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FABRICATED STEEL BEAM

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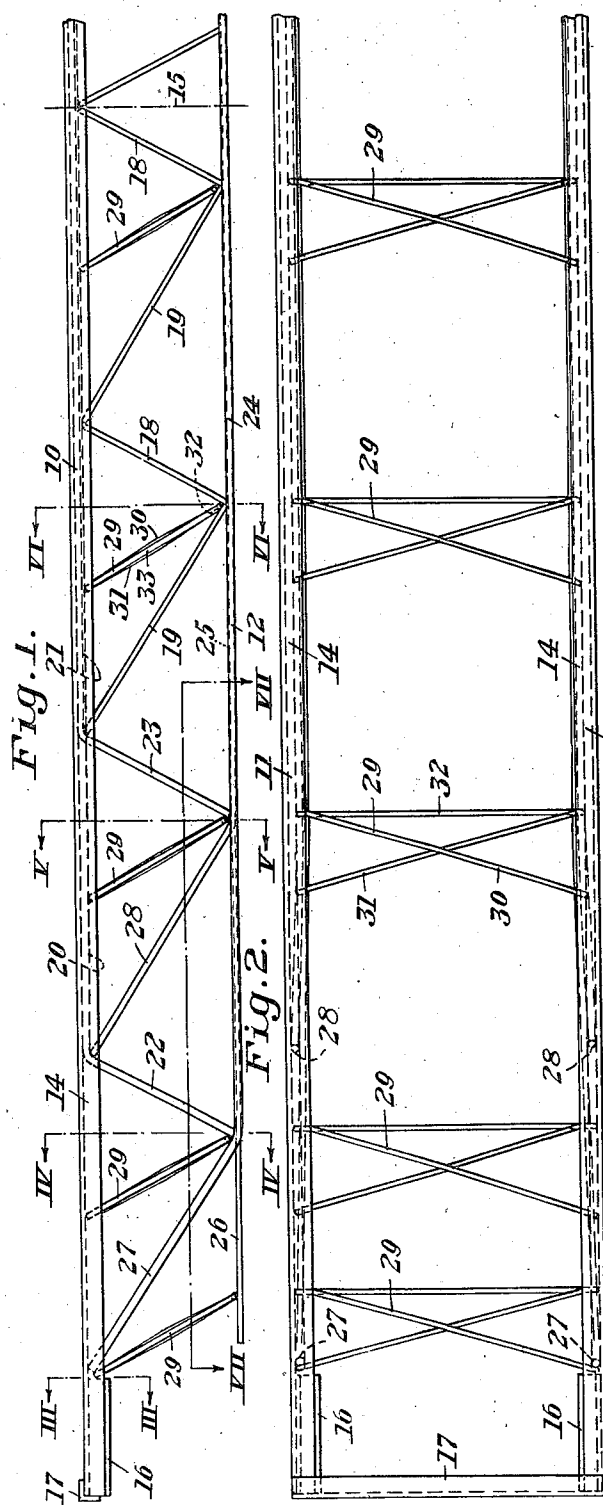


Fig. 1.

Fig. 2.

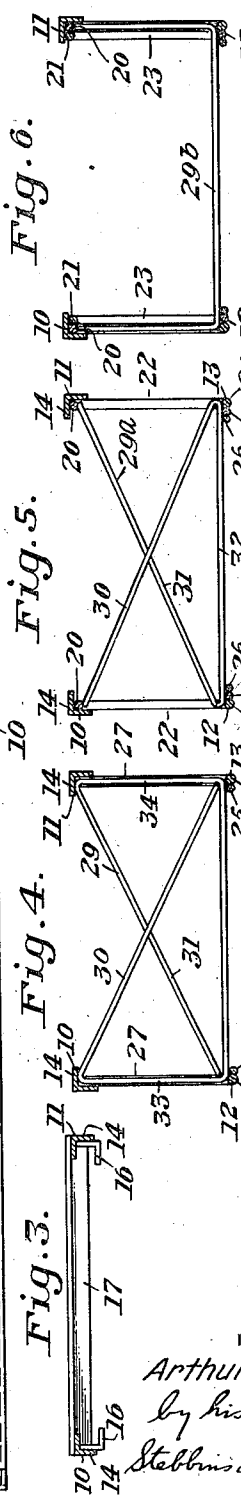


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

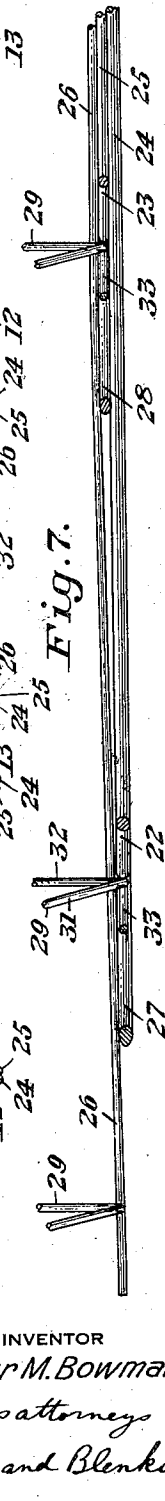


Fig. 7.

INVENTOR

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FABRICATED STEEL BEAM

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10 Claims. (Cl. 189—37)

This invention relates to a building construction member and in particular to a fabricated beam of the type particularly suited for use as a floor joist.

Numerous forms of fabricated steel beams, generally known as "bar joists" have heretofore been proposed, but have been characterized by certain rather serious objections thereto. These objections are well recognized and, in fact, are actually pointed out to prospective users in the manufacturers' handbooks in which the details of the known joists are given. In the first place, bar joists as known heretofore require lateral bracing between joists such as that provided by concrete slabs at least 2'' thick or otherwise. When using bar joists, furthermore, just as in the case of wooden joists, the lateral support of the top deck is an essential element, and before being bridged, steel joists cannot be expected to sustain considerable loads, especially moving loads common in building construction. Such loads on unstayed joists may easily result in serious accidents. The performance of a steel-joist floor construction can only be determined by applying the top deck with a uniform load, and the center-to-center spacing of the joists must not be over 2' or 2' 6''.

I have invented a fabricated steel beam particularly adapted to serve as a floor joist, which overcomes the aforementioned objections to bar joists as previously made. In the preferred embodiment of the invention, I provide a beam having a pair of spaced top chord members and a pair of spaced bottom chord members, the chord members in a transverse section of beam being located at the corners of a rectangle. Each top chord member is connected to the bottom chord member therebelow by a web of lacing bars which, with the chord members, constitute a truss. The two trusses are secured in spaced relation by bracing X-frames spaced along the length of the beam. The X-frames are disposed in planes inclined to a plane normal to the axis of the beam.

The chord members are preferably composed of a plurality of bars, certain of said bars terminating short of the ends of the beams. These bars, furthermore, are preferably bent adjacent their ends, and have their extreme ends welded to the opposite cord members, thus serving as lacing bars. When the beam is designed for uniformly distributed loads, the size of the lacing bars decreases from the ends of the beam toward the center. The details of the various members of the beam and their arrangement may be varied within a wide range, according to the stresses developed in such members by any particular combination of loads for which the beam may have to be designed.

Further novel features and advantages of the invention will become apparent during the following detailed description and explanation, which refer to the accompanying drawing illustrating the preferred embodiment outlined above

In the drawing:

Figure 1 is a side elevation;

Figure 2 is a plan view:

Figures 3 through 6 are transverse sectional views taken along the correspondingly numbered planes of Figure 1 showing various forms of X-bracing; and

Figure 7 is a partial horizontal section taken along the plane indicated by the line VII—VII of Figure 1.

Referring now in detail to the drawing, the beam of my invention comprises a pair of spaced top chord members 10 and 11 and a pair of spaced bottom chord members 12 and 13, vertically aligned with the top chord members, respectively. The top chord members are each composed of a plurality of bars including an angle bar 14, the latter extending the full length of the beam. It will be understood that Figures 1 and 2 show only one-half of the beam which, when designed for symmetrical loading, is symmetrical about its central transverse plane 15. As shown in Figures 4 through 6, the chord members 10, 11, 12, and 13, in a transverse section through the beam, are located at the corners of a rectangle. Each angle bar 14 is disposed with its vertex coincident with one of the upper corners of the rectangle. Instead of a standard angle, any other suitable shape may be used, e. g., a special shape adapted to receive wood nailing strips.

Short lengths of angle bar 16 are welded to the angle bars 14, adjacent each end thereof, to provide bearing surfaces adapted to rest on a wall or girder. An angle bar 17, welded to the ends of the bars 14, ties them rigidly together. The bar 17 may be omitted, however, when the beams extend in opposite directions from a common supporting wall or girder and it is desired to have the ends of the beams on opposite sides of the support interfitting with each other. Diagonal lacin bars 18 and 19 are welded to the top chord member of each truss and to the bottom chord member therebelow, adjacent lacing bars being attached to the same chord member at substantially a common point.

Each pair of top and bottom chord members with the lacing bars secured thereto constitute a truss of which the lacing bars are the web members. Ordinarily, the bars 18 are compression members and the bars 19 are tension members. The tension members, as shown, are longer than the compression members. In beams designed for uniform loading, the sizes of the lacing bars 18 and 19 decrease respectively from the ends of the beam toward the central transverse plane

15. This is permissible because the shear stress decreases in the same manner.

When the beam is designed for a single concentrated load, centrally located, the compression bars 18 are the same size throughout the beam and the same is true of the tension bars.

As previously stated, each of the chord members is composed of a plurality of bars. The top chord member 10, for example, includes, in addition to the angle bar 14, round bars 20 and 21, and the chord member 11 is similarly constituted. The bars 20 and 21 are welded to the bar 14, but terminate short of the ends of the latter. The ends of the bars 20 and 21 are bent down, as shown at 22 and 23, and are welded to the bottom chord member 12, to replace separate welded lacing members similar to 18, which would otherwise be inserted at these locations.

The bottom chord members 12 and 13 are each composed of a plurality of round bars 24, 25, and 26. The bars 26 extend substantially the full length of the beam, as shown in Figure 1, but the bars 24 and 25 are bent upwardly at successive panel points inwardly of the ends of the beam, as at 27 and 28, and have their extreme ends welded to the top chord members, whereby the portions 27 and 28 serve as tension lacing bars such as those shown at 19. The decrease in the total section of the chord members toward the ends of the beam is permissible because the bending moment decreases similarly, whether the load is distributed or concentrated.

Bracing X-frames or cross frames 29 are spaced along the length of the beam. Each frame includes crossed members 30 and 31, a bottom tie 32, and side struts 33 and 34. These cross frames are preferably made of a single piece of round bar bent to the shape shown. After the trusses are completed, these frames are distributed at intervals along and between the trusses and welded at the points of contact with the top and bottom chords. The ends of each of the crossed members 30 and 31 are welded to the top chord member of one truss and the bottom chord member of the other. The lower corners of the X-frames are welded to the bottom chords substantially at the intersections of the lacing bars 18 and 19 therewith, except in the case of the X-frame at the extreme ends of the beam, which is simply welded to the bottom chord bars 26 adjacent their ends. The X-frames are disposed in planes inclined to a plane normal to the longitudinal axis of the beam. By virtue of this arrangement, the X-frames in addition to bracing the trusses against side sway, prevent longitudinal creeping of one truss relative to the other. The side members 33 and 34 of the X-frame, furthermore, serve to transmit a portion of the compression load applied to the top chord members between intersections of the lacing bars therewith into the truss as a whole.

Various forms of cross-frames may be used. Instead of that shown at 29, a modification such as that shown at 29a will serve equally well. A U-frame such as that shown at 29b may also be designed to have sufficient rigidity to provide transverse bracing for the trusses. While Figures 4, 5, and 6 show these several forms of bracing, it will be understood that this is merely for illustration as in actual practice, all the cross frames in a given beam will be of the same design, as shown in Figures 1 and 2.

It will be apparent that the beam of my invention is characterized by numerous advantages of great practical importance. In the first place, the beam is self-supporting, i. e., requires no lateral staying as do conventional bar joists. The beams may simply be laid on the supporting walls or girders and loaded with perfect safety. This is important because it permits rapid erection of a working deck merely by locating the beams in place and laying deck planking thereover. The resulting deck is perfectly safe for moving as well as stationary loads. A further advantage is that the beams may be placed on any desired centers depending on the load to be sustained. During construction, furthermore, the beams may be disposed in side by side abutting relation, if desired, to carry a temporary load greater than that for which the finished floor or roof is designed. Moreover, it is not necessary to install continuous bridging between adjacent beams, because each beam is internally braced against side sway. This is particularly important when the beams are spaced on longer centers.

The fact that the section of the chord and web members varies from the ends of the beams toward the central transverse plane, in accordance with the loads to which its elements are subjected, means a greatly increased economy of metal, compared to conventional beams or bar joists which are of uniform section throughout or substantially so, both as to web and chords. The resistance to creeping of one truss relative to the other afforded by the inclination of the X-frames has already been mentioned. By making the tension lacing bars longer than the compression bars, the length of the latter is reduced to an extent such that a relatively small bar is capable of carrying the compression load without bending.

The invention fully overcomes the disadvantages of conventional bar joists previously mentioned. No lateral staying of the beams is required, they are capable of acting as structural members during construction, and continuous bridging is not necessary to make the beam safe for supporting moving loads. The bracing X-frames, being shop-welded, are more reliable than bridging placed in the field.

The invention is susceptible of a considerable range of modifications to adapt the beam to different types of loads. In fact, different types of beams may easily be designed for special types of loads without materially increased engineering and construction cost. It is unnecessary to illustrate such modifications, but some of them may be mentioned briefly. In the first place, under certain loading, it is not necessary that the lacing bars nearest the central transverse plane intersect with the latter, as shown in Figure 1. As a matter of fact, under certain conditions the lacing bars nearest the central plane may be spaced apart by a considerable distance. Adjacent the ends of the beams, furthermore, I may install a plurality of X-frames connected by lacing bars. I may also use X-frames adjacent the central transverse plane inclined oppositely to those shown in the drawing. The X-frames may also be applied with the tie portions 32 at the top. These and other modifications will be apparent to those skilled in the art to which the invention relates, but it is to be understood that all such modifications may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A fabricated beam for use in building construction as a floor joist, for example, comprising spaced top chord members extending sub-

stantially the full length of the beam, spaced bottom chord members extending substantially the full length of the beam, said members in a section of the beam being located at the corners of a rectangle, bracing cross frames spaced along the length of the beam, disposed in planes inclined to that normal to the length of the beam, and welded at their corners to said top and bottom chord members, and additional top and bottom chord members welded to said first mentioned top and bottom chord members, said additional top and bottom chord members being bent adjacent their ends and welded to the opposite (i. e., bottom or top) chord member, forming compression and tension web members.

2. A fabricated beam for use in building construction as a floor joist, for example, comprising spaced top chord members extending substantially the full length of the beam, spaced bottom chord members extending substantially the full length of the beam, said members in a section of the beam being located at the corners of a rectangle, bracing cross frames spaced along the length of the beam, disposed in planes inclined to that normal to the length of the beam, and welded at their corners to said top and bottom chord members, and lacing bars welded to said top and bottom chord members forming the webs of a pair of trusses including said chord members.

3. A fabricated beam for use in building construction as a floor joist, for example, comprising spaced top chord members extending substantially the full length of the beam, spaced bottom chord members extending substantially the full length of the beam, said members in a section of the beam being located at the corners of a rectangle, bracing X-frames spaced along the length of the beam, disposed in planes inclined to that normal to the length of the beam, and welded at their corners to said top and bottom chord members, additional top and bottom chord members extending from the central transverse plane of the beam toward both ends thereof and welded to said first mentioned top and bottom chord members, respectively, and lacing bars welded to at least some of the top and bottom chord members and forming the webs of a pair of trusses including all said chord members.

4. A fabricated beam for use in building construction as a floor joist, for example, comprising spaced top chord members extending substantially the full length of the beam, spaced bottom chord members extending substantially the full length of the beam, said members in a section of the beam being located at the corners of a rectangle, bracing X-frames spaced along the length of the beam, disposed at oblique angles to the length of the beam, and welded at their corners to said top and bottom chord members, and lacing bars welded to said top and bottom chord members forming the webs of a pair of trusses including said chord members, the lower ends of the lacing bars being welded to the bottom chord members substantially at the points where the bracing frames are secured thereto.

5. A fabricated beam for use in building construction as a floor joist, for example, comprising spaced top chord members extending substantially the full length of the beam, spaced bottom chord members extending substantially the full length of the beam, said members in a section of the beam being located at the corners of a rectangle, bracing cross frames spaced along the length of the beam, disposed at oblique angles to the length of the beam, and welded at their corners to said top and bottom chord members, and lacing bars welded to said top and bottom chord members forming the webs of a pair of trusses including said chord members, adjacent lacing bars being inclined oppositely to the vertical, and adjacent bars being secured to each chord member substantially at a common point.

6. A fabricated beam for use in building construction as a floor joist, for example, comprising spaced top chord members extending substantially the full length of the beam, spaced bottom chord members extending substantially the full length of the beam, said members in a section of the beam being located at the corners of a rectangle, bracing X-frames spaced along the length of the beam, disposed in planes inclined to that normal to the length of the beam, and welded at their corners to said top and bottom chord members, and lacing bars welded to said top and bottom chord members forming the webs of a pair of trusses including said chord members, adjacent lacing bars being inclined oppositely to the vertical, those inclined upwardly toward the ends of the beam being longer than those inclined in the opposite direction.

7. A fabricated beam for use in building construction as a floor joist, for example, comprising spaced top chord members extending substantially the full length of the beam, spaced bottom chord members extending substantially the full length of the beam, said members in a section of the beam being located at the corners of a rectangle, bracing cross frames spaced along the length of the beam and welded at their corners to said top and bottom chord members, and diagonal lacing bars secured to said chord members, the size of the lacing bars decreasing toward the central transverse plane through the beam, said frames lying in planes at an angle to said transverse plane.

8. A fabricated beam for use in construction, as a floor joist, for example, comprising a pair of trusses disposed side by side, each having spaced top and bottom chord members and diagonal lacing bars forming the web of the truss, and X-frames having their members in a plane oblique to the length of the beam and welded to opposite chord members of the two trusses.

9. A fabricated beam for use in construction, as a floor joist, for example, comprising a pair of trusses disposed side by side, each having spaced top and bottom chord members and diagonal lacing bars forming the web of the truss, and X-frames having their members welded to opposite chord members of the two trusses, said X-frames being spaced along the beam and disposed in planes inclined to a plane normal to the axis of the beam.

10. A fabricated beam for use in construction, as a floor joist, for example, comprising a pair of trusses disposed side by side, each having spaced top and bottom chord members and diagonal lacing bars forming the web of the truss, and X-frames secured to chord members of both trusses in planes inclined to the plane normal to the axis of the beam, the size of the lacing bars decreasing toward the central transverse plane through the beam, each chord member being composed of a plurality of bars, the ends of some of the chord bars being bent adjacent the ends of the truss to form some of the lacing bars.

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