

March 29, 1938.

E. D. CODDINGTON

2,112,480

JOIST

Filed Sept. 3, 1935

2 Sheets-Sheet 1

Fig. 1.

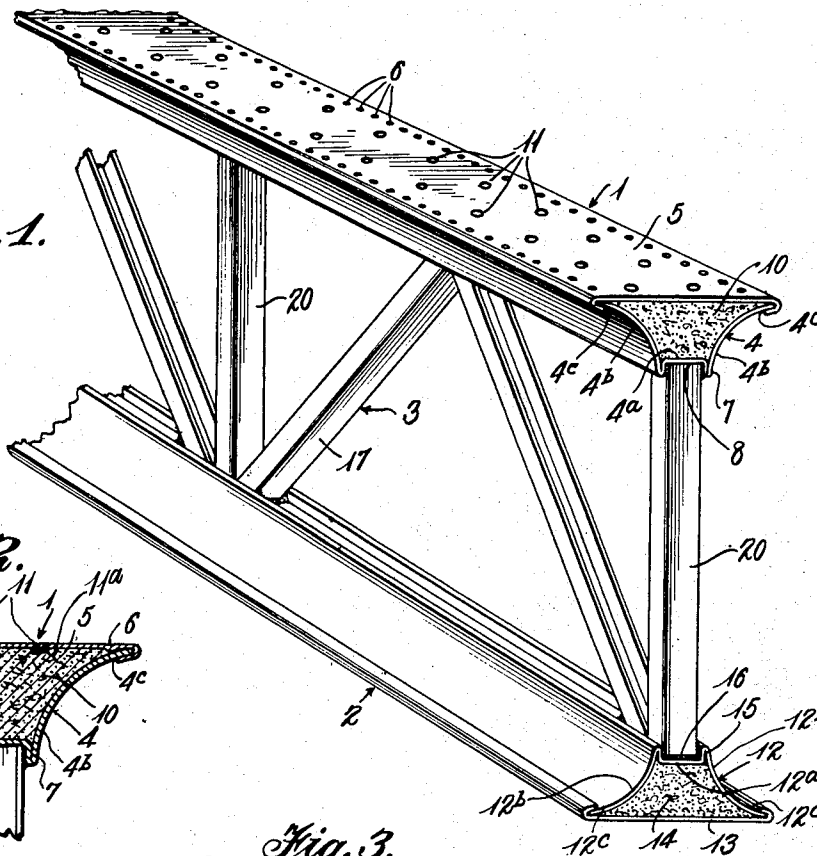


Fig. 2.

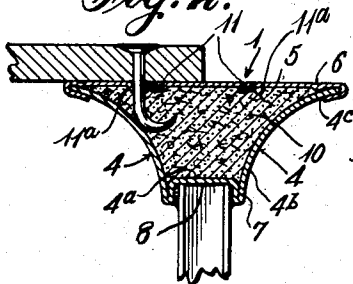


Fig. 3.



Fig. 4.

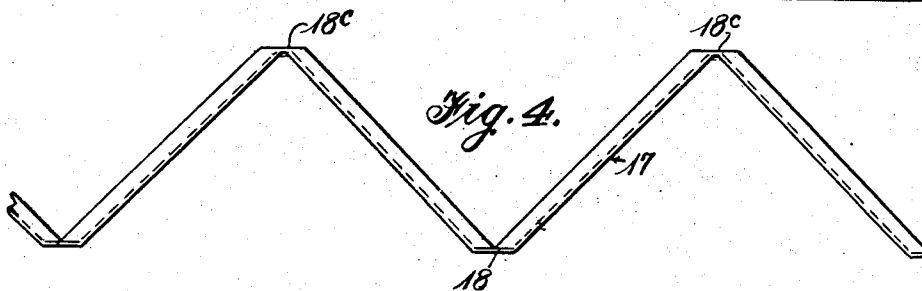
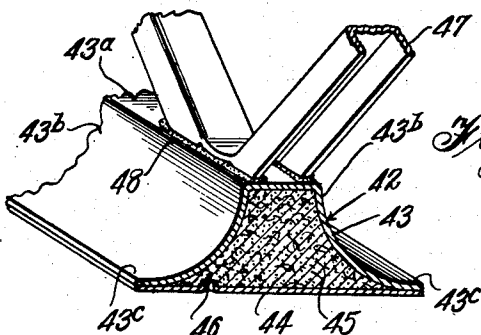


Fig. 9.



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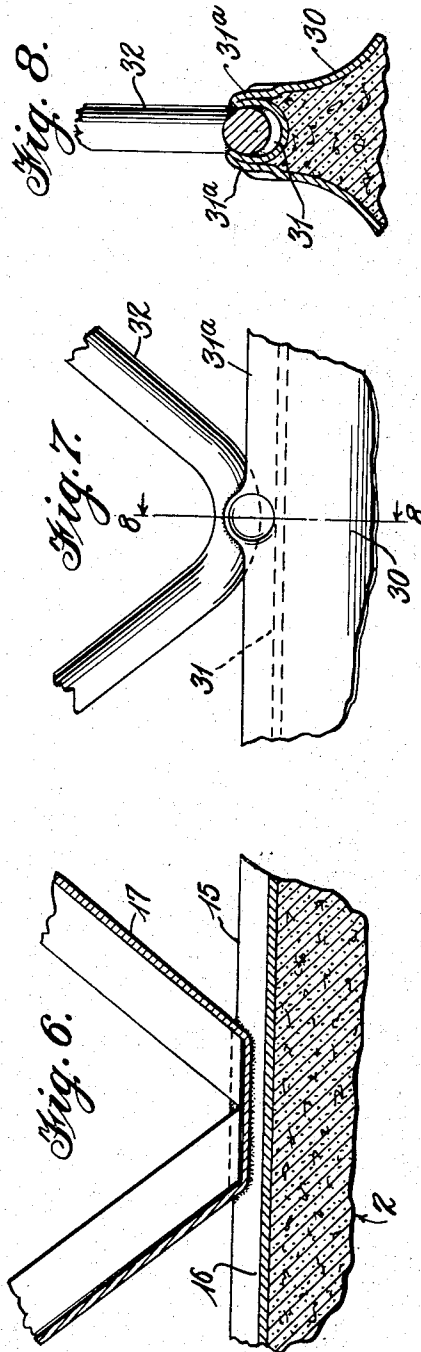
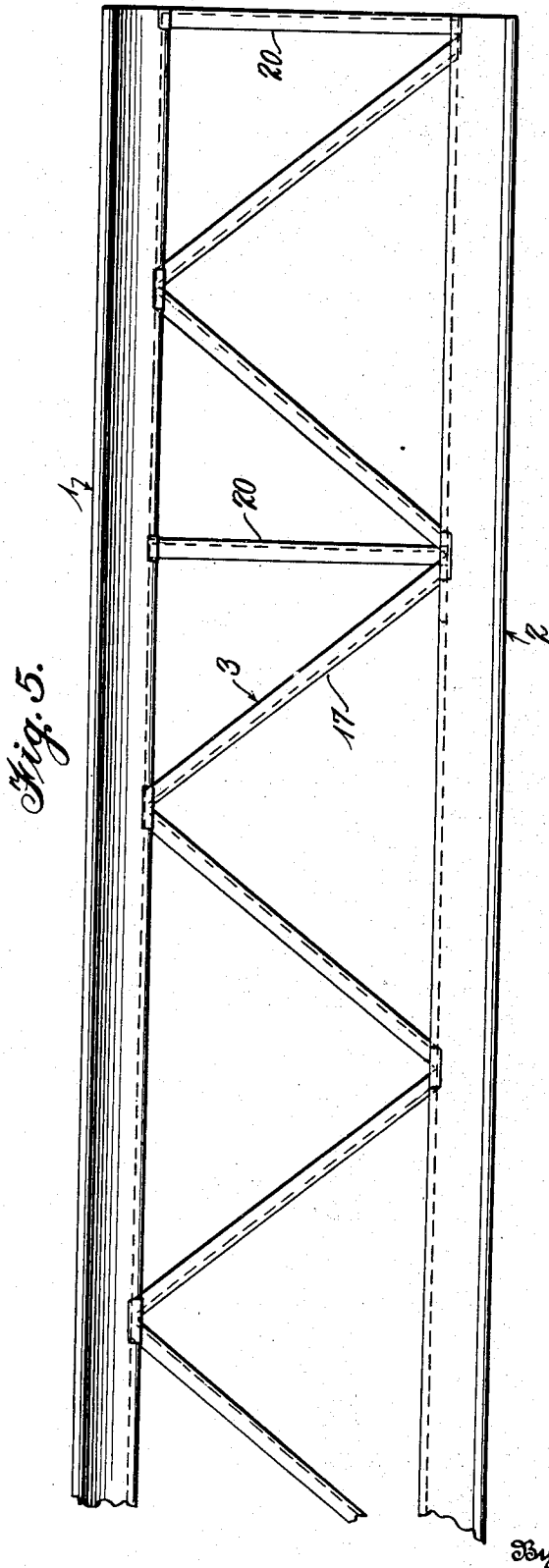
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,112,480

JOIST

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Application September 3, 1935, Serial No. 39,025

10 Claims. (Cl. 189—37)

This invention relates to structural members and more particularly to joists suitable for use in building construction.

An important object of the invention is to provide a composite joist of sheet metal and a cementitious core material which is light, strong and well balanced and proof against decay and attack by destructive insects. Joists of this general character find useful application in building construction as horizontal load supporting members. While metal has to a great extent displaced wood in the erection of large buildings, because of its greater strength and permanence and because of its fire-proof character, however, all-metal structural members owing to their excessive weight, relatively high cost and inconvenience of assembly have not proved commercially practicable for employment in less imposing structures, such as bungalows and small homes. By making joists of a composite of sheet metal and cementitious filling material, a light, low-priced structural unit is obtained fully capable of withstanding heavy loads without deformation by crushing or bending.

Another object of the invention is to provide a joist of the truss type, comprising two parallel chords supported in spaced relation, each composed of a trough-shaped element formed of heavy gauge sheet metal and having a cover plate of thinner nail-penetrable sheet metal closing its top and forming with the trough a closed tube of generally trapezoidal cross-section. Within the tube is contained a core of cementitious material into which nails may be driven and frictionally retained in making attachment to the joist of secondary members. An important feature of the invention resides in forming the walls of the trough of sufficient thickness so that they function as deflecting or clenching surfaces for nails driven through the cover plate into the core.

In order for the joist to admit of economical manufacture, without sacrificing the important advantages of light weight and rugged construction, the invention has as a further object to provide a joist having an improved form of web for rigidly supporting the chords in spaced relation. More particularly this web comprises a continuous channel iron or a continuous rod bent into zig-zag shape and secured, as by welding, at its reverse bends in flat bearing contact with the chords. In order that the channel may be more readily bent in the fashion indicated, where a channel composes the web, its sides are suitably deformed, as by notching or swaging.

For lending increased strength to the structural member I provide at suitably spaced intervals uprights or struts, which may be constituted of channel sections similar to the web, extending perpendicularly between the chords. These struts enable the chords of the joist to more effectively resist bending due to locally concentrated loads upon the joist.

The joist in its preferred form is fashioned so that each trough shaped element presents a shallow, longitudinally-extending recess upon its exterior bottom face, the recess being of a width corresponding to the transverse thickness of the channel or rod constituting the web, thus permitting the sides of the web to be attached to the side walls of the recess for effecting a rigid union of the parts.

Other objects and advantages of the invention will become apparent from the following detailed description of a preferred form of joist embodying the features of the invention, together with several alternative forms of the same, reference being had to the annexed sheets of drawings in which:

Figure 1 is a perspective view of an end of a joist exemplifying the invention;

Figure 2 is a transverse cross-section taken through the upper chord of the joist of Fig. 1 and showing the manner in which the side walls of the trough function as clenching surfaces for nails driven into the core;

Figure 3 shows a channel shaped web having its sides notched preparatory to bending;

Figure 4 illustrates the web of Fig. 3 bent into zigzag shape to form the web extending between the chords;

Figure 5 is a side elevation of the joist of Fig. 1;

Figure 6 is a detail cross-sectional view of the lower chord of the joist of Fig. 1, illustrating one mode of attaching the web to the chord;

Figure 7 is a fragmentary view of the lower chord of a joist in which a rod constitutes the web and indicating the mode of uniting the web with the chord;

Figure 8 is a cross-sectional view on the line 2-2 of Fig. 7; and

Figure 9 is a sectional perspective view of another type of chord showing the manner of fastening a channel-shaped web thereto.

The joist illustrated in Fig. 1 comprises generally two chord members 1 and 2 supported in parallel spaced relation by a web 3. The upper chord 1 is composed of relatively heavy metal plate rolled so as to form a trough 4 having a bottom 4a and outwardly flaring side walls 4b

terminating in substantially horizontal flanges 4c. Supported upon and extending between the flanges 4c is a flat cover plate 5 of sheet metal of substantially less thickness than the metal plate forming the trough 4. The longitudinal edges of the cover plate are folded over the flanges 4c of the trough and the cover plate is united to the flanges by crimping, as indicated at 6, or by puncturing or welding, so as to avoid slippage of the cover relative to the trough when the joist is placed under load and stress is induced in the chord. The cover plate 5 thus closes the top of the trough and forms therewith a tubular casing of generally trapezoidal cross-section, as shown in Fig. 1.

The side walls 4b of the trough are extended beyond its exterior bottom face and folded back upon themselves so as to form perpendicular side walls 7 of a recess 8 extending longitudinally of the trough. The tubular casing encloses a hardened core 10 of nailable material, such as a solidified body of gypsum, Portland cement and sawdust represented in the proportion, by weight, 55:20:9. One process which lends itself to the fabrication of chords for this type of joist is described and claimed in my copending application Serial No. 39,022, in which a dry mixture of the component materials is packed within the casing, moisture then being introduced through the walls of the casing to supply the necessary water of crystallization to the confined filler which hardens into a solid core. The cover plate 5 is, to this end, provided with rows of perforations 11, these perforations being punched inwardly so as to form burrs 11a (Fig. 2) upon the interior of the tube which become embedded within the core and serve to anchor the casing to the core.

The lower chord member 2 is of identically the same construction as upper chord member 1 just described, comprising a trough-shaped member 12 made of heavy sheet metal and having a flat bottom 12a and outwardly flared walls 12b terminating in horizontal flanges 12c. A flat cover plate 13 extends between and is fastened by crimping, puncturing or welding to the flanges so as to form with the trough member a tubular casing enclosing a core 14 of cementitious filling material of the character described above. The cover plate 13 is provided with rows of perforations (not shown) similarly to cover plate 5, and the side walls of the trough are extended in folded relation to form the sides 15 of a longitudinally-extending recess 16 upon the external face of the trough bottom 12a.

The chords are arranged in parallel spaced relation with the bottom 4a of one trough directed toward the bottom 12a of the other trough. The web 3 as shown in Fig. 3, before bending comprises a straight, continuous channel member 17 made of sheet metal the parallel sides 17a of which are cut away to the bottom 17b of the channel at coinciding, regularly-spaced intervals, defining wedge-shaped notches 18 and V-shaped notches 18a. The channel is adapted to be bent back and forth between these notches into the zig-zag shape indicated in Fig. 4, the edges of the wedge-shaped notches 18 folding inwardly against the bottom of the channel, as best illustrated in Fig. 6, and the edges of the notches 18a spreading apart so as to lie in the plane of the bottom of the channel, as indicated at 18c in Fig. 4. The flattened apices of the zig-zag web thus produced repose within the recesses 8 and 16 formed upon the bottoms of the troughs

4 and 12, and the sides of the channel are welded to the side walls of the recesses by a process known as smash welding which in addition to depositing weld metal between the parts to be bonded, simultaneously compresses the side walls of the recesses and swages their upper edges inwardly into locking engagement with the web. Thus a joist of truss form is produced, the two chords of which are supported in parallelism by a continuous channel-shaped web which weaves diagonally back and forth between the chords.

For affording additional support to the chords, a pair of upright struts 20 made of straight channel sections, similar to the channel 17 constituting the web, are arranged adjacent the ends of the joist and, as shown in Fig. 5, these struts extend between the bottoms of the trough members 4 and 12 and foot in the recesses 8 and 16. One end of each strut rests upon the web at the point of junction of the latter with one of the chords, while both ends of the strut are welded to the sides of the recesses. When the web and the strut are composed of the same size stock, the end of the strut abutting upon the web may be compressed laterally so as to be receivable between the walls of the channel-shaped web. A pair of struts will ordinarily close each end of the joist since the joist at its ends is subject to greatest compression, although if desired, additional struts may be provided at suitably spaced intervals throughout the length of the member.

As has been previously stated the trough-shaped members 4 and 12 are composed of heavy metal plate while the cover plates 5 and 13 are of relatively light sheet metal. This heavy metal plate imparts great rigidity and strength to the chords. Also by reason of this construction, nails may be readily driven through the cover plate into the core 11 in attaching, for example, floor boards or slabs, (Fig. 2), to the joist. However, the thick flaring side walls of the trough operate to deflect the ends of the nails and to clench them within the body of the core. Thus, nails driven into the joist in such a manner as to ordinarily pass completely through its marginal portions and be insecurely retained therein are, by my improved joist construction, firmly anchored in place and offer appreciable resistance to withdrawal.

In those cases where a solid metal rod is employed as the web, in lieu of a channel iron as previously described, a somewhat similar type of bond can be effected between the web and the chords. In Figs. 7 and 8, a portion of a lower chord 30 is shown having a longitudinal recess 31 of semicircular cross-section extending along its external bottom face, the side walls 31a of this recess being constituted of the extended sides of the trough-shaped element forming the lower chord.

The web 32 is made of a continuous rod of metal of circular cross-section bent back and forth in zig-zag manner and having its reverse bends which contact the lower chord 30 seated within the recesses 31. By the process of welding heretofore referred to, the web 32 is bonded to the sides of the recess and the top edges of the recess are swaged partially around the circumference of the rod, as best indicated in Fig. 8.

A joist utilizing a modified form of chord element is illustrated in Fig. 9, this chord being adapted to take the place of the chords 1 and 2 of Fig. 1. Each chord 42 comprises a tubular casing made up of a trough-shaped member 43 having a flat bottom 43a, two outwardly flaring

side walls 43b terminating in horizontal flanges 43c and a cover plate 44 supported upon the flanges and bridging the top of the trough. In this modification, as in the joist construction just described, the trough is made of a heavy gauge metal capable of deflecting nails driven into contact with its inclined side walls, and the cover plate is made of light nail-penetrable sheet metal. The cover plate 44 may be spot welded to the horizontally extending flanges 43c of the trough member in lieu of the crimped connection between these parts employed in the construction of Fig. 1.

The tubular casing encloses a core of cementitious filling material 45 providing a nailing block, and perforations 46 (only one being indicated) formed in the cover plate affords means for introducing moisture into the core and allowing the escape of excess moisture therefrom. In this type of truss, instead of presenting a recess for the reception of the web, the bottom of the trough for its entire width is flat. A web composed of a continuous channel iron 47, which may be constructed similarly to the web described in connection with the joist of Fig. 1, passes back and forth between the chords and is welded to this flat surface at spaced intervals therealong. In this figure the channel is shown welded at 48 to the flat bottom of the trough, the channel having been previously bent so that the V-shaped notches originally formed in its sides are stretched apart permitting the edges of these notches to lie flat against the bottom of the trough. The web may be united with the top chord (not shown) in the manner illustrated in Fig. 6, except that in the absence of a recess upon this chord the bottom of the web will lie flat against and be welded to the bottom of the trough. An advantage of this type of joist resides in its simplicity of design.

It will be apparent from the above description that a joist is produced which is light, strong and well-balanced and which lends itself to rapid and economical manufacture. Manifestly either of the forms of chords described may be employed in the construction of the joist as seems preferable. Similarly, varying the number of struts 20 in the joist, or omitting such struts altogether, are changes which depend largely upon the particular employment for which such structural members are designed.

Obviously various other changes in arrangement and design may be made in the joists described above without departing from the spirit of my invention.

I claim:

1. In a structural member, a trough-shaped element of relatively heavy metal, a cover plate of light nail-penetrable sheet metal closing the top of the trough-shaped element, and a nailable core enclosed by the trough-shaped element, the rigidity of the metal composing the trough-shaped element being such as to be normally impenetrable by nails.

2. A joist comprising a pair of chords, means rigidly supporting the chords in spaced relation, one of said chords comprising a trough-shaped element of sheet metal, a cover plate closing the top of said trough-shaped element and composed of nail-penetrable metal of thinner gauge than the metal of the trough-shaped element, and a nailable core enclosed by the trough-shaped element and cover plate.

3. A joist comprising a pair of chords, means rigidly supporting the chords in spaced relation,

one of said chords comprising a trough-shaped element of sheet metal having outwardly flaring side walls, a cover plate of light nail-penetrable sheet metal closing the top of the trough, the sheet metal of the trough-shaped element being of sufficient rigidity to provide a nail clenching surface for nails driven through the cover plate into the core, and a cementitious core enclosed by the trough-shaped element and cover plate.

4. A joist comprising a pair of chords, a web rigidly supporting the chords in parallel spaced relation, said chords each comprising a trough-shaped element of relatively heavy sheet metal, a cover plate of light nail-penetrable sheet metal closing the top of the trough-shaped member, and a cementitious nailable core enclosed by the trough-shaped member and cover plate, said web comprising a channel member having its opposed sides notched at spaced intervals lengthwise of the channel and bent diagonally back and forth between the chords, and the sides of the channel being united with the trough-shaped members at locations coinciding to the notched sides of the channel.

5. A joist comprising a pair of chords, a web rigidly supporting the chords in parallel spaced relation, said chords each comprising a trough-shaped element of heavy sheet metal, a cover plate of light sheet metal closing the top of the trough-shaped element and a cementitious nailable core enclosed by the trough and cover plate, the web comprising a channel member bent diagonally back and forth between the chords, and the bottom of the channel being united at its apices with the trough-shaped elements, said channel having its sides removed at its points of union with the trough-shaped elements, and a plurality of struts extending perpendicularly between the chords.

6. A joist comprising a pair of chords, a web rigidly supporting the chords in parallel spaced relation, each of said chords comprising a trough-shaped element of relatively heavy sheet metal, a cover plate of light nail-penetrable sheet metal closing the top of the trough-shaped element and a cementitious nailable core enclosed by the trough-shaped element and cover plate, the bottom of each of said trough-shaped elements being exteriorly provided with a longitudinally-extending recess, and said web comprising a channel member bent so as to extend diagonally back and forth between the chords and into the recesses of said trough-shaped elements, said channel being welded at its bends to the trough-shaped elements.

7. A joist comprising a pair of chords, a web rigidly supporting the chords in parallel spaced relation, each of said chords comprising a trough-shaped element of relatively heavy sheet metal, a cover plate of light nail-penetrable sheet metal closing the top of the trough and a cementitious nailable core enclosed by the trough-shaped element and cover plate, the bottom of each of said trough-shaped elements being exteriorly provided with a longitudinally-extending recess, and said web comprising a channel member bent so as to weave diagonally back and forth between the chords and having its apices seated within the recesses of the trough-shaped elements and welded to the sides of said recesses.

8. A joist comprising a pair of chords, a web rigidly supporting the chords in parallel spaced relation, each of said chords comprising a trough-shaped element of relatively heavy sheet metal, a cover plate of light nail-penetrable sheet metal

closing the top of the trough-shaped element, and a cementitious nailable core enclosed by the trough-shaped element and cover plate, the bottom of each of said trough-shaped elements being exteriorly provided with a longitudinally-extending recess, and said web comprising a channel member bent transversely across its bottom so as to weave back and forth between the chords and having its sides cut away at its points of bend, said bends being seated within and welded to the sides of the recesses.

9. A joist comprising a pair of chords, each of said chords comprising a tubular sheet metal casing, a nailable core completely enclosed within the casing, a web rigidly supporting the chords in parallel spaced relation, said web comprising a continuous metal rod of generally circular cross-section bent back and forth into zig-zag shape and extending between the chords, said chords having recesses formed along their opposed bottom faces of semicircular cross-section receiving the bends of the rod, the rod being rigidly retained in the recesses by both welding and de-

formation of the side walls into partially overlapped engagement with the circumference of the rod.

10. A joist comprising a pair of chords, a web rigidly supporting the chords in parallel spaced relation, each of said chords comprising a trough-shaped element of relatively heavy sheet metal, a cover plate of light nail-penetrable sheet metal closing the top of the trough-shaped element and a cementitious nailable core enclosed by the trough-shaped element and cover plate, the bottom of each of said trough-shaped elements being exteriorly provided with a longitudinally-extending recess, and said web comprising a unitary member coextensive with the chords bent transversely across its bottom so as to extend diagonally back and forth between the chords and into the recesses of said trough-shaped elements, said web being rigidly united at its bends to the trough-shaped elements.

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