May 31, 1966 H. NAGIN 3,253,288

INTEGRATED FLOOR STRUCTURE

Filed June 18, 1962

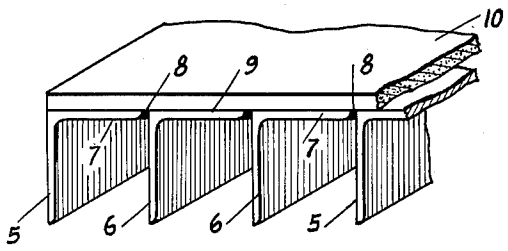


Fig. 1.

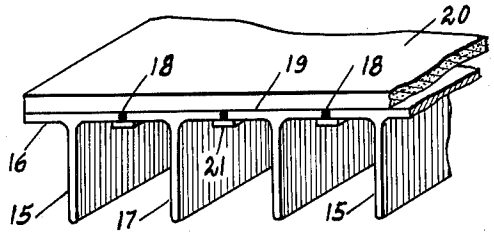


Fig. 2.

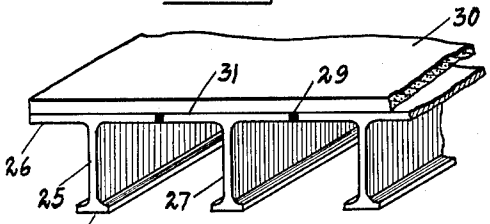


Fig. 3.

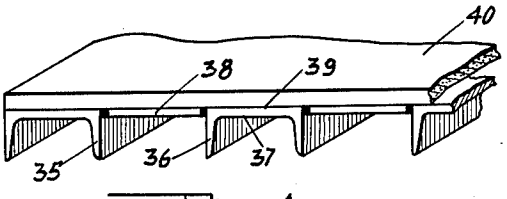


Fig. 4.

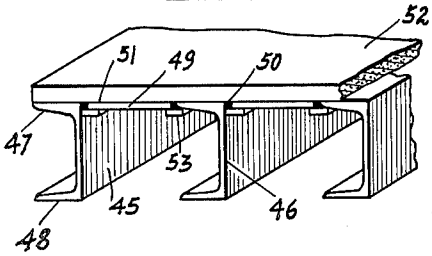


Fig. 5.

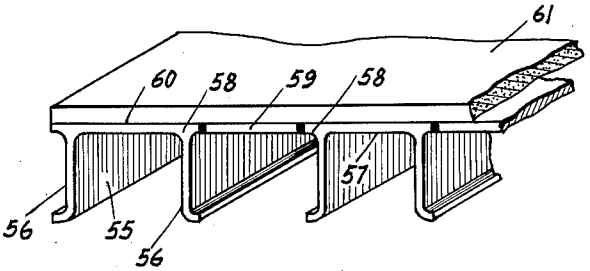


Fig. 6.

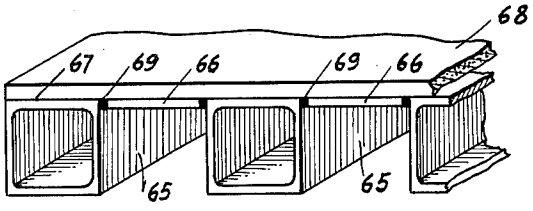


Fig. 7.

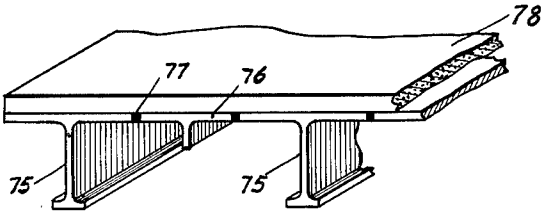


Fig. 8.

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United States Patent Office 3,253,288 Patented May 31, 1966

3,253,288

INTEGRATED FLOOR STRUCTURE

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Filed June 18, 1962, Ser. No. 203,082
8 Claims. (Cl. 14—73)

This invention relates to floor structures integrated from individual structural sections for use in steel structures, and while its use is not confined to bridge floors, it is especially adapted to such use. It is particularly adapted for use in an orthotropic bridge floor, where the floor, instead of being dead weight, is an active structural component of the bridge structure, functioning for example, both to carry traffic and as the bottom chord of a bridge truss.

Orthotropic bridge floors have heretofore comprised a heavy flat metal plate or panel to the under surface of which are welded a plurality of spaced parallel metal strips or sections set edgewise to the plane of the plate. The structure is cumbersome, heavy and presents difficult handling problems in that the transportation of the large metal plates from the rolling mill to the fabricating shop presents a problem, adequate large storage areas in the plant are required for the plates and adequate clearance, not only on the shop floor but from the unloading or storage area to the actual working floor must be provided in the fabricating plant. A typical panel may be thirty feet or longer, and generally not less than six feet wide. Jigs must be provided to hold the metal strip vertical until it is welded. Labor due to handling problems of this nature adds significantly to the cost of the finished product.

According to the present invention a floor panel is constructed by welding together the abutting edges of parallel flanged structural sections, or by the use of bars interposed between the sections and welded thereto, in either case forming an integrated panel with a continuous flat deck and parallel structural sections. The deck is designed to carry a surface covering or pavement.

An important object of the invention is to provide a floor panel constructed of metal sections providing a continuous deck and depending parallel beams which is especially useful for, but not limited to use in the construction of bridges using an orthotropic floor.

A further object of the invention is to provide a panel for such purpose which can be constructed with less labor and less welding, and which does not require transporting and bringing into the plant large difficult-to-handle metal plates.

These and other objects and advantages are secured by my invention which may be more fully understood by reference to the accompanying drawings which show several embodiments of my invention, each of which has certain advantages.

FIG. 1 is a fragmentary perspective view of a portion of an integrated panel embodying one form of the present invention;

FIGS. 2, 3, 4, 5, 6, 7 and 8 are similar views of different modifications thereof.

Referring to the drawings, FIG. 1 discloses a portion of typical panel formed of parallel angle bars **5**, each with a vertical leg **6** and a hornzontal leg or flange **7**, all disposed in the same position with the outer edge of the horizontal flange of each abutting and welded at **8** to the outside corner of the next angle, providing a continuous flat deck **9** with the vertical legs of the angles forming spaced parallel beams. The weld at **8** is a continuous weld along the entire length of the panel. Over the surface of the deck there is a layer **10** of paving material. It may desirably be an epoxy resin abrasive grit mixture as disclosed in Patent No. 2,948,201, granted August 9,

1960, which is applied either in the fabricating plant or in the field, or it may be any of the more usual paving materials such as concrete, asphalt, bricks, etc., in which case it is applied in the field. Since the panel is integrated from a plurality of structural sections forming in effect a continuous deck plate and depending beams, it may be used as an orthotropic bridge floor wherein it functions not only as a traffic-bearing surface, but is also an active part of the bridge structure itself.

The arrangement shown in FIG. 1 is best suited for lighter structures because the welding at the corners of the angles may impair the strength of the sections to resist flattening under very heavy loads. The arrangement shown in FIG. 2 is comprised of parallel T sections **15** with top flanges **16** projecting laterally from each side of the vertical leg **17**. The flanges of the sections **15** are placed in abutting relation and joined along the line of contact by a continuous weld **18**. In this case the weld is remote from the juncture of the vertical web and the top flanges. The structure provides as in FIG. 1 a continuous flat deck **19** on which there is a surfacing layer or paving **20**. In making the longitudinal welds it is often desirable to use backing strip beneath the weld to retain molten metal. Such backing strips, which have little structural significance, are shown at **21**.

FIG. 3 shows a structure similar to FIG. 2, but wherein the T sections **25** are specially rolled sections with wide top flanges **26**, a vertical leg **27** with the bottom edge of the leg having a narrow bottom flange **28**. The abutting top flanges are continuously welded at **29** and there is a wearing surface or covering **30** as previously described over the flat top deck **31**. By the inclusion of the bottom flange **28** a much stronger structure is provided than that shown in FIG. 2.

In each of the preceding modifications, all of the sections are flanged with the sections themselves in contact with each other. However in many cases the required strength and reduced weight can be secured by using main sections which are spaced from each other and joined by a lighter or different intervening section. Embodiments of this are shown in the remaining figures.

In FIG. 4 the structural panel is comprised of parallel main members in the form of channels **35** having the flanges **36** faced down and the flat webs **37** horizontal. Instead of being in abutting relation, they are joined by intervening sections **38**, which in this case are flat bar sections. Each bar section is welded along its edges to the top corners of the channels which it abuts with the top of the bar flush with the top of the webs of the channels which it joins, forming a flat top deck or panel **39**. It is provided with a surfacing **40** as previously described.

In FIG. 5 the panel is formed of channel sections **45** set edgewise, so that the web **46** is vertical and one flange **47** is at the top and the other flange **48** at the bottom. All of the channels are preferably faced in the same direction, as this avoids having two of them back-to-back, but in some cases opposite facing may be desired. Between the channels are sections **49** which are here also in the form of flat bars welded along their two edges to confronting channel surfaces, which in this particular case involves welding to one top flange **47** and one outside corner at **50** to form a flat deck or panel surface **51**. Here, as in all forms, the welds are continuous throughout the lengths of the sections. The surfacing **52** is the same as described specifically in connection with FIG. 1. Backing strips for welding are shown at **53**.

FIG. 6 uses channels much as in FIG. 4, but in this instance the channels **55** are especially rolled sections having depending vertical flanges **56**, the outer edges of which turn away from each other. In addition to having a web **57**, the sections has a laterally-extending flange **58** along

each side. These sections may be welded together as are the sections in FIG. 2 with the contacting flanges **58** being joined, or, as here shown there may be sections **59**, here shown also as flat bars, between each two channels with the edges of the bars welded to the confronting flanges **58** of the two channel sections between which they are interposed, forming a flat deck **60** to carry a surfacing **61**, such as previously described. This structure has the advantage of FIG. 2 in that the weld is spaced from the webs or vertical flanges of the main sections.

FIG. 7 is generally similar to FIG. 4 except that the main sections **65** are square tubular sections instead of channels. The tubular sections **65** are spaced from each other and are joined by intervening sections **66**, which here also are flat bars welded along their edges to the confronting top corners of the two tubes which they connect. In this way a flat deck or panel **67** is formed to which may be applied the surfacing **68** as hereinbefore described. The continuous welds are designated **69**.

In FIG. 8 the main sections **75** are similar to those shown in FIG. 3, but instead of having the flanges directly abutting as in FIG. 3, the T-sections are spaced and an intervening secondary section **76** is welded along its edges to the confronting flanges of each two sections **75**, the welds being indicated at **77**. The sections **76** may be bar sections, as in FIGS. 4 to 7 inclusive, or they may be some shallow ribbed section, such as a shallow T or channel with downwardly-extending legs or flanges. This provides main beams or bars which are relatively deep and widely spaced with intervening secondary beams or bars of smaller section. Since the deflection is a function of the cube of the depth of the section alternate six-inch and two-inch webs under the deck will resist deflection under load more effectively than a structure having all beam or flange elements of four-inch depth with no increase, however, in overall weight. The surfacing is indicated at **78** and is of the character first described.

This same arrangement shown and described in FIG. 8 is applicable to FIGS. 4 to 7 as well, and in any of the forms shown there may be the same arrangement of deeper main sections and shallower intervening sections with downwardly-turned flanges. In any case, the deck-forming portion of the structural sections is a generally flat rectangle with parallel edges. This is the case whether they be formed with depending webs or flanges or merely intervening bars, and they must be thick enough for continuous welding of the abutting edges, and thick enough so that their structural qualities will carry the stresses to which they are subjected in an orthotropic floor. In other words thin gauge metal strips which are not load-carrying sections would not comply with the requirements of this character. The back-up strips are shown only in FIGS. 2 and 5, but they need not be used in these constructions, or they may be used with the other forms here shown, their use or omission being largely up to the individual fabricator. While in each case the deck is shown and described as flat, this means that it is generally planar, and is not intended to exclude the presence of any ribs, projections or concavities provided to interlock with the surfacing or paving material.

Since the panel is intended to be used as an integrated structural element, the welds preferably extend continuously throughout the lengths of the elements. It will be apparent that a great deal of labor in the fabricating shop is eliminated in bringing together lengths of metal sections over the use of large metal plates, and the amount of welding is reduced over the conventional panel since the beams which are welded to the plate should be welded along both edges where the beam contacts the plate and the instant invention requires only a single weld between two sections.

In each case there is a spacing between the downwardly-turned beam-forming portions of the panel. This provides access between them when the panel is set over structural framing for welding the panel to the bridge or other structure in which it is used. This may be done from underneath, or by burning a hole through the top of the panel and welding down through the top.

While I have shown and specifically described several different specific embodiments of my invention, this is by way of illustration and is not inclusive of all shapes and combinations of shapes to which the invention is applicable, and insofar as any feature in any form shown is applicable to any other form, this is contemplated by this specification. Generally speaking, each panel will comprise sufficient structural sections to meet good engineering and field practice, panels of the general order of six feet in width and up to thirty or more feet in length being contemplated, depending of course on the specifications for the bridge or other structure where the panel is to be used. However, the distance between the main sections should be of the general proportions here shown where the span between the vertical webs of the main sections is not as much as three times the depth of the sections. The invention therefore provides an integrated floor panel and structural component in which there are a plurality of parallel structural sections having flange portions and integral depending legs or webs, the flange portions being in a common plane with a welded connection joining the flange portion of each section either directly or through an intervening bar or bar-like section with the top portion of the section to each side so that the panel has a continuous rigid deck and integral spaced webs on its under surfaces. It provides a panel in which every section, or at least every alternate section, has at least one depending web, which may be the leg of an angle, the leg of a T-section, a flange or web of a channel or the leg formed as square tube.

I claim:

1. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an integral deck-forming top portion of flat rectangular section with parallel edges, said edges abutting in a common plane with the edges of the deck-forming top portions of the adjacent sections to provide a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every alternate section at least having at least one depending integral web, all of the depending webs in the assembly being spaced from each other, the spaces between the depending webs being continuously open along their lengths to afford access to the under side of the abutting edges of the several deck-forming portions for welding.

2. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an intergral deck-forming top portion of flat rectangular section with parallel edges, said edges abutting in a common plane with the edges of the deck-forming top portions of the adjacent sections providing a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every alternate section at least having one integral downwardly-extending vertical web and at least one deck-forming top portion perpendicular to the web, all of the depending webs in the assembly being continuously open along their lengths to afford access to the under side of the abutting edges of the several deck-forming portions for welding.

3. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an integral deck-forming top portion of flat rectangular section with parallel edges, said edges abutting in a common plane with the edges of the deck-forming top portions of the adjacent sections providing a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every alternate section at least being a T section with the web depending and completely separate from and spaced from the adjacent sections except through the top portions.

4. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an integral deck-forming top portion of flat rectangular section with parallel edges, said edges abutting in a common plane with the edges of the deck-forming top portions of the adjacent sections providing a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every alternate section at least being an angle section with a depending leg, each depending leg of each section being separate and spaced from the adjacent sections except through the top portions.

5. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an integral deck-forming top portion of flat rectangular section with parallel edges, said edges abutting in a common plane with the edges of the deck-forming top portions of the adjacent sections providing a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every alternate section being a channel section, each channel section being spaced from the next by an intervening flat bar section.

6. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an integral deck-forming top portion of flat rectangular section with parallel edges, said edges abutting in a common plane with the edges of the deck-forming top portions of the adjacent sections providing a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every alternate section being a channel section with two depending webs with the intervening sections being flat bar sections.

7. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an integral deck-forming top portion abutting along its edges in a common plane with the top portions of adjacent sections providing a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every section being a section with at least one integral web extending vertically downward from the deck-forming top section with the webs of each section being spaced from the webs of adjacent sections and with the sections being in contact only where the edges of the top portions are welded.

8. A combined floor panel and structural component for metal structures comprising a series of elongated parallel structural sections, each having an integral deck-forming top portion of flat rectangular section with parallel edges, said edges abutting in a common plane with the edges of the deck-forming top portions of the adjacent sections providing a continuous deck surface, said abutting edges being continuously welded to integrate said sections into a unit, every alternate section at least having one vertical web and at least one deck-forming top portion perpendicular to the web, every intervening section being a bar section of a thickness equal to the thickness of the top-forming top portions of the alternate sections.

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