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BOX GIRDERS

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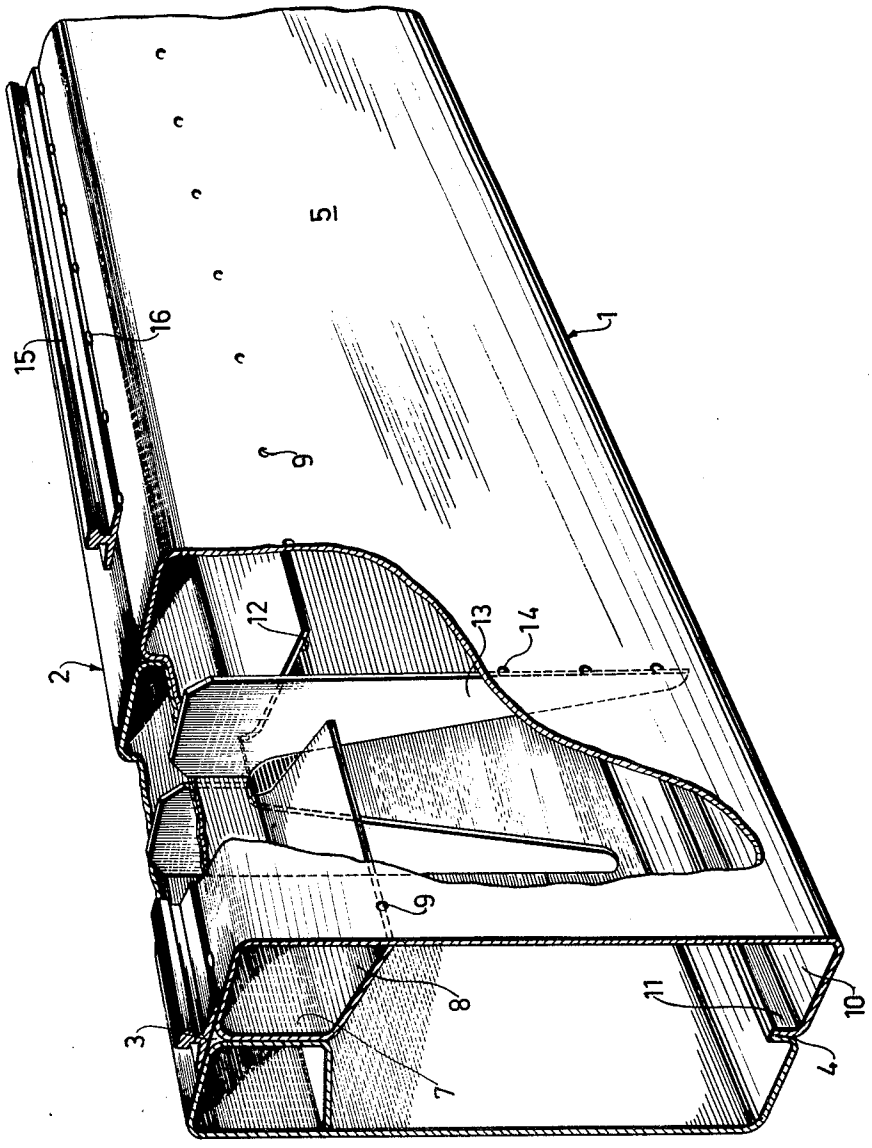

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BOX GIRDERS

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The present invention relates to a box girder which is primarily, although not exclusively intended to be used in a bridge for a traveling crane, although it can, of course, also be used for other purposes.

Bridges for traveling cranes have hitherto as a rule been built as truss structures. For many reasons, inter alia to facilitate maintenance work, one has recently gone over to construct said bridges from box-girders built from metal plates. Such box girders have usually been made of four plates which are welded together along their edges to form a box having a rectangular cross-section, which box is disposed with the narrower sides extending horizontally. The girder is essentially subjected to a vertical force depending on the weight of the trolley and the load, and horizontal forces appearing during starting and stopping of the movement of the bridge, and to make the girder more suitable for taking up these forces and to prevent bending or buckling of the plates stiffening members have been arranged in the form of internal longitudinally extending I beams and the like along the middle of the top horizontal plate and along the two vertical plates at about a third of their vertical height from the top surface of the girder. Furthermore transverse stiffening members are disposed with suitable intervals along the girder. The rail carrying the trolley is disposed along one edge of the girder above one of the vertical plates. This construction has many disadvantages. Above all, there appear during the welding operation varying welding stresses, which have the effect that it is very difficult to make the girder straight with the required accuracy. Of necessity, some of the welding work has to be carried out within the box girder which makes the work difficult and dangerous. It is also to be noted that the plates forming the girder have to be cut and trimmed with a high degree of accuracy in order that it shall be possible to weld them together in the manner desired. It is further to be noted that the disposition of the rail along one side of the girder introduces a great torque in the girder under the action of the load acting on the rail. A central disposition, however, would require additional stiffening or enforcement of the girder and thus complicate the structure.

Other box girder constructions have also been suggested, but none of them has entirely eliminated the above disadvantages.

The main object of the present invention is to provide a box girder construction which is free from the disadvantages of prior art box girders. The box girder of this invention comprises two substantially equal halves arranged in symmetrical relationship and joined together along the longitudinal center line of the top and bottom sides of the girder. Each half consists of a plate which is tubular in its top portion so as to form half the top face of the girder, a vertical central stiffening member and a horizontal or inclined stiffening member which extends from the central stiffening member to the outer side portion of the girder, to which it is suitably joined, said plate being also bent in its bottom portion to form half the lower face of the girder. In each half transverse stiffening members are provided.

A great advantage of this construction is that its manufacture is simple. Each half of the girder is manufactured separately, and this operation can be carried out

without difficulty, whereupon the two halves are joined. The welds which have to be made for this purpose, are preferably intermittent with long intervals, wherefore distortions due to the welding operation are practically unimportant. The construction also admits of other methods of joining the two halves e.g. riveting.

The total length of the welds can be only a fraction of the length of the girder. Furthermore, the load (the rail of the crane trolley) can be placed symmetrically, so that undesirable torques are avoided. The total amount of material for the girder can be low for a given load.

Other advantages will appear from the following description of an embodiment of the invention shown in perspective on the accompanying drawing.

The box girder illustrated on the drawing is composed of two longitudinal halves 1 and 2, each consisting of a bent plate. The two halves are held together by an upper weld 3 and a lower weld 4. The plate forming the half 1 is bent so that it has a vertical side portion 5, a top horizontal portion 6, a portion 7 extending vertically downwards from the portion 6, said portion 7 having considerably lower height than the side portion 5, and a portion 8 which extends outwardly horizontally or obliquely downwardly from the lower edge of the central vertical portion 7 toward the side portion 5, to which it is joined by welding, suitably intermittently as shown at 9. It is to be noted, however, that the portion 8 can be unconnected to the side portion 5, in which case it is suitable to provide a weld joint along the lower edges of the vertical portions 7 when the two halves 1 and 2 are joined. Thus, the portions 6, 7, 8 form together with the upper part of the side 5 a tubular construction. Furthermore, the half 1 includes a lower horizontal portion 10 which terminates in an upwardly bent flange 11.

Openings 12 are provided at suitable intervals in the portion 8 to enable transverse stiffening plates 13 to be inserted, these plates being welded, suitably intermittently, as seen at 14, to the portions 5, 6 and 7 of the plate 1. These stiffening plates serve to prevent the appearance of large buckling areas in the high side portions 5 of the girder and assist in distributing the forces in an advantageous manner from the center of the girder to the outer parts of the girder.

The girder half 2 is constructed in the same way as the half 1 and need not be described in detail.

Each girder half 1 or 2 is manufactured by bending the plate in the manner described (after the openings 12 have been provided) and if desired, welding the edge of the portion 8 to the side portion 5, whereupon the transverse stiffening plates 13 are inserted and attached by welding. These operations are easily carried out and the welds, which are made only intermittently, do not introduce great stresses, which cause bending of the girder half. Insofar as bendings occur, they must be substantially symmetrical in the two girder halves so that they can be compensated when the halves are joined. The halves are then placed with the flanges 11 and the vertical portions 7 in opposed relationship and the halves are joined by making the above-mentioned welds 3 and 4. These are symmetrically disposed and therefore they cannot introduce any bending of the plate in the horizontal plane. If one of the welds results in bending of the girder vertically, this can be compensated when the other weld is made. In some cases it may, moreover, be desirable to permit a slight vertical bending (crown) of the girder, and the extent thereof can be controlled when the welding is carried out. Moreover, as pointed out, the two welds 3 and 4 need not be continuous, but can consist of short intermittent welds, in which case they do not cause significant distorsion of the girder.

Suitably, when the weld 3 is intermittent, the upper

joint should be sealed with bitumen or the like to prevent entry of water into the girder.

The rail 15 intended to carry the trolley of the travelling crane is positioned centrally above the two opposed vertical portions 7 and is welded, as seen as 16, or attached in any other suitable manner. Due to the considerable stiffening action provided by the plate portions 7, it is thus possible to dispose the rail centrally, which is a considerable advantage, as one eliminates torque in the girder. When a rail is disposed in this manner, the rail may sometimes be sufficient to keep the two girder halves together, so that the weld 3 can be dispensed with.

The top tubular part 6, 7, 8 of each girder half forms a shell structure, which is resistant to buckling. As for the shape of this tubular structure the following points are to be considered: The upper portions of the girder are subjected to compression stresses and its lower portions to tension stresses and therebetween is a neutral zone where the stress is zero. In a symmetrical girder the neutral zone is at half the height and the danger zone for buckling is at a quarter of the height from the top. For a girder constructed in accordance with this invention, the distance to the neutral zone is less than half the height from above. The danger zone for buckling will also be higher. The plate portion 8 shall engage the side portion 5 substantially in the danger zone for buckling and the most suitable height is at a fifth of the total girder height, from above. If the plate portion 8 engages the side portion 5 at a higher or lower level, the plate has to be made thicker for the same load to be carried by the girder.

The tubular section may be corrugated, if desired.

It is further to be noted that the plates need not be cut and bent with so high degree of accuracy as for prior art box girders. For example, it is not absolutely necessary that the width of the portion 8 is made exactly accurate, since any small variations in the width can easily be compensated for by adapting the inclination thereof according to the actual width. It is not necessary that the two girder halves have exactly equal heights. If only the top horizontal portions 6 are placed in the same plane, it does not matter, if there is a slight difference in level between the two lower horizontal portions 10. Similarly, the two vertical portions 7 need not be of exactly equal height. Also, it is not necessary that the edges of the two plates are trimmed exactly even, since such smaller irregularities in the edges, which usually occur, are without importance.

Although it is stated above that each half is made by bending a single plate, which is the preferred embodiment for most applications, this is not intended to exclude a construction where each half is made from several plates, which may be welded together or joined by other means.

In particular for larger sizes of box girders, sufficiently wide plates may not be commercially available, and then it is necessary to make each half from two or more plates. Furthermore, it is within the scope of the invention to use for each half plate sections of different thicknesses to save material in those parts of the girder where the stresses are smallest (the neutral zone). It is, of course, also possible to use special plates which are manufactured so as to have a smaller thickness in the section which is to form the neutral zone.

It is further to be noted that the side portions 5 need not be vertical. For example, they can be inclined so that the cross-section of the girder tapers from top to bottom. Of course, the side portions can also be vertical in an upper part and then taper downwardly toward the lower side.

I claim:

1. A box girder made of sheet metal comprising two substantially symmetrical longitudinal halves secured together, each half forming a lateral side and half the top and bottom sides of the girder, each half being bent to form a top tubular section including the upper portion of the lateral side, the half of the top side, a central vertical portion extending downwardly from the inner edge of the half of the top side and a portion extending outwardly from the central vertical portion at a point intermediate the top and bottom of the vertical side, the two halves being positioned with said central vertical portions contiguous and being welded together centrally to form joints along the top and bottom sides, respectively, and individual transverse stiffening plates positioned at intervals within each half.

2. A box girder as claimed in claim 1 in which the bottom side of each half terminates with an upwardly directed flange, which is joined to the flange of the other half.

3. A box girder as claimed in claim 1 having a rail extending along the top side centrally above said top joint.

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