Dec. 11, 1934. W. B. MILLER ET AL 1,983,632

TRUSS TYPE JOIST

Filed Nov. 19, 1931

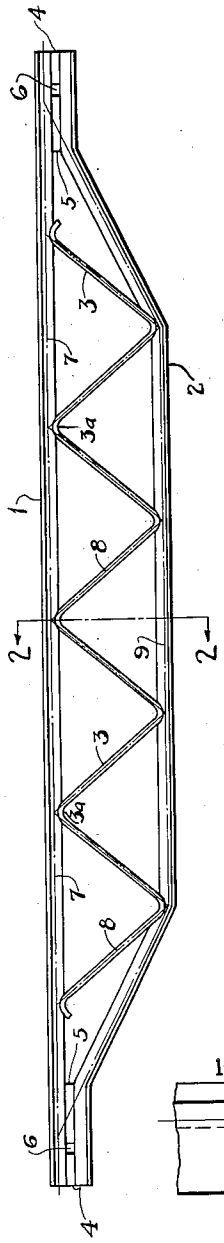


FIG. 1

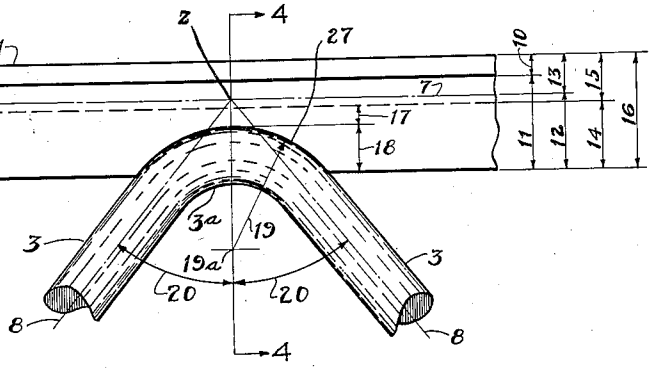


FIG. 3

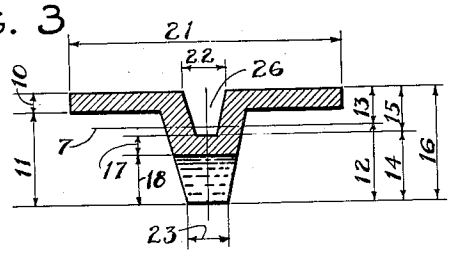


FIG. 4

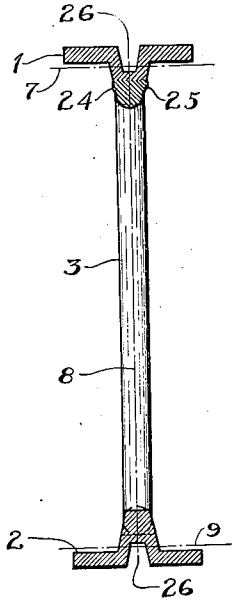


FIG. 2

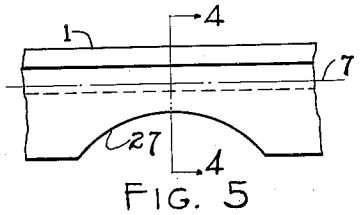


FIG. 5

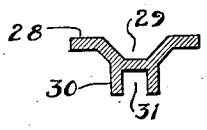


FIG. 6.

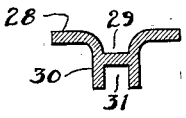


FIG. 7.

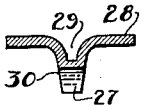


FIG. 8

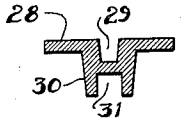


FIG. 9

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TRUSS TYPE JOIST

William B. Miller, Lakewood, and Frank Eroskey, Lyndhurst, Ohio

Application November 19, 1931, Serial No. 575,998

4 Claims. (Cl. 189—37)

Our invention pertains to a truss-type joist and to the method of making it.

The object of our invention has been to originate what we are convinced is demonstrably an all-purpose or ideal joist construction, comprising a minimum of weight with a maximum of strength for any specific load-carrying duty and which will be more reliable while more economically manufactured. Specifically, our invention will guarantee avoidance of an occurrence of secondary stresses either in the top and bottom chords or in the connecting web. The avoidance of bending or other secondary stresses in the web components is achieved in part by the proper location of the points of intersection of the center lines of gravity of the web components in the neutral axes of the chords and in part achieved by inserting the bends of the continuous wave-shaped web in arcuate grooves in the stems of the chords so that the curved bend sections are in their entirety braced within the grooves preparatory to welding or otherwise securing them therein; in part by maintenance of the constant depth of the web for a given depth of joist regardless of the area of the chord members so that the distance between the intersection of the top and bottom chords with the web is a constant; and in part by reason of our unique cross-sectional shape of chord member with its contrived lateral displacement of metal, with its continuous groove in the chord head or flange on the side opposite to the side from which the stem of the chord projects in order to accomplish a displacement of metal in required amount and direction and with its inclosure of the web bends to form a greater area and hence better pressure welded job.

It is to be realized that the scope of our invention comprehends many equivalent methods and constructions. The showing of the drawing and the particular description are merely specific exemplifications of a plurality of mechanical embodiments and arrangements and performances.

Adverting to the drawing:

Figure 1 is a side elevation of joist embodying the principles of our invention.

Figure 2 is an enlarged vertical section on line 2—2 of Figure 1.

Figure 3 is a still further enlarged fragmentary elevational detail of the interlocked connection between web bends and chord members with certain important dimensions measured and designated.

Figure 4 is a section on line 4—4 of Figure 3, likewise with certain measurements.

Figure 5 is a view showing one of the arcuate grooves in the chord members.

Figures 6 to 9 inclusive portray four sectional views of modified chord members embodying featured principles of our invention.

Our fabricated metal truss-type of joist comprises a top chord member 1 and bottom chord member 2 and a connecting web structure 3 of continuous zigzag or wave-like shape. While the cross sectional shape of the upper and lower chord members 1 and 2 to comprise a stem and a flange is the same, most essentially at so-called panel points where the bends of the web are secured thereto, it will be observed that the lower chord member 2 has its ends bent upwardly and its extremities closer to the extremities of the upper chord member for the interposition at each end of separated fillers 4 and 5 between each pair of which is a hole 6 for the purpose of facilitating any appropriate anchoring means. The method of securement of the two ends of the chord members is of no consequence to our invention. The neutral axis of the upper chord member has been designated with the numeral 7, the center of gravity lines of the angle-forming parts of the web have been designated (in Fig. 3) with the numeral 8 and the neutral axis of the lower chord member with the numeral 9.

Inviting attention to Figures 3 and 4 where certain dimensional measurements which are of importance to our invention are graphically displayed, we state the numeral 10 to designate the thickness of the chord flange, the numeral 11 to designate the distance between the lower surface of the chord flange and the bottom of the stem S of the chord member, which latter approximates a T shaped cross section, the numeral 12 to designate the distance between the neutral axis 7 of the chord member 1 and the bottom of the T, the numeral 13 to designate the distance between the neutral axis 7 and the top of the chord member or the top of its head or flange, the numeral 14 to designate the distance between the bottom of the stem S and the bottom of a continuous upper groove to be later explained, the numeral 15 to designate the vertical distance between the bottom of the continuous upper groove and the top of the chord member, the numeral 16 to designate the distance between the top and bottom of the complete joist, the numeral 17 to designate the distance between the bottoms of the upper and lower grooves (to be later explained) at panel points, the numeral 18 to designate the distance of recession of the bends 3a of the web 3 into the stem S of each chord member, the numeral 19 to

designate the radius of curvature of the bends 3*a*, the numerals 20 to designate the constant angles of each diagonal web component with a vertical line, the numeral 21 to designate the width of the chord flange, the numeral 22 to designate the outer and constant width of the upper and continuous groove, the numeral 23 to designate the variable width of the lower end of the stem S, the numerals 24 and 25 (Figure 2) to designate the welding burrs, and the numeral 26 to designate a continuous longitudinally extending groove along the center line of the flange of the chord member, which groove 26 on the side of the chord member opposite to the location of the stem is to displace metal in such an amount and direction as to insure final intersection at each panel point of all center of gravity lines.

The external vertical dimension of each chord member is according to our invention to remain constant for all sizes or for all areas. Always, the vertical distances between the neutral axis 7 and both the top and bottom of the complete joist is to remain constant. Preferably, the distances of 15 and 22 as dimensions of the continuous groove are constant for any area of chord section for the purpose of standardizing the top rolling performance and facilitating joist assembly. A series of chord members will have their dimensions 12, 13, 14, 15 and 16 constant and their dimensions 10, 11 and 21 variable to comply with the requirement for different areas having different load carrying capacity. The angle 20 which each component or section makes with a chord is a constant for all depth of joists and all sizes of webbing and correspondingly dimensioned series of chord members. The depth of joist is determined by its span. The variable area (width times thickness of a section) is determined by the expectable load.

It is to be understood that the arcuate grooves 27 in the extremities of the stem S are aligned and longitudinally spaced but, as exemplified, those in the upper chord member are staggered with relation to those in the appositioned stem of lower chord member so that the bends 3*a* may be almost entirely accommodated to be effectively braced therein. In so interlocking the bends 3*a* in the stems of the chord members preparatory to final pressure welding, a compensation is provided for any apparent loss of area due to the accommodating displacement of metal by reason of the existence of the outer groove 26, by the insertion of the web bends which become an integral part thereof, to achieve the neutral axis and center lines of gravity intersections earlier mentioned as in conformity with sound engineering in order to avoid incalculable secondary stresses. It is mentioned that in all joists of a given depth the out to out dimension of the web bends is a constant regardless of the combinations of sectional areas (thickness of the chord stem and flange and width of the latter) of chord members and webs. Moreover, the spacing of the arcuate grooves 27 for any chosen depth of joist will remain a constant, regardless of the adopted size combination of chord member and web, in order to bring the gravity line intersection points where desired and incidentally to standardize manufacture.

Secondary stresses are not set up because of the perfect intersection of the web angles with the chord members and because the stresses become transmitted directly along oblique web sections which are wholly straight between points of contact at their ends. No secondary stresses are set up in the chord members because of the correct intersection of the center lines of gravity. By setting the bends of the web into the arcuate grooves or of other conforming contour the bends of the web are firmly braced throughout their entire curved extent and offer a larger area for more secure welding. The constant depth of the web maintained for a given depth of joist regardless of the area of the chord members so that the distance between the top and bottom chord members and web is a constant, makes possible, together with insertion of the web bends, realization of a straight line between points of contact of the web components with the chord members and makes it possible to employ webs of less or smaller section than required to be used in joists where the web components are not so braced at their points of connection with the chord members. By having thus increased the area of the welded connections a joist is obtained which is not only better able to resist the loads that it will have ultimately to carry, but stronger for resisting the construction stresses that are set up due to construction loads, transportation or any other handling. During the welding operation the desired accurate fit over the full contour of the grooves into which the web bends are inserted is readily accomplished by the application of adequate pressure. The continuous groove 26 serves a purpose of decreasing the thickness of the metal between the welding electrodes to facilitate and cheapen and also preestablishes the neutral axis of the chord member and its shape is maintained by the temporary occupancy thereof of one of the welding electrodes and to allow the web bends to be pressed and secured into the staggered inner chord grooves while maintaining the important intersection (Z, Figure 3) of the center lines of gravity with neutral axes at all panel points.

It is to be understood that while the joist illustrated in Figure 1 has only nine panels the number will vary according to the span and depth of the joist, mindful that the zig-zag angles are always maintained uniform, because of the desideratum of gravity line intersection. The groove and web bend interlock favors correct manufacture by maintaining the alignment of the web and resisting a tendency of the chords or webs to become distorted or to move out of place.

It is desirable to be able to change the size of the web members to accommodate varying loads without disturbing in any way the intersection of the gravity lines. This is accomplished by adjusting the location of the radial point 19*a* while the angle of inclination of the line 8 remains unchanged.

As one example of the method in which our joist may be assembled we cite as follows:

Starting with straight chord and web members of the required section, the chord members of required section are first cut to the proper length for the particular length of joist to be manufactured allowing additional length of material for the lower chord to take care of bent up ends.

The chords are then grooved at the proper intervals to receive the bends of the zigzag web member. The ends of the lower chord member are then bent up so as to form a connection with the upper chord member when assembled. The web members are then bent into zig-zag shape so that the interval of the bends conforms to the grooves in the chord members. Next the web is fitted to the chords while both are on a table so that each bend in the zigzag web is recessed properly into its respective groove.

The elements of the joist are then clamped into position at intervals and the joist is then run through a welding machine preferably of the pressure welding type. The type of welding machine would preferably be one having one electric element of such shape as would conform to the continuous grooved profile of the joist section and the other of such shape as would conform to the shape of the bends of the zigzag web section.

During the assembly and welding process of the joist, machine guides of the electric welding machine will fit into the continuous groove of the joist chords and hold the joist in alignment as it advances through the welding machine, making a finished product of precision. At the same time that the guides in the continuous grooves of the chord members are holding chord alignment the accurate grooves of the chord members hold the web in alignment and prevent creeping of the joist elements.

After all the web member welds are made the end chord connections are welded to complete the joist fabrication.

Figures 6 to 9 are all modifications of the cross sectional design of the chord members and since they so slightly differ they will be given like reference characters to designate like parts. Each comprises a flange 28 provided along its median line with a continuous metal displacing compound groove 29, each includes a stem 30 and while the forms shown in Figures 6, 7 and 9 additionally show stem grooves 31, Figure 8 differs in showing one defining wall of its groove 31 in elevation.

We consider one important feature of novelty of our invention to reside in any one point of connection of one chord member with the web whereby we have established the possibility and realized the great advantage of employing variable chord sections and variable web sections with the latter having components converging at panel points while constantly maintaining for every size, strength and weight of joist an intersection at one unvaryingly positioned point Z, (Figure 3) at each panel connection between the gravity center lines of said web components and the horizontal and vertical neutral axes of the chord section. Consonantly, we can successfully employ in a truss-type metal joist a chord member of varying sectional area as well as two chord members of comparatively different sectional areas while always maintaining their horizontally extending neutral axes in intersection with their vertical gravity center line at one unvaryingly positioned point. Any type of continuous zig-zag web having its diagonal sections forming the same angle with the vertical while the web has a uniform vertical dimension, may be secured to a pair of chord members so that the completed joist has a uniform external vertical dimension even though the areas of the top and bottom chord members vary and yet always maintain the intersection at panel points of all center lines of gravity passing therethrough.

We claim:—

1. A metallic joist comprising top and bottom chord members fashioned with spaced arcuate grooves in staggered apposition and a web structure having bend portions and reversely inclined diagonal portions extending between and secured in said arcuate grooves of said top and bottom chord members, the entire depth dimensions of said chord members being constant irrespective of limited variations in thickness of the assembled parts yet remaining so arranged that the respective center of gravity lines constantly intersect at points substantially lying in the neutral axes of said chord members, said groove-interlocking connections being adapted to resist secondary stresses in the web structure and also compensatorily to replace the metal displaced from said grooves.

2. A metallic joist comprising top and bottom chord members fashioned on their outer sides with a longitudinally extending groove and a zig-zag web structure having portions secured to said top and bottom chord members, the entire depth dimensions of said chord members being constant and the distances between the bottom of each groove and the top and bottom of its chord member being constant irrespective of limited variations in thickness of the assembled parts yet remaining so arranged that the respective center of gravity lines of angle-forming parts of the web structure constantly intersect at points substantially lying in the neutral axes of said chord members.

3. In a truss-type joist, the combination of a pair of parallelly spaced chord members of inversely arranged T-shaped cross section each to comprise a stem and flange, said appositioned stem ends each being fashioned with a row of grooves, the grooves of one row being staggered with reference to the grooves of the other row, said flanges each being fashioned opposite its stem with a longitudinally extending groove, a wave-shaped web having staggered bends occupying said stem grooves in both chord members to establish intersection of pairs of converging components of said web substantially in the neutral axes of said chord members and means for securing said bends in said grooves.

4. A metal truss-type joist comprising a continuous wave-shaped web and a pair of chords of T shaped cross section and with their stems appositioned and fashioned with relatively staggered grooves for the reception of the crests of said web, the intersection of said web in said chords being so contrived that the center of gravity lines of parts of said web intersect at points in the neutral axes of said chords.

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