directions.

19. A grate bar which comprises a carrier having portions of different widths and with a substantially uniform overall width from end to end, trunnions at the ends of the carrier lying in a vertical plane passing through the axis of the carrier, and cross-bars mounted on the carrier, said cross-bars extending substantially equal distances on both sides of said plane and being capable of a substantial degree of angular movement relative thereto, each cross-bar having spaced lugs normally lying completely out of contact with said carrier and adapted upon occurrence of said relative angular movement in opposite directions to cooperate alternately with a relatively wide portion of said carrier to lock said cross-bar and carrier together.

20. A grate bar which comprises a carrier having portions of different widths and having a substantially uniform overall width from end to end, a plurality of cross-bars mounted on the carrier and capable of a substantial degree of angular movement relative thereto, each cross-bar having spaced lugs normally lying completely out of contact with said carrier and on opposite sides of a vertical plane passing through the axis thereof, said lugs upon occurrence of said relative angular movement in opposite directions engaging beneath a relatively wide portion of said carrier to limit said angular movement and lock said cross-bar and carrier together.

21. In a grate bar, a fuel-supporting unit which comprises a plate having side walls converging downwardly from the top, said plate having a row of spaced lugs extending from at least one face thereof and a plurality of projections extending upwardly therefrom, said projections being arranged in groups with air channels separating the projections of a group and larger air channels separating the groups, said channels receiving air flowing upwardly along said unit with certain of said channels communicating with the spaces between adjacent lugs.

22. In a grate bar, a fuel-supporting unit which comprises a plate having a row of spaced lugs extending from at least one face thereof to define vertical air passages, said plate having a fuel-supporting top made up of small projections separated by air channels, said projections in part forming upward continuations of said lugs with each lug terminating at its top in at least a pair of said projections, certain of said projections forming upward continuations of said plate.

23. A grate bar which comprises the combination of a carrier, having a substantially uniform overall width between its ends, and a plurality of fuel-supporting units mounted thereon, each unit being capable of a substantial degree of angular movement relative to said carrier and having spaced lugs lying at opposite sides of a vertical plane passing through the axis of the carrier and under normal conditions completely out of contact with said carrier, said lugs being alternately engageable with the carrier upon occurrence of said angular movement in opposite directions to limit said relative angular movement of the carrier and unit.

24. A grate bar which comprises the combination of a carrier, having a substantially uniform overall width between its ends, a plurality of fuel supporting units mounted thereon and capable of a substantial degree of angular movement relative to said carrier, and means on said units cooperating with said carrier for preventing dislodgment of said units from said carrier, said means including projections on each unit lying on opposite sides of a vertical plane passing through the axis of the carrier and under normal conditions completely out of contact with the carrier, but alternately engageable therewith upon occurrence of relative angular movement of the carrier and unit in opposite angular directions, the engagement of one or the other of said projections with said carrier terminating said relative angular movement.

In testimony whereof I affix my signature.

JOHN J. BUCKLEY.