Nov. 12, 1963 H. NAGIN 3,110,049

BRIDGE FLOOR

Filed March 1, 1956 2 Sheets-Sheet 1

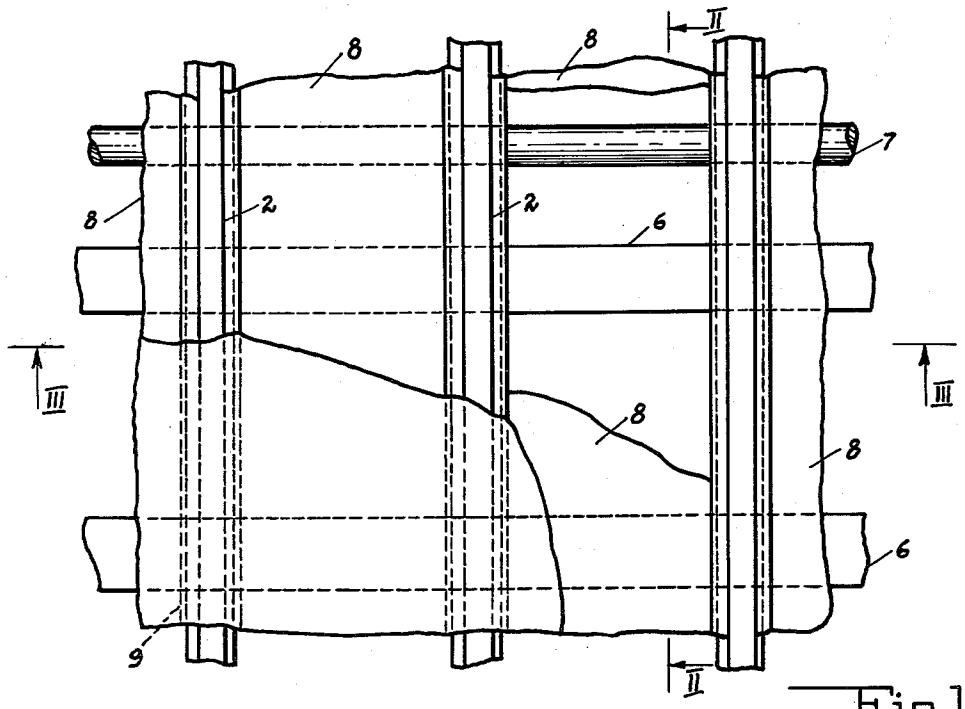


Fig. 1.

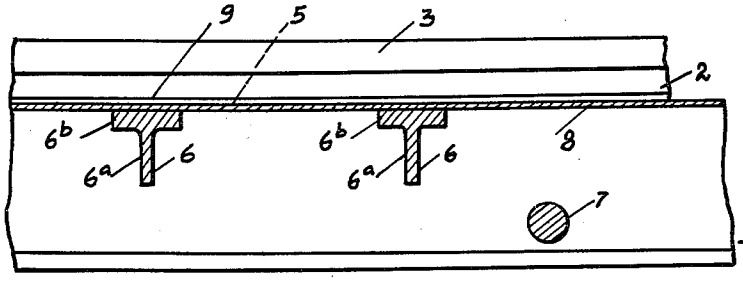


Fig. 2.

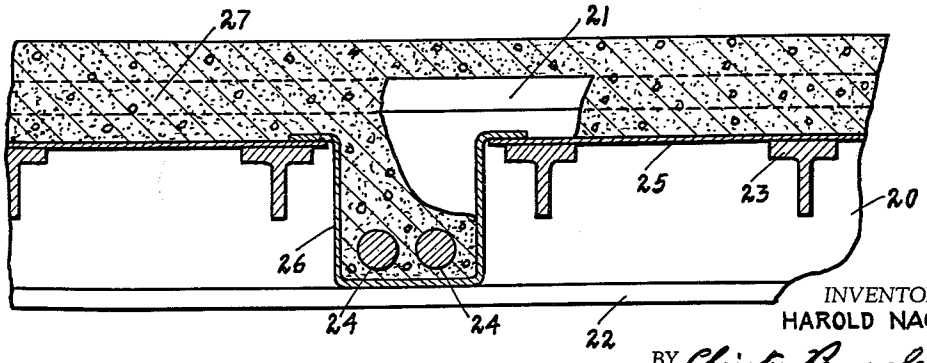


Fig. 7.

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BRIDGE FLOOR

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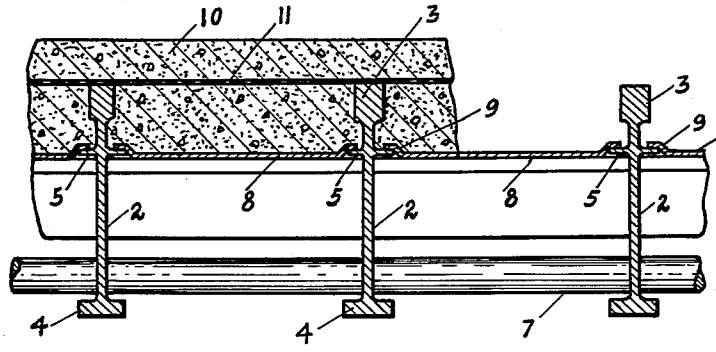


Fig. 3.

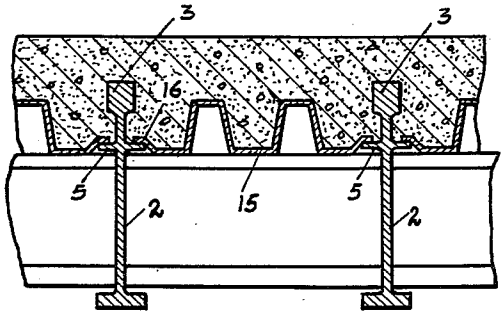


Fig. 4.

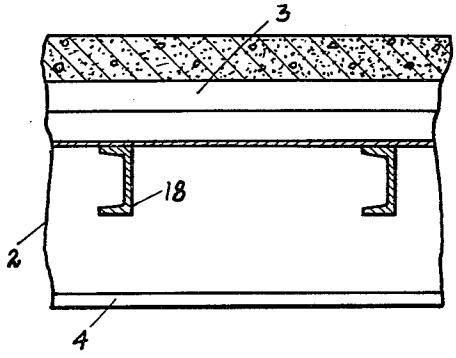


Fig. 5.

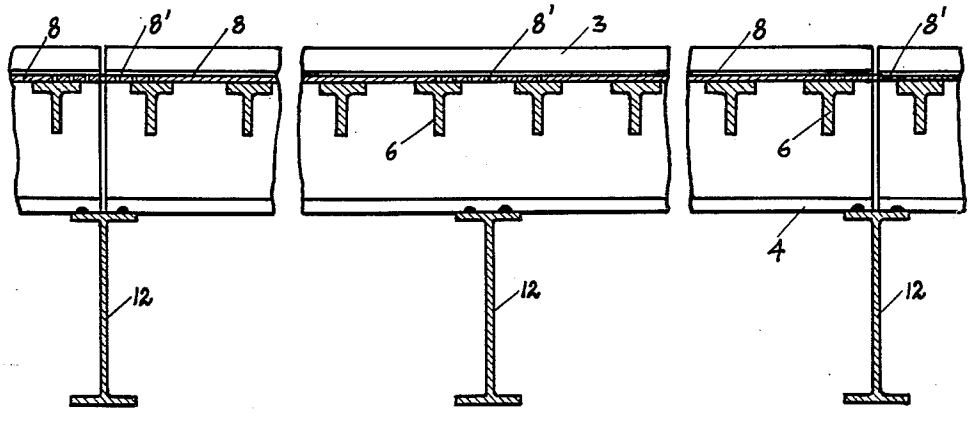


Fig. 6.

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BRIDGE FLOOR

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1 Claim. (Cl. 14—73)

This invention is for a bridge floor and more particularly to a bridge floor made up of intersecting structural sections to which is applied a surfacing material such as concrete or asphalt.

It is common practice in bridge floor construction at the present time to place metal grating over transverse stringers. Metal pans are placed between the lower edges of the main bearer bars of this grating and concrete is poured into the cells of the grating, flush with the top or above the top of the grating. The grating comprises the real traffic bearing structure, while the concrete is largely a filler to improve the riding qualities of the surface, since an open grating may be objectionable for certain conditions. The concrete is the full depth of the grating and adds substantially to the dead weight of the bridge floor while contributing little to its load-carrying capacity.

It is of course elementary that the greater the dead weight of the bridge deck, the more expensive becomes the whole bridge structure. Engineers have been constantly searching for a more effective and lighter bridge deck structure. This is required both because of the increasingly severe traffic, the increasingly high unit cost per pound of erected bridge structure in new bridges, and the need for increasing the live load-carrying capacity of existing bridges that are structurally sound but inadequate for the demand placed upon them.

The present invention has for its principal object to provide a bridge floor which is much lighter per unit of area, or which has much less weight per unit of load-carrying capacity. A further object is to provide an improved bridge floor of unique and economical construction.

In the present invention, the grating, instead of having the tops of cross bars flush with the tops of the main bearer bars as with conventional grating, has the tops of the cross bars well below the tops of the main bearer bars, at a level, for example, somewhere near the level of the neutral axis of the main bearer bars. The main bearer bars are provided with pan-supporting ledges below the tops thereof, and pans, supported by these flanges and by the cross bars, provide a support for paving material which is filled in between the main bearer bars. This provides an extremely rigid support for the paving material and the paving material is entirely above the cross bars of the grating.

The invention provides certain other improvements and advantages which will become more apparent from the following description in conjunction with the accompanying drawings.

FIG. 1 is a plan view of a section of a bridge floor with various parts broken away;

FIG. 2 is a transverse section in the plane of line II—II of FIG. 1;

FIG. 3 is a transverse section in the plane of line III—III of FIG. 1;

FIG. 4 is a fragmentary section similar to FIG. 3 showing a slightly modified form of pan;

FIG. 5 is a fragmentary view similar to FIG. 2 showing a modified form of cross member;

FIG. 6 is a more or less schematic view in the nature of a longitudinal section through a portion of a bridge floor constructed in accordance with the present invention; and

FIG. 7 is a view similar to FIG. 2 showing a further modification.

Referring to the drawings, the deck or floor of the bridge is constituted of a grating which is supported on stringers extending crosswise of the bridge at predetermined intervals in the usual manner. This grating as shown in FIGS. 1 to 3, is comprised of main longitudinally-extending load-bearing bars or sections 2 which preferably have an enlarged head portion 3 at the top and a flange 4 at the bottom. Projecting from each face of the web of the section 2 below the head 3 and near or slightly above the plane of the neutral axis of the section are longitudinally-extending flanges or ledges 5. Each section 2 therefore comprises a main web portion, a head, a base, and longitudinally-extending projecting flanges below the head. These main bearer bars are parallel with one another and are spaced from one another a distance of several inches, the spacing of course depending upon the traffic which the structure is intended to carry, but being of the order of that now generally used in bridge floor grating.

Passing through the webs of the main bearer bars 2, preferably just below the flanges 5, at intervals approximately equal to the distance between the main load-carrying bars themselves are cross bars designated 6. These cross bars are in the form of sections having a relatively wide, flat top and a depending vertical web. In FIGS. 1 to 3 the sections are indicated as being T sections having a web portion 6*a* and a head portion 6*b*. The head portions 6*b* are in a plane just below the flanges 5 of the main bearer bars so that the tops of the cross bars are close to the plane of the neutral axis of the main bearer bars 2, the exact depth not being critical. This neutral axis is roughly 40% of the distance down from the top of the main bearer bar. From about 30 to 50% of the total height of the main bearer bars is desirably above the level of the tops of the cross bars in most cases.

There is thus provided a metal grid structure in the nature of a grating, but in which the cross bars are not flush with the tops of the main bearing bars as in the conventional grating, and the cells formed by the intersecting longitudinal members and cross members are at a plane below the tops of the main bearing members, and above the cells are channels between the main load-carrying members 2.

Additionally there may be provided at less frequent intervals than the cross members 6, bottom cross members or load-distributing bars 7 which are adjacent to the bottoms of the main bearer bars.

Set in the channels between the main bearing bars are pans 8 which may be formed of sheet metal, and which have lip portions 9 that rest on top of the flanges 5 while the bottoms of these pans are supported on the tops of the cross members 6. The pans are thus supported longitudinally and transversely with the result that the area

of the pan extending over each cell of the grating is supported on four edges, or along four sides, imparting to the pan tremendous rigidity and load-carrying strength. The load-carrying strength of a pan thus supported along four sides is increased more than tenfold over a similar pan supported on only two opposite edges, as in conventional structures.

After the grating has been secured in place on the stringers and the pans have been installed, paving material such as asphalt or concrete is filled in over the pans at least to the level of the tops of the main bearer bars 3 and preferably to a level above the bearer bars 3. The overfill above the tops of the main bearer bars 3 is optional, but since no part of the grating is relied upon as providing an armored traffic surface, the paving material may completely cover the tops of the main bearer bars. This paving material is designated 10, and if it is formed of concrete it may be reinforced by a layer of expanded metal mesh 11 or other reinforcing mat carried over the tops of the main bearer bars as shown in FIG. 3.

The manner of installing the bridge floor may be more readily understood by reference to FIG. 6 in which 12 designate stringers located at intervals and extending crosswise of the bridge structure. The grating is set on these stringers with the bottoms 4 of the main bearer bars resting on the tops of the sections 12, and the grating units are made up in such length that abutting ends of sections will rest on the stringers 12. The pans 8 can be installed and tack welded in place at the place where the grating is fabricated, but as shown in FIG. 6 the pans 8 are of such length that they do not extend over the stringers 12. This enables welding tools to be inserted from the top of the grating to weld the main bearer bars in position on the stringers. After the welds have been completed supplementary pans, indicated in dotted lines in FIG. 6 and marked 8', are put in place to span the opening thus left between the ends of the pans 8 and establish the continuity of the pans. The application of the paving material 10 is of course effected only after the supplementary pans 8' are in place.

Because of the high load-carrying strength and rigidity provided by supporting the pans in this way, the pans themselves are of relatively light construction. The paving material 10 constitutes a relatively shallow slab as compared with the practice heretofore generally followed of placing the pans on the flanges 4 at the bottoms of the main bearer bars and filling the concrete to a depth almost equal or exceeding the full depth of the main bearer bars. All of the concrete or paving material, or substantially all of it, is above the plane of the neutral axis of the main bearer bars where it is in compression. The cross members 6, being depressed below the level of the tops of the main bearer bars, still serve just as effectively to distribute the load from one main bearer bar to another, and the strength of the structure is not impaired in any way by reason of the fact that the cross members 6 have been thus lowered. Since it is customary to perforate the main bearing bars 2 to receive the cross members, the perforations through the webs of the main bearer bars in the present instance being in the region of the neutral axis, do not weaken the tops of the main bearer bars so that they can more effectively resist tensile strains whenever the tops of the bars are placed in tension. (The tops of the bearer bars are in tension immediately above the place where the bearer bars rest on the stringers). Rupture of the main bearer bars due to fatigue under tension by reason of the concentration of stresses which occur in the usual grating as a result of notching of the tops of the main bearer bars to receive the cross bars is completely eliminated with the present construction. With the present construction therefore I am able to provide a bridge floor having the required structural strength with a relatively shallow slab of paving, and very substantially decrease the dead weight of the bridge floor per unit of area, while providing adequate strength for the live load. An incidental advantage is that the concrete or paving material 10 is keyed under the enlarged heads 3 of the main bearer bars so as to be locked in place against relative vertical movement. It may also bond itself or frictionally engage the webs of the main bearer bars.

In FIG. 4 the construction illustrated is substantially the same as that shown in FIG. 3, and corresponding reference numerals have been used to represent the corresponding parts, except that in this figure the pans are designated 15, and they have longitudinal edges 16 to rest on the flanges 5. Instead of being flat, however, the pans have been corrugated or embossed to provide a surface roughly resembling that of a waffle iron with upwardly-extending projections and intersecting channels, this adding increased strength to the pans while also effectively keying the paving material in place, and it is desirable for use with softer fills or paving such as asphalt.

In the modification shown in FIG. 5 the main bearer bars are constructed as heretofore described, but the cross bars, designated 18, instead of being T sections, are shown as channel sections having a wide flat top 18*a* and a vertical web 18*b*. It will be apparent that other sections may be used in place of the channel or T, but it is desired that the cross members have a wide top both for the purpose of providing strength and an adequate support for the pans, but the width of these sections also facilitates the joining of the pans in end-to-end relation since the ends of two abutting pans may rest on the same cross member.

The bottom load-distributing bar 7 may be provided as in conventional grating. With the present invention, however, it is possible to further integrate these bottom cross bars into the floor structure as illustrated in FIG. 7. In this FIGURE, 20 designates the longitudinal load-carrying members having head portions 21 and base portions 22. The cross bars are designated 23. Conventionally, but not necessarily, the bottom cross members, designated 24, may be arranged in pairs or groups. The pans 25 which are supported on the cross bars 23 and on the flanges of the main bearer bars 20 in the manner heretofore described, are interrupted at the places where the bars 24 are located. A trough-like supplemental pan 26 having its bottom extending under the lower cross bars 24 is inserted at this point, the top edges of the supplemental pan 26 overlapping the pans 25. Concrete 27 is then cast over the bridge floor in the manner hereinbefore described, filling the troughs 26 and surrounding the cross bars 24. The concrete in these troughs forms transverse beams in the floor at spaced intervals. This is of course useful only when the paving material is concrete or other castable material, and would be of no advantage with asphalt. This arrangement substantially increases the strength of the bridge floor and gives an additional function to the bars 24 while adding very little to the weight, since the bottom cross bars are provided only at relatively widely spaced intervals. Inasmuch as the cross bars are close to the bottoms of the main bearer bars, they are low down in the beam structures thus formed in the troughs where they are most effective to reinforce these beams or ribs.

While I have illustrated and described certain specific embodiments of my invention and enumerated certain objects and advantages, it will be apparent to those skilled in the art that the invention is not restricted to the particular construction shown, and that other advantages will inhere from this structure.

I claim:

A bridge floor comprised of metal grating supported on stringers, each grating having a plurality of longitudinally extending main bearer bars, each bar having a main web portion, a head portion at the top of the web portion, each web portion having a longitudinal pan-supporting ledge on each side face thereof below the head portion, cross bars passing through the main bearer bars and con-

necting them, the tops of all of the cross bars being below the said ledges on the main bearer bars, pans extending lengthwise between the main bearer bars having their longitudinal edges supported on said ledges, the pans resting on said cross bars, and a paving material on the pans filling the space between the main bearer bars and forming the traffic bearing surface of the floor, said pans having transversely-extending trough-like portions at intervals which extend downwardly from the level of the pans to a level below said cross bars, and bottom cross bars connecting the lower portions of the main bearer bars received in the trough-like portions, the paving material being concrete which fills said trough portions and surrounds the bottom cross bars, providing at each such trough portion a transverse reinforced rib.

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