Sept. 23, 1941. W. B. MILLER 2,256,812

METHOD OF FABRICATING JOISTS

Filed Oct. 6, 1939

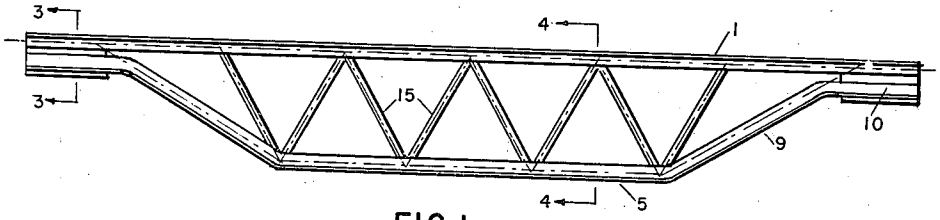


FIG. 1.

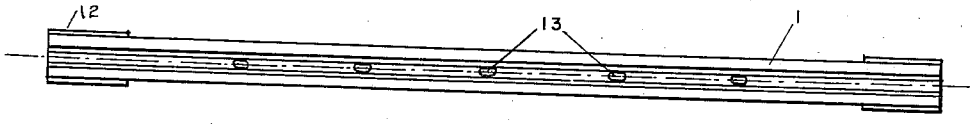


FIG. 2.

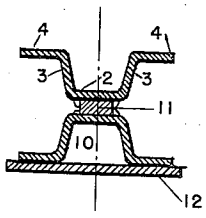


FIG. 3.

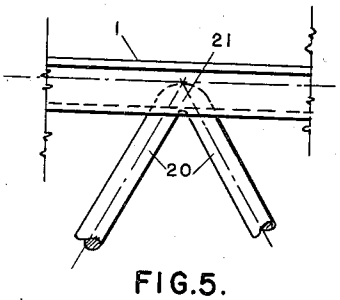


FIG. 5.

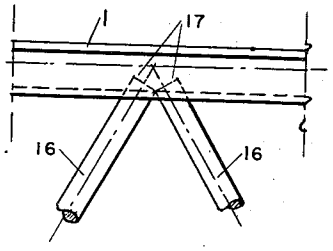


FIG. 6.

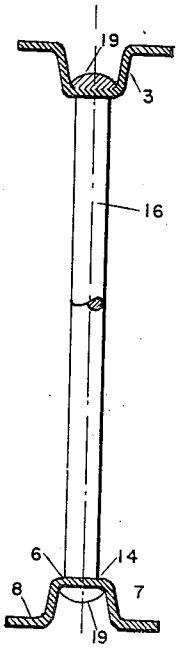


FIG. 4.

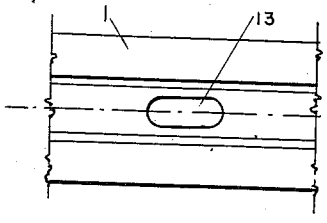


FIG. 7.

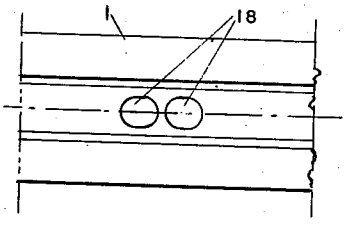


FIG. 8.

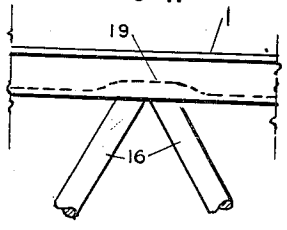


FIG. 9.

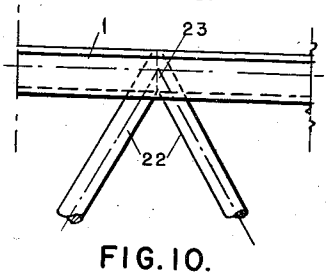


FIG. 10.

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BY

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METHOD OF FABRICATING JOISTS

William B. Miller, Lakewood, Ohio

Application October 6, 1939, Serial No. 298,275

5 Claims. (Cl. 29—155)

My invention pertains to the method of fabricating a joist.

Long experience with the engineering phases and problems of the building industry has brought me familiarity with every marketed form of joist and nearly a decade ago convinced me that an improved construction was needed. The problem attended origination of a design which would furnish the maximum strength while having the minimum weight and which would eliminate secondary stresses. One of the primary features is the establishment of a common point of intersection between the center of gravity lines of each pair of converging web sections and the horizontal and vertical neutral axes of the chord member to which such pair of web sections are secured; as shown, described and claimed in domestic Patent No. 1,983,632 issued December 11, 1934 to me as joint inventor. However, the development of an ideal design has brought my reconsideration of the importance of achieving the theoretically perfect product with a reduction of certain items of cost. This invention retains the primary features of my earlier joist patent while simplifying and cheapening the manufacture and yet facilitating the accomplishment on a commercial production basis with realization of the object which trial and test have confirmed to have been correct if not indispensable to enduring success.

My truss-type joist is composed of a pair of parallelly spaced and superposed chord members of the U-shaped cross section and relatively inversely appositioned so that their middle bight sections are nearest each other, together with a zig-zag webbing therebetween. The ends of the lower chord member are bent upwardly to meet and be secured to the ends of the upper chord member respectively. The web is of composite form with either straight line diagonal sections or with variable V, Z or W-shaped sections. The middle bight sections of the chord members are fashioned with suitably spaced holes, sockets or recesses for the reception of the meeting ends of straight line sections of the webbing or for occupancy by bends of zig-zag webbing sections. If each straight line web section is initially a separate piece, the middle bight section of the chord members are provided with oblong apertures for occupancy by meeting ends of a converging pair of web sections preparatory to welding while holding the common intersection point relationship. The apertures in one chord member are suitably staggered with reference to the holes in the other chord member. The appositioned ends of a pair of converging straight line web sections may optionally be cut on a bias to permit their proper positioning within their common hole or socket. My present manufacture employs chord members of carbon steel and web sections of structural steel and their attachment is being successfully effected by electric arc welding. Web splices may be made as often as may be desired and individual straight line web sections may have their ends welded separately or in pairs at each panel point (place of attachment of chord members and webbing).

In general, the perfect intersections of the two center of gravity lines of a pair of converging, straight line web components with the two neutral axes of each chord member eliminate secondary stresses which are prevalent in earlier marketed joists. Web components of round cross section and in a straight line between chord members provide added strength over zig-zag webs hitherto used. Causing initially separate webbing components (with or without return bends) to project through holes in the chord members makes possible the end to end variation in size and strength of the webbing. For instance, at the ends where the shear stress is greatest there could as readily be a series of straight line web components which are proportionately larger and stronger or any number of such components could be decreased in size at the middle of the joist span. Causing web portions to project through holes in the manner I teach, facilitates assembly of a fabricated joist and performance of the welding operation while also making it possible to weld high carbon steel chords to a softer web because the latter may be projected through sufficiently to provide ample web material for fusing during the welding procedure without crystallizing the high carbon steel of which the chords are composed. The optional employment of preformed zig-zag web components with either or both their bends and terminals projecting through holes in the chords permits splicing of the contiguous ends of two initially separate zig-zag web components under a single weld burr.

Other objects have been to make possible the use of somewhat simpler forms of chord and web members previously available on the market or adapted to alternative uses besides in my design of joist, to lessen storage and handling costs, to reduce the hazard of camber distortion both prior to assembly and subsequent thereto and to build and apply a suitable jig for proper spacing preparatory to assembly and secured union.

The abutment of ends of a pair of separate straight line web components against each other and against the remote ends of an oblong hole or within two adjacent holes insures the desired common intersection of their center of gravity lines and the neutral axes of the chord members. Likewise, bends of any length of zig-zag web components are properly wedge-held against disalinement or displacement by engagement with the remote margins of the oblong holes.

Adverting to the drawing:

Figure 1 is a side elevation of a joist embodying my invention.

Figure 2 is a top plan view of Figure 1 showing weld burrs at each panel point.

Figure 3 is an enlarged cross sectional view of one end of the joist showing a spacer interposed between the corresponding ends of two chord members, the lower of which is resting upon a plate supported on a building wall.

Figure 4 is an enlarged vertical cross section, taken on line 4—4 of Figure 1.

Figure 5 is an enlarged broken detail view showing the joint between chord and web bend.

Figure 6 is an enlarged detail view like Figure 5 though showing a joint effected by use of two converging straight line web components projected through a single oblong hole in the chord.

Figure 7 is a plan view of the chord member showing one of the oblong holes therein.

Figure 8 is a similar plan view showing the middle or bight area of a chord member fashioned with two adjacent round holes as an alternative or modified form.

Figure 9 is a longitudinal section of a portion of one of the chord members showing a completed weld therewith of a pair of converging web sections.

Figure 10 illustrates a modification employing mitre-cut ends of straight line web components (projected either through one oblong hole or through two closely adjacent round holes) to provide more web metal for fusing into the completed weld.

I would have it understood that the scope of my invention comprehends modified constructions and equivalent methods. The showing of the drawing and the descriptions herein are merely specific exemplifications of a plurality of mechanical embodiments and arrangements and procedures.

An upper chord member 1 is of approximately U-shaped cross section to comprise a flat middle bight section 2, leg sections 3 rising therefrom and a pair of terminal sections 4 which are substantially parallel with the middle section 2, as clearly revealed in Figure 3. A lower chord member 5 is of like cross sectional shape to comprise a middle section 6, downwardly diverging legs 7 and angularly related terminal sections 8 which, like the terminal sections 4, will be substantially horizontal when the joist is in use. It will be observed that the chord members are inversely disposed with reference to each other or so that, while in predetermined parallelly spaced superposed relation, the middle sections 2 and 6 are in nearest apposition. That arrangement is clearly disclosed in Figure 4.

The two ends of the lower chord member are bent at 9 toward the upper chord member and terminate in sections 10 which are parallel with the upper chord, but selectively variously spaced therefrom by interposition spacer blocks 11 which are secured by welding or any other suitable means to the ends of both chords. The spacer block appears to view in Figure 3, where is also to be seen a bearing plate 12 to be secured to the terminal sections 8 of the lower chord while in turn affixed in any appropriate manner to the top run of a wall of masonry. The middle sections 2 and 6 of the upper and lower chords are fashioned with a row of oblong apertures 13 and 14 respectively and the holes in one chord member are staggered with reference to the holes in the other chord member for occupancy by portions of a zig-zag webbing designated in its entirety by the numeral 15. The webbing comprises straight line round rod sections 16 of which all except the two end ones converge in pairs toward and project through one of the holes, The meeting ends 17 of two of the rod sections thus inserted are illustrated in Figure 6 or they may be alternatively be projected through the two closely adjacent holes 18 shown as a modified provision in Figure 8. In either case each pair of meeting ends 17 are properly positioned by abutment against each other and by abutment either against the longitudinally remote margins of the oblong holes 13 or by abutment not only against each other, but against the relatively remote edges of the pair of holes 18. The declared proper or ideal positioning is such that the center of gravity lines of each pair of converging rod sections 16 which have their ends meeting within the confines of a U-shaped chord member have a common point of intersection with both the horizontal and vertical neutral axes of the particular chord member which they intersect thus advantageously restoring and maintaining the gross section of the chord. Thereupon, electric arc welding of the two ends 17 to each other and to the relatively remote sides of the middle sections 2 and 4 forms the weld burrs 19.

Either V-shaped or Z-shaped or W-shaped integrally preformed web sections, each comprising two or more straight line webbing units 20, may alternatively be employed as shown in Figure 5 so that their return bend sections 21 may be seated in the oblong holes 13 preparatory to there welding such bend sections to the chords while similarly maintaining the desired common intersection point of the center of gravity lines of each pair of integral rod sections 20 and of the two neutral axes of the particular chord in which they are seated. Remote longitudinal marginal edges of the oblong holes will properly so locate the rods 20.

Optionally, any pair of the meeting straight line sections 22 may have their ends 23 mitered as shown in Figure 10 whereby to permit of a larger area of abutment against each other and incidentally advantageously to provide more of the structural steel metal of which the rods 22 are composed for fusing flow.

In performing the improved method of manufacture, the series of pairs of rod ends or the bend sections 21 are caused to project through the staggered holes in a pair of chord members and the welding of all at one chord member first effected while providing any suitable supporting means for holding those which project through the other chord member against displacement. A suitable jig has been contrived for that accomplishment and comprises a pair of rigid guides for holding and for clamping the two chord members in the desired parallelly spaced relationship together with abutment plates of appropriate conformation which are to be temporarily clamped against the pairs of ends 17 or the bends 21, as the case may be, which are not to be first

welded. After the row of welds to one chord member has been effected, the holding plates or perhaps a single elongated plate may be removed preparatory to effecting the other row of welds. The welding together of the ends of the two chord members may follow with or without intervening spacers of whatever chosen thickness and length. An outstanding advantage attending adoption of my method of manufacture is the ready possibility of varying the size and strength of the straight line rod sections, whether individual or in zig-zag groups of varying number, according to the foreknown load which the joists are to sustain. For instance, a plurality of straight line rod sections at each end may frequently be made stronger than those at the middle part of the composite webbing.

The zig-zag webbing might have alternate straight line sections perpendicular to the chords so that certain pairs of holes are not staggered, instead, the pairs for the perpendicularly disposed web sections ultimately be in vertical alinement. Such an arrangement reduces compression length, but requires more welds to increase the cost of manufacture.

For some uses, the chords might not be in the preferred, inversely appositioned arrangement, which is to say, might have their middle sections furthest apart, but with less success because at the sacrifice of the ideal arrangement of quadruple intersections which have been earlier explained.

While the provision of the holes in the chords are preferable because insuring proper intersections, I declare my realization that the holes 13 and 14 are not indispensable for certain purposes though likely that their absence would result in the production of an inferior joist because of the difficulty and uncertainty of establishing and maintaining the desired points of multiple intersection with a butt-welding procedure.

I claim:

1. The method of fabricating a joist comprising, fixing a pair of chords, each having a row of holes, in parallelly spaced relation to each other, jig-clamping converging pairs of meeting and mitered ends of an initially composite connecting webbing within so that they project beyond the holes of both chords respectively to provide adequate weld material there, while establishing points of quadruple intersection by the center of gravity lines of each pair of meeting webbing ends and by both neutral axes of the chord through which said webbing ends project and then welding all the pairs of said meeting ends to achieve a balanced chord with increased webbing resistance.

2. The method of fabricating a joist comprising, holding a pair of chords, each having a row of holes alined along a middle line thereof, in parallelly spaced relation to each other, jig-clamping converging pairs of meeting ends of an initially composite connecting webbing within so that they project beyond each of the holes of both chords respectively to provide adequate weld material, with establishment of a point of quadruple intersection by the center of gravity lines of each pair of meeting webbing ends and by both neutral axes of the chord through which said webbing ends project, welding all the pairs of said meeting ends to one chord and then welding all the opposite pairs of meeting ends of the webbing to the other chord while maintaining the essential points of quadruple intersection along the median plane of each chord to achieve a balanced chord and webbing resistance to failure under excessive load.

3. The method of fabricating a joist, comprising, fixing a pair of high-carbon-grade-steel chords, which are of zig-zag cross section and each of which is provided with a row of holes, in parallelly spaced relation to each other, inserting ends of structural-grade-steel webbing units through said holes so that said ends meet to provide adequate weld material there and then welding said meeting mitered ends.

4. The method of fabricating a joist, comprising, fixing a pair of metal chords, which are of U-shaped cross section and each of which is provided longitudinally along its middle section with a row of holes, in parallelly spaced relation to each other, inserting mitered ends of metal webbing units through said holes so that said ends meet within the confines of said chords and then unifying said meeting ends while establishing points of quadruple intersection by the center of gravity lines of the webbing units and by the neutral axes of the chords to obtain the maximum strength with a minimum of metal.

5. The hereindescribed method of fabricating a building unit comprising, jig-clamping a pair of elongated members of U-shaped cross section, each having a row of oblong holes in their middle sections, in parallelly spaced relation to each other, temporarily fixing meeting ends of pairs of webbing units within most of said holes so that the extremities of said webbing units project beyond the relatively remote margins of the holes in said members respectively while establishing points of quadruple intersection by the center of gravity lines of each meeting pair of webbing units and by both neutral axes of the member through which they project and while also maintaining a uniform, relatively transverse distance between said members and then securing pairs of said meeting extremities to each other and to one of said members while maintaining the desirable points of quadruple intersection along the median longitudinal plane of each member to achieve a balance therein by restoring and maintaining the gross section thereof.

WILLIAM B. MILLER.