Feb. 14, 1928. 1,658,839

F. A. FAHRENWALD

GRATE BAR

Filed April 21, 1926

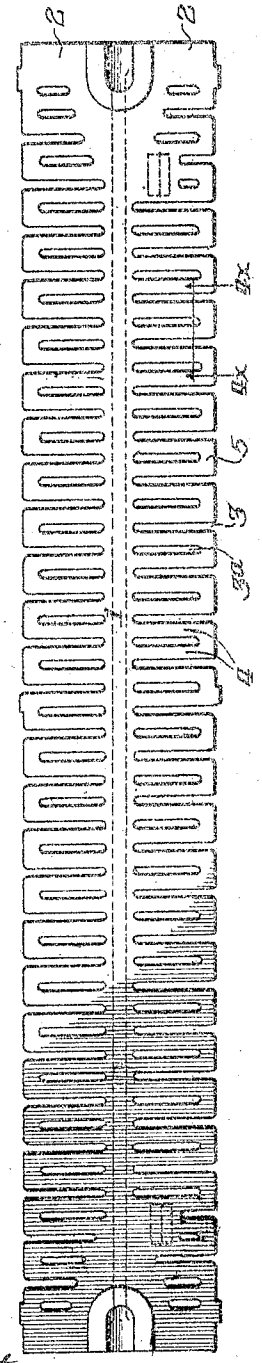


Fig. 1.

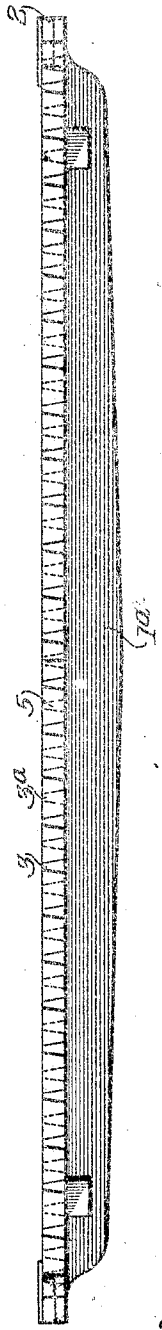


Fig. 2.

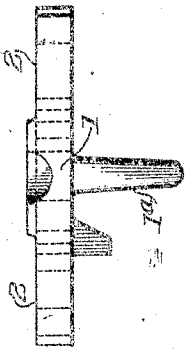


Fig. 3.

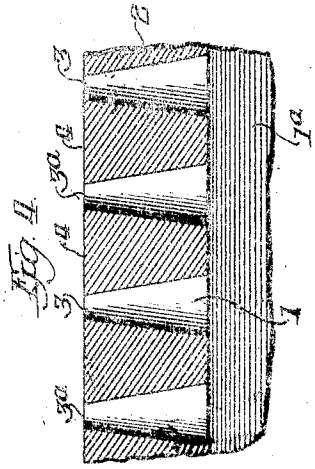


Fig. 4.

Witness:
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UNITED STATES PATENT OFFICE.

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GRATE BAR.

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This invention relates to bars to be assembled in the development of a grate upon which to burn fuel, roast ore, or carry on other industrial processes involving the heating of materials to high temperatures simultaneously with the passage of air or gases through the grate.

In all processes of the kind referred to, great difficulty has been encountered in preventing the grate bars from becoming excessively warped, and even cracked and fractured, by stresses resulting from excessive localized thermal expansion and contraction. In any solid or rigid metal member, such as an ordinary cast grate bar, the production of limited hot or cold areas will result in a corresponding expansion or contraction at the particular point involved, and if this expansion or contraction is of such an extent that it exceeds the elastic limit of the material, a permanent set, either in contraction or expansion, is produced. In most cases, stresses in excess of the elastic limit, and which are alternately stresses of compression and tension, will be produced by each temperature fluctuation. A sufficient number of these stress reversals will cause cracking at high temperatures, just as alternate stresses produce fatigue failures in metals at ordinary temperatures. Moreover, if the grate is not entirely rigid, it will attempt to adjust itself to the dimensional changes referred to by warping or bending from its original shape.

Many attempts have been made to meet the problem presented by the conditions above referred to. It has been proposed to subdivide the lateral portions of the grate bars on opposite sides of a middle longitudinal portion into transversely extending finger-like projections, or in such a manner as to develop interrupted margins which prevent transmission of stresses of expansion and contraction longitudinally of the bar, and it has even been proposed to connect up the outer ends of these lateral portions of the bar in pairs or groups and develop so-called parallelograms or rectangular or diagonally designed frame work for the sake of sustaining them. But none of the attempts heretofore made to meet the difficulty, so far as I am aware, have been successful because even where transversely extending finger-like subdivisions of the shelves have been joined by longitudinally extending integral portions, the fingers have been connected in such large groups or else the thickness of the fingers were so great, compared with their length, as to defeat the object of relieving the middle longitudinal portion of the grate bar from stresses; and even when the fingers were connected in pairs, fingers of a pair were so widely spaced that there was too great an opportunity for difference in temperatures between them; longitudinal expansion of one relatively to the other acted upon the other through excessive leverage of the long connecting portion, thereby producing objectionable transverse stresses in the cooler finger; and the excessive length of the connecting portion, by its own expansion, introduced objectionable transverse stresses in the fingers which it connected; and thus the design failed to insure the results which are the aim of my invention.

The present invention proceeds upon the principle of so designing, spacing, and connecting up the outer ends of adjacent subdivisions or finger-like portions of the lateral shelves of a grate bar, that these subdivisions or portions, hereinafter referred to as "fingers", will be connected only in pairs; while designed with any desired depth to insure vertical sustention of their load, they will be very much greater in length than in width; they will be spaced apart a distance substantially less than their width and very greatly less than their length; and the portions which connect their outer ends will, by reason of the reduced spacing of the fingers, be so short that differential longitudinal expansion in the connected fingers, which is necessarily reduced by their closeness together, will be transmitted through such a short leverage as to be largely absorbed by a component of longitudinal tension as well as transverse flexure in the cooler fingers; moreover, the thickness of the portion which connects the outer ends of the fingers is greater than the space which it bridges; a substantial advantage incident to the expedient arising from the fact that it involves a closeness of spacing of the fingers or subdivisions which renders the bar peculiarly well adapted for sintering or roasting ores.

The invention is realized by transversely slotting the longitudinally extending shelves which project laterally from opposite sides of a middle supporting spine, thereby developing closely spaced fingers and preventing development of objectionable stresses from localized expansion or contraction of the fingers; the fingers being united in pairs by connecting yokes integral with their outer ends, and these connecting yokes having a dimension transverse to the bar, or in the direction of the length of the fingers, which is large relatively to the space which the yoke bridges, so that differential expansion or contraction of the two connected fingers, instead of developing serious stresses in the connecting yoke, will be absorbed in longitudinal elasticity as well as transverse resiliency or flexing of the fingers theinselves, and will have insufficient capacity to seriously stress the middle member or spine; moreover, the pairs of connected fingers on one side are offset longitudinally of the bar relatively to the pairs on the other side, so that the distance from an open slot on one side to an open slot on the other side is at a substantial angle to the transverse dimension of the middle member, and therefore offers much greater resistance to fracture of the middle member.

The preferred embodiment of the invention is illustrated in the accompanying drawing, in which—

Figure 1 is a top plan view of a grate bar embodying in its construction the several features of the invention.

Figure 2 is a side elevation of the same.

Figure 3 is an end view; and

Figure 4 is a section on the line 4^x—4^x of Figure 1, but on an enlarged scale.

1 represents the middle member or spine of the bar, which is designed with a deep sustaining flange 1^a on its underside, and 2 represent the longitudinally extending shelves laterally disposed to and integral with the spine 1 and affording a main supporting area of the bar. The shelves 2 are subdivided by transverse slots 3 and 3^a into a series of fingers 4, so that there can be no stresses due to expansion or contraction in the direction of the length of the shelves at their outer margins, or any serious differential in dimension developed between the outer portions of the shelves and the middle sustaining member, as in grate bars with uninterrupted marginal portions. The slots 3^a are closed in by yokes 5 integral with the outer ends of adjacent fingers and joining together the fingers in pairs so as to render the fingers mutually sustaining; but these closed slots are quite narrow in order that the dimension of the connecting yokes in the bridging direction may be short, and the dimension transversely to the bar relatively large, and thereby cause stresses developed by unequal expansion or contraction of two connected fingers to be absorbed in the fingers themselves as flexing influences, and reduce to a minimum transverse stresses on the middle member or spine. Moreover, the pairs of connected fingers on one side are offset in the direction of the length of the bar relatively to those on the other side so that the enclosed slots 3^a on one side, in the preferred embodiment, are in alignment with the open slots 3 on the other side; and for this reason, the open slots 3 are of the same width as the enclosed slots. In other words, in order to maintain symmetry of design on both sides of the middle, and insure dissipation of stresses throughout the bar, the fingers are all closely spaced, and all the slots are narrow. A substantial advantage arising from the narrowness of slots is that the bar is particularly adapted to serve as a member of a grate used for roasting or sintering ores, although it is not restricted in its usefulness to this purpose.

I claim:

1. A grate bar, comprising a middle longitudinal sustaining spine, and broad longitudinally extending shelves laterally related to and integral with said spine; said shelves being slotted transversely, thereby interrupting thermally developed stresses in the shelves in the direction of the length of the bar, and subdividing each shelf area into a series of closely spaced fingers projecting from the spine; said fingers being united in pairs by connecting yokes integral with their outer ends; said connecting yokes having a dimension transverse to the bar which is greater than the width of the slots which they bridge; the width of the fingers being greater than the width of the said slots, and the length of the fingers being materially greater than their width.

2. A grate bar, comprising a middle longitudinal sustaining spine, and broad longitudinally extending shelves laterally related to and integral with said spine; said shelves being composed of transversely extending fingers of substantial width connected together at their outer ends in pairs, with the fingers of each pair independent of and free from expansional influence over the fingers of the other pairs; the fingers of each pair being spaced apart a distance materially less than the width of a finger, and the length of the fingers being materially greater than their width.

3. A grate bar, comprising a deep middle longitudinally extending sustaining spine, and broad longitudinally extending shelves laterally related to and integral with said spine; each shelf being subdivided into a series of fingers by uniformly spaced narrow transverse slots, the fingers being united in pairs, and the slots between the fingers of the several pairs being enclosed by yokes

of metal integral with the outer ends of the fingers; the slots between the several pairs being left open at their outer ends; the slots between the fingers of each pair being materially less in width than the width of said fingers, and the length of the fingers being materially greater than their width; and the enclosed slots on one side of the spine being in alignment with the open slots on the other side thereof.

Signed at Chicago, Illinois, this 14th day of April, 1926.

FRANK A. FAHRENWALD.