June 23, 1942. H. S. NAGIN 2,287,558

GRATING STRUCTURE

Filed May 21, 1938 2 Sheets-Sheet 1

Fig. 1.

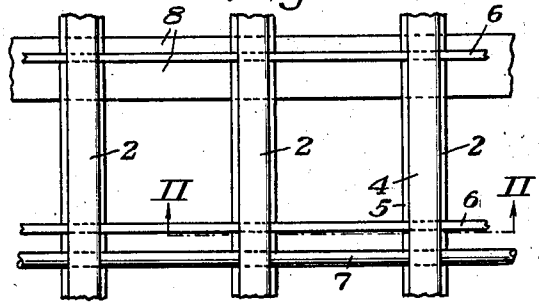


Fig. 2.

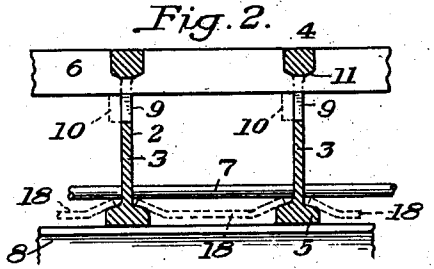


Fig. 3.

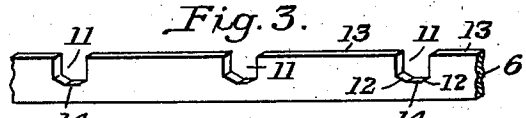


Fig. 4.

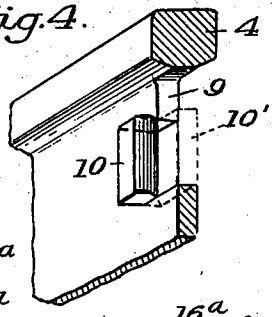


Fig. 5.

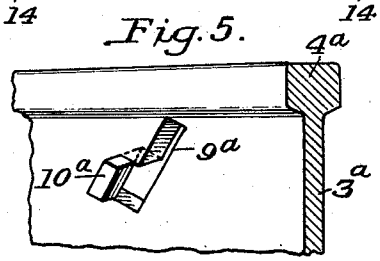


Fig. 6.

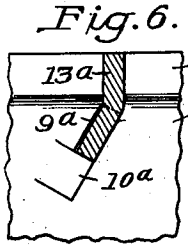


Fig. 9.

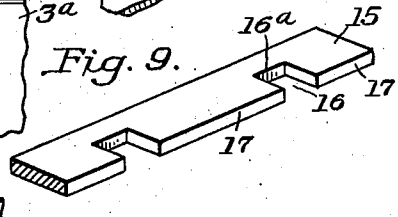


Fig. 7.

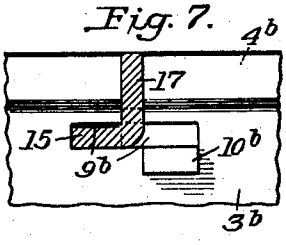


Fig. 8.

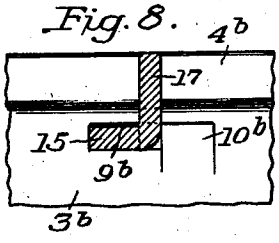


Fig. 12.

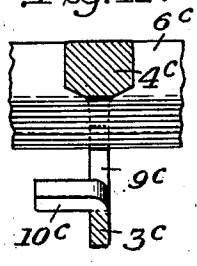


Fig. 10.

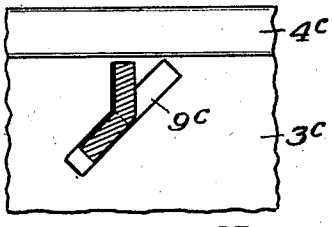


Fig. 11.

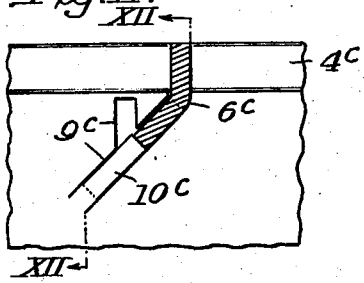
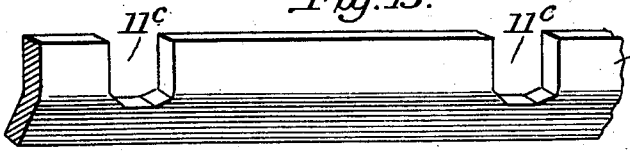


Fig. 13.



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By Stebbins Blenko & Carmelee

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GRATING STRUCTURE

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Fig. 14.

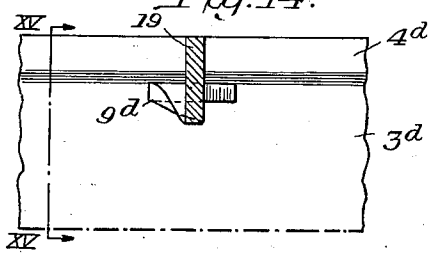


Fig. 15.

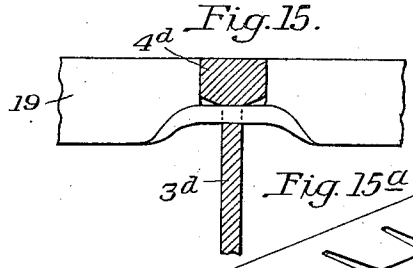


Fig. 15a

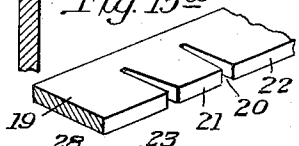


Fig. 16.

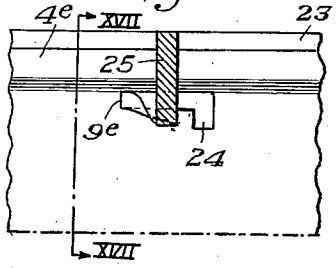


Fig. 17.

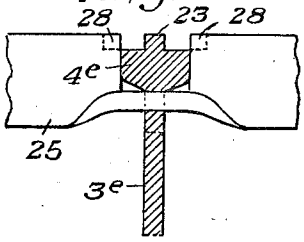


Fig. 18.

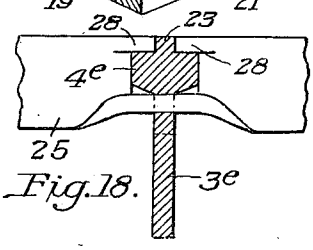


Fig. 20.

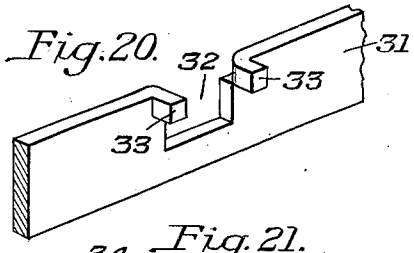


Fig. 19.

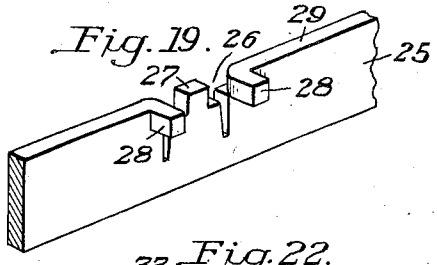


Fig. 21.

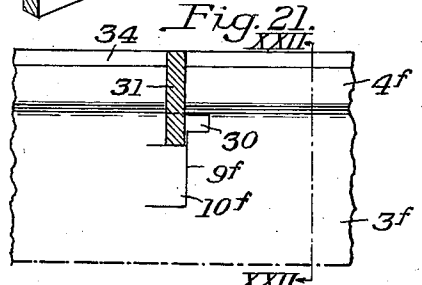


Fig. 22.

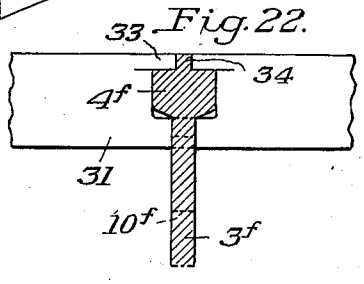


Fig. 23.

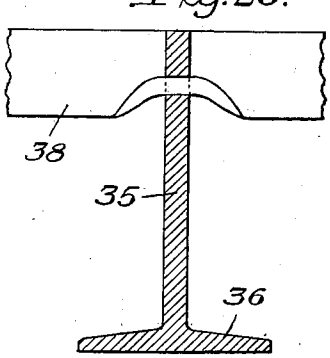


Fig. 24.

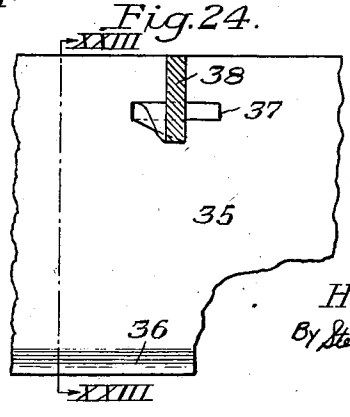
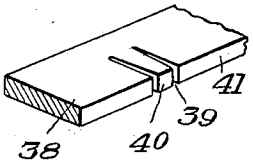


Fig. 25.



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By Stebbins, Blanchard & Parmalee

ATTORNEYS

Patented June 23, 1942 2,287,558

UNITED STATES PATENT OFFICE

2,287,558

GRATING STRUCTURE

Harry S. Nagin, Pittsburgh, Pa., assignor to Reliance Steel Products Company, Rankin, Pa., a corporation of Pennsylvania

Application May 21, 1938, Serial No. 209,255

4 Claims. (Cl. 189—82)

This invention relates to grating structures and is particularly applicable to grating structures such as are used for reinforcing in bridge floors, runways, vault covers, loading platforms, stair-treads and in other locations. The grating structure may be used with or without a filling of concrete or other material.

It is the common practice at present to form bridge floors and the like by laying previously assembled units or slabs over a skeleton supporting structure, such as the sills or stringers of a bridge. Such units or slabs of a convenient size are fabricated in the shop from metal elements and after assembly in position in the structure, the units or slabs are usually welded together to form a continuous floor. Each unit in general is made of spaced apart bearer bars of a desired size and shape secured together by transverse cross bars usually at the top. In many structures bottom cross bars are also used. The tops of the cross bars and the top bearer bars are usually in the same plane and serve as surface armoring when a filling material is employed. After assembly, the spaces between the various bars of the slab are commonly filled with concrete or other material, although in some instances the structure is used without a filling as an "open mesh" floor.

It is a fairly wide spread practice in the art to secure the bearer bars and cross bars together by electric pressure welding. In some instances it is preferred to join the bearer bars and cross bars by passing the cross bars through slots in the webs of the bearer bars and then to deform or fasten the bars together so as to make a rigid structure. According to my invention the joining of the bearer bars is accomplished by a comparatively simple arrangement of cross bars and slots in the webs of the bearer bars to form a rigid structure.

Such structures are usually subject to severe strain and it is essential that the various shearing, bending, and transverse stressses be properly distributed. It is one of the objects of my invention to provide a unit or slab which is simple and inexpensive to fabricate and erect and which will adequately resist the various stresses to which it is subjected.

By use of a structure made according to my invention, the various stresses encountered are effectively taken care of and the structure is simple and inexpensive to fabricate and erect, and the completed structure is a rigid and strong one.

In the accompanying drawings where I have shown, for purposes or illustration only, certain preferred embodiments of my invention:

Figure 1 is a fragmentary plan of a unit or slab;

Figure 2 is an elevation along the line II—II of Figure 1;

Figure 3 is a fragmentary detail of a suitable top cross bar;

Figure 4 is a fragmentary view in enlarged perspective showing a portion of a bearer bar with a vertical slot;

Figure 5 is a fragmentary view in enlarged perspective of a portion of a bearer bar with an inclined slot;

Figure 6 is a fragmentary view in elevation, showing the cross bar of the construction shown in Figure 5, in final position;

Figures 7 and 8 are fragmentary details in elevation showing a horizontal slot, and with a cross bar in position;

Figure 9 is a fragmentary view in perspective of a top cross bar suitable for use in connection with the form of slot shown in Figures 7 and 8, but to a smaller scale;

Figures 10 and 11 are fragmentary views in elevation of still another form of slot with a cross bar in various positions;

Figure 12 is a fragmentary cross section along the line XII—XII of Figure 11;

Figure 13 is a fragmentary view of a top cross bar suitable for use in connection with the form of slot shown in Figures 10 and 11;

Figure 14 is a fragmentary view in elevation of another slot and cross bar construction;

Figure 15 is a view along the line XV—XV of Figure 14;

Figure 15*a* is a fragmentary view in perspective of a top cross bar suitable for use in the construction shown in Figures 14 and 15;

Figure 16 is a fragmentary view in elevation showing still another construction;

Figures 17 and 18 are views along the line XVII—XVII of Figure 16, Figure 17 showing the construction when nearly finished, and Figure 18 showing the completed construction;

Figure 19 is a fragmentary view in perspective of a top cross bar suitable for use in the construction shown in Figures 16, 17 and 18;

Figure 20 is a fragmentary view in perspective of a top cross bar suitable for use in the construction shown in Figures 21 and 22;

Figure 21 is a fragmentary view in elevation showing still another form of construction;

Figure 22 is a view along the line XXII—XXII of Figure 21;

Figure 23 is a view along the line XXIII—XXIII of Figure 24;

Figure 24 is a fragmentary view in elevation showing still another form of construction; and

Figure 25 is a fragmentary view in perspective of a top cross bar suitable for use in the construction shown in Figures 23 and 24.

In the drawings there is shown in Figures 1 and 2 a portion of a slab or unit which consists of spaced apart longitudinally extending main bars or bearer bars 2 of a desired shape and size. The bearer bars 2 herein described and illustrated have a web 3, a head 4 and a base 5. The longitudinal bars 2 are connected adjacent their tops by cross bars 6 and the bases 5 are usually connected by cross bars 7 near the bottom of the webs. In some instances, the bottom cross bars 7 may be dispensed with. The top of the bearer bars 2 and the top of the cross bars 6 lie in substantially the same plane when assembled in the unit. For ease in fabrication and erection, units or slabs are formed in convenient sizes in the shop and are assembled in the field to form the completed structure which may rest on a support 8, for example, a stringer of a bridge. The desired number of units or slabs are placed side by side and welded together at appropriate contact points to form the flooring. The spaces in the flooring are customarily filled with concrete or other filling material, but it is to be understood that in some installations unfilled units may be used.

The web 3 of the longitudinal bearer bar 2 is slotted near the head 4. The slots may assume various forms, but all of them are so arranged as to have a locking lug associated therewith to lock the transverse top cross bars 6 in position.

In the construction shown in Figures 1 through 4 there is shown a unit in which the web slots 9 are vertical. The slots 9 are of a size to receive top cross bars 6 (Figure 3). Cooperating with the lower portion of the slot is a lug 10 stamped out of the material of the web. The transverse bars 6 are substantially rectangular in cross-section and one edge thereof has a plurality of recesses 11 with sloping bottom portions 12. The recesses 11 are shaped to conform to the shape and size of the head 4 of the bearer bars 2 and are spaced apart the same distance as the spacing of the bearer bars 2. The depth of the slots 9 is substantially the same as the depth of the bars 6, and the lug 10 is so positioned that when the cross bars 6 are raised into the final position shown in Figure 2, the top portion of the lug 10, when forced back into the slot 9, as shown in dotted lines in Figure 4, and numbered 10', contacts the bottom of the bar 6 and holds it securely in position with the bottom of recesses 11 tightly pressed against the bottom of head 4 and the top of the bar 6 is in substantially the same plane as the top of the head 4.

In assembling this unit, the longitudinal bars 2 are properly spaced and the top cross bars 6 are passed through the aligned slots 9 until the recesses 11, which are spaced apart the same distance as the space of the girder members 2, are in position to cooperate with the heads 4 of the bars 2. The top bars 6 are then raised into the position shown in Figure 2 where the tops of the cross bars and the tops of the girder bars 2 are in substantially the same plane. The lugs 10 are then forced back into the slots 9 to lock the cross bars 6 securely in position.

The bottom parts of the bearer bars 2 may be secured together by bottom transverse bars 7 which may conveniently be of circular cross-section. These bars are passed through appropriate holes in the lower part of webs 3 adjacent the base 5. The bars 7 are then welded to the webs 3. If desired, the bottom cross bars 7 may be of any other section, for example, rectangular. If rectangular bars are used, they may be passed through horizontal slots in the webs 3 and after the bars 7 are in position, these portions of the bars between the adjacent bearer bars 2 are twisted through an angle of about 90°, thus locking the bottom cross bars and the longitudinal bars in fixed relation.

In Figure 5 there is shown one of the preferred constructions, in which the slots 9*a* are at an angle to the vertical. I have found an angle of about 30° to be a convenient one. Each of the slots 9*a* has associated with it a lug 10*a* formed from the material of the web 3*a*. The length and thickness of the slots is sufficient to accommodate the top cross bars 6. In this inclined slot construction, the top cross bars 6 are passed through the aligned slots 9*a* and the bars 6 are then moved upwardly along the slots until the bottoms 14 of the recesses 11 are pressed firmly against the tops of the slots 9*a*. The position of the slots 9*a* is such that when the lugs 10*a* are forced back into the slots 9*a*, the tops of the lugs contact the bottoms of the bars 6. After the bars 6 are in their uppermost position in the slots, the portions 13 between the recesses 11 are turned upwardly to a vertical position 13*a*, as shown in Figure 6. The slots 9*a* and the bars 6 are so proportioned that when the bottoms 14 of recesses 11 contact the bottoms of the heads 4*a*, the top edges of portions 13 of the bars 6, when bent upwardly to the vertical position, will be in substantially the same plane as the tops of the heads 4*a*.

In the slot construction shown in Figures 7 and 8, the slots 9*b* are substantially horizontal and have associated with them outstanding lugs 10*b* formed from the material of the webs 3*b*. The cross bars 15 (Figure 9), used in this construction, are substantially rectangular in cross-section and one edge thereof has a plurality of recesses 16, with bottoms 16*a*, formed at intervals corresponding to the spacing of the bearer bars of the slab. In assembling this construction, the bars 15 are passed through the aligned slots 9*b* in the spaced apart bearer bars. The portions 17 between the recesses 16 are then bent upwardly to a vertical position, as shown in Figures 7 and 8, and the lugs 10*b* are bent back into the slots 9*b* where they contact the corner of the bend formed in the bars 15. The size of the slots, their position in the webs and the bars 15 are all so proportioned that the bars 15 are securely held in slots 9*b* and the top edges of the portions 17 are in substantially the same plane as the tops of the heads 4*b*. This is clearly shown in Figures 7 and 8. In Figure 7 the lugs 10*b* are in the position in which the bars are first assembled and in Figure 8 the lugs 10*b* have been bent back to be received in the slots 9*b*.

In the construction shown in Figures 10, 11 and 12 there is shown inclined Y slots 9*c*, formed in the webs 3*c* as indicated. Formed in connection with these slots from the material of the webs 3*c* are lugs 10*c*. In this construction, the cross bars 6*c* are of angular shape and have recesses 11*c* formed in one leg of the angle at spaced apart intervals corresponding to the desired spacing apart of the bearer bars. In assembling this unit, the cross bars 6*c* are inserted

in the slots 9c as shown in Figure 10. The bars 6c are then moved upwardly and to the right to the position shown in Figure 11, in which position the top parts of the bar 6c are in substantially the same plane as the tops of the heads 4c. The lugs 10c are then forced back into the slots 9c where they bear against the bottoms of the bars 6c and hold them securely in position. The size of the slots, their location in the webs and the proportions of the bars 6c are all such that when the bars 6c are in the position shown in Figure 11, the bottoms of recesses 11c bear tightly against the bottoms of the heads 4c, the tops of the bars 6c are in substantially the same plane as the tops of the heads 4c and the lugs 10c bear against the bottoms of the bars 6c.

In Figures 14 and 15 there is illustrated a construction in which the webs 3d have horizontal slots 9d formed therein near the bottom of the head portions 4d of the bearer bars. Through these slots the cross bars 19, which are substantially the same size as the slots, are passed. The cross bars 19 have recesses 20 formed at intervals along one edge of the cross bar. The recesses 20 are formed so that there is a tab portion 21 in the recess, the width of the cross bars at the tab portions being uninterrupted. The recesses 20 are spaced apart a distance corresponding to the desired spacing apart of the bearer bars. In assembling this construction the cross bars 19 are threaded through the aligned slots 9d until the tab portions 21 are in register with the webs 3d of the bearer bars. The portions 22 between the recesses 20 of the cross bars 19 are then bent through an angle of approximately 90° so that the slotted edges of the cross bars 19 are in substantially the same plane as the top of the bearer bar heads 4d as shown in Figure 14. The position of the slots 9d and the depth of the recesses 20 are such that the top of the cross bars 19 and the top of the heads 4d lie in substantially the same plane when the unit is assembled. The uninterrupted width of the cross bars 19 at the tab portions insures that the slots 9d will be completely filled, preventing movement of the cross bars along the bearer bars.

In Figures 16, 17 and 18 I have shown a construction in which the bearer bars have a narrow welding rib 23 projecting vertically upward from the center of the top of the heads 4e. Through the web 3e generally horizontal slots 9e are formed. Each slot has an adjoining cut out portion 24 extending downwardly at right angles to the longitudinal axis of the slot. The cross bars 25 used in this construction have recesses 26 formed in one side thereof, the recesses having a projecting tab portion 27 and lug portions 28 as shown in Figure 19. The recesses 26 are spaced apart the same distance as the desired spacing of the cross bars with which they are used. In assembling this construction, the bars 25 are passed through the slots 9e, the lugs 28 passing through the portions 24 of the slots. The center of the tab portions are placed in line with the center line of the webs 3e of the cross bars. The portions 29 of the cross bars 25 between the recesses 26 are then bent upwardly to the position shown in Figure 17 and the lugs 28 are forced into the position shown in Figure 18 where the ends thereof are in close contact with the sides of the welding ribs 23. The proportions of the various parts of the bearer bars and the cross bars are such that the top edges of the portions 29 of the bearer bars 25 and the top of the welding ribs 23 lie in substantially the same plane.

In Figures 21 and 22 there is illustrated a construction in which bearer bars similar to those shown in connection with Figures 16, 17 and 18 are used. In this construction the slots 9f in the webs 3f are vertical and have associated with them lugs 10f formed from the material of the webs 3f. At the top of the slot there is an adjoining cut out portion 30 projecting generally at right angles to the slot as shown in Figure 21. The top of the slot is preferably situated immediately adjacent the bottom of the heads 4f and extends downwardly a sufficient distance to accommodate the cross bar 31. The cross bars 31 (see Figure 20) are substantially rectangular in cross section and one edge thereof has a plurality of recesses 32 formed at intervals corresponding to the desired spacing of the bearer bars. At the sides of the recesses 32, adjacent the top there is provided projecting lugs 33. In assembling this construction, the cross bars 32 are passed through the aligned slots 9f in the spaced apart bearer bars. The bars 31 are then moved upwardly to the position shown in Figure 21 and the lugs 10f are forced back into the slots 9f and the lugs 33 are deformed so as to contact the sides of the welding ribs 34 projecting upwardly from the heads 4f. The bars 31 are so formed and the slot 9f so shaped and positioned that when the cross bars 31 are in the position shown in Figures 21 and 22, the sides of the recesses 32 closely engage the sides of the heads 4f of the bearer bars. The lugs 33 are in close contact with the welding ribs 34 and the top of the bearer bars 31 are in substantially the same plane as the top of the welding ribs 34.

In the construction shown in Figures 23 and 24, there are provided bearer bars of inverted T shape having a web portion 35 and a base portion 36. A horizontal slot 37 is formed a short distance below the top of the web 35. This slot is the proper size to accommodate the cross bar 38 shown in Figure 25. The cross bar 38 has recesses 39 formed in one edge thereof at spaced apart intervals corresponding to the spacing of the bearer bars with which it is used. The recesses 39 have tab portions 40 therein, the width of the bar at the tab portions being uninterrupted. In assembling this construction, the bars 38 are passed through the aligned slots 37 until the centers of the tab portions 40 are in line with the center line of the webs 35. The portions 41 between the recesses 39 of the cross bars 38 are then rotated through an angle of approximately 90°. The portions of the cross bar between the bearer bars 41 will then be vertical. The location of the slot 37 and the depth of the recesses 39 are such that the tops of portions 41 of the cross bars 38 and the tops of the webs 35 of the bearer bars are in substantially the same plane in the completed unit as shown in Figure 24.

It is understood in all of the constructions illustrated that the top cross bars may be welded to the heads as shown, for example, in Figure 12, but this welding is not necessary to a rigid and strong structure. It is also understood that the recesses in the cross bars may closely follow the conformation of the heads of the bearer bars, as shown in Figure 3, or may generally follow them as shown in Figure 9.

In some instances it will be desirable to provide plates 18 between the base portion of the bearer bars to serve as bottom form plates for the concrete fill, if used. These plates 18 may rest on the base portions and, if desired, may be spot welded thereto at intervals.

While I have shown and described several specific preferred embodiments of my invention, it will be understood that I do not wish to be limited precisely thereto and that various modifications may be made within the scope of the following claims.

I claim:

1. In a grating structure a plurality of bearer bars set on edge in spaced parallel relation, said bars having a bulbous uninterrupted head portion and a web portion, aligned straight slots in the web portion adjacent the head portion and flat cross bars disposed to extend through the slots of adjoining bearer bars, the top portion of said cross bars having recesses to conform to the head portion, and a tab portion extending from the base of each recess, the bottoms of said cross bars being continuous, the cross bar having bendable portions between the recesses which project vertically upwardly in the structure, the slots being so disposed and the bars so proportioned that the cross bars in the structure extend substantially to the top of the bearer bars and the tab portions lie in the slots, the top portions of the cross bars between the bearer bars being substantially straight.

2. In a grating structure a plurality of bearer bars set on edge in spaced parallel relation, said bearer bars including a bulbous head having a rib projecting vertically upwardly from the center thereof and a web portion below the head, aligned rectangular slots in the web portion adjacent the bottom of the head, a cut out portion extending downwardly at right angles to the longitudinal axis of the slot, and rectangular cross bars extending through the aligned slots, one edge of the cross bars having recesses, the sides of which lie along the sides of the bulbous head, a tab portion projecting from the cross bar at the bottom of each recess and received in the horizontal slots of the bearer bars, and lug portions which extend into the recesses to a point adjacent the rib of the head, the bottoms of said cross bars being continuous, the cross bars having portions between the recesses which extend vertically and substantially straight horizontally between the bearer bars, the slots being so disposed and the bars so proportioned that the portions of the cross bars between the bearer bars extend substantially to the top of the ribs of the bearer bars, the tab portions lie in the slots and the leg portions extend across the edge of the bulbous head to the rib thereof.

3. In a grating structure, a plurality of bearer bars set on edge in spaced parallel relation, said bars having a web portion and a top portion, the top portion of the bars being continuous, straight aligned slots in the web portion adjacent to the top portion and flat cross bars disposed to extend through the slots of adjoining bearer bars, the tops of said cross bars having recesses to conform to the top portion of the bearer bars, and a tab portion extending from the cross bars at the base of each recess, the bottoms of said cross bars being continuous and the parts of the cross bars extending between the said bearer bars being bent upwardly to a position which is vertical when the structure is horizontal, the top portions of the cross bars extending between the bearer bars being straight.

4. In a grating structure, a plurality of bearer bars set on edge in spaced parallel relation, said bars having a web portion and a top portion, the top portion of the bars being continuous, straight aligned slots in the web portion adjacent to the top portion and flat cross bars disposed to extend through the slots of adjoining bearer bars, the tops of said cross bars having recesses to conform to the top portion of the bearer bars, and spaced apart the same distance as the bearer bars, and a tab portion extending from the cross bars at the base of each recess which registers in the slots, the width of the cross bar at the tab portion being the same as the width of the rest of the cross bar and substantially equal to the width of the slots in the web portion, said cross bars having portions extending between the recesses which are bent into a vertical plane when said grating structure is horizontal, the top portions of the cross bars being substantially straight, the bottom of each cross bar being continuous.

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