July 16, 1968 I. J. McMANUS 3,392,499

STEEL JOIST CONNECTION

Filed May 2, 1966 3 Sheets-Sheet 1

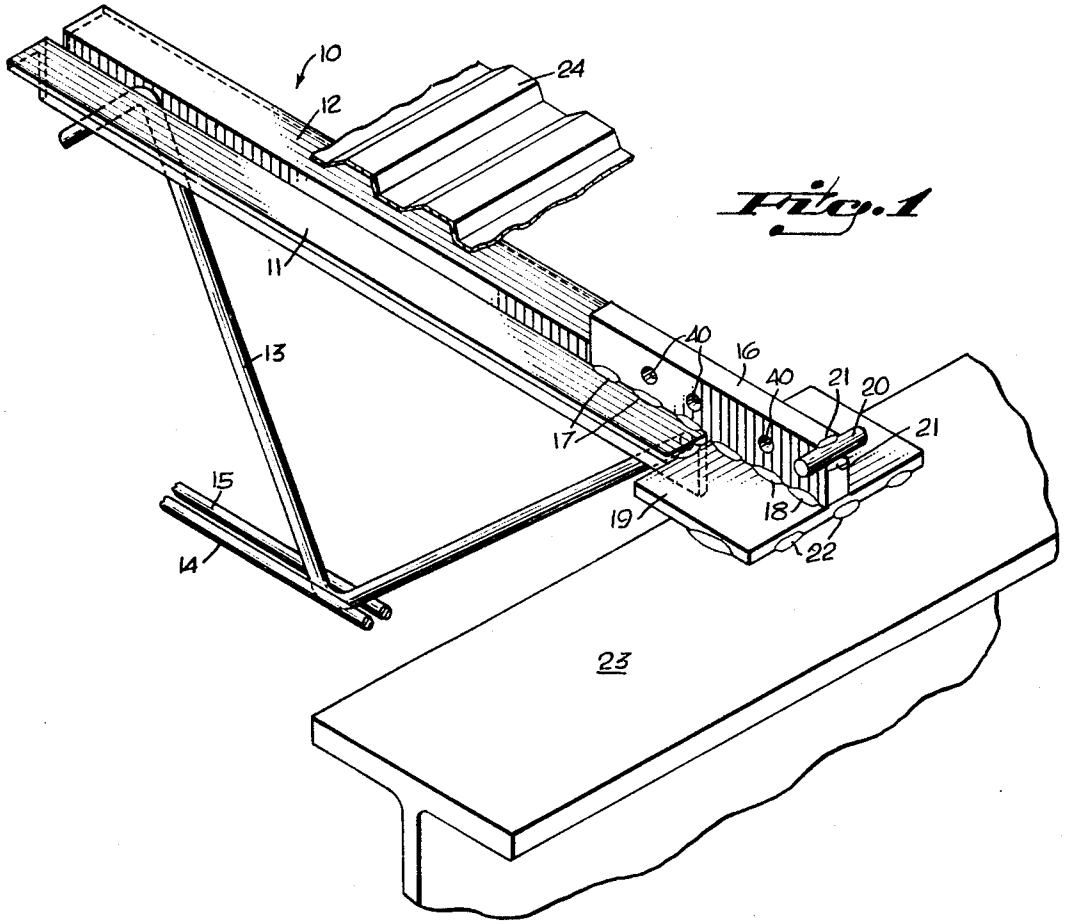


Fig. 1

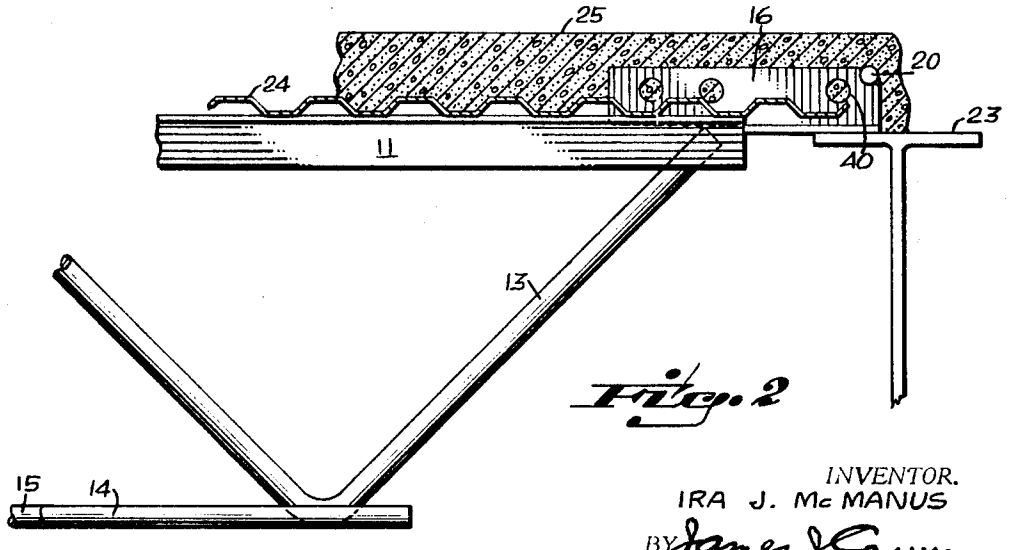


Fig. 2

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July 16, 1968 I. J. McMANUS 3,392,499

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Filed May 2, 1966 3 Sheets-Sheet 2

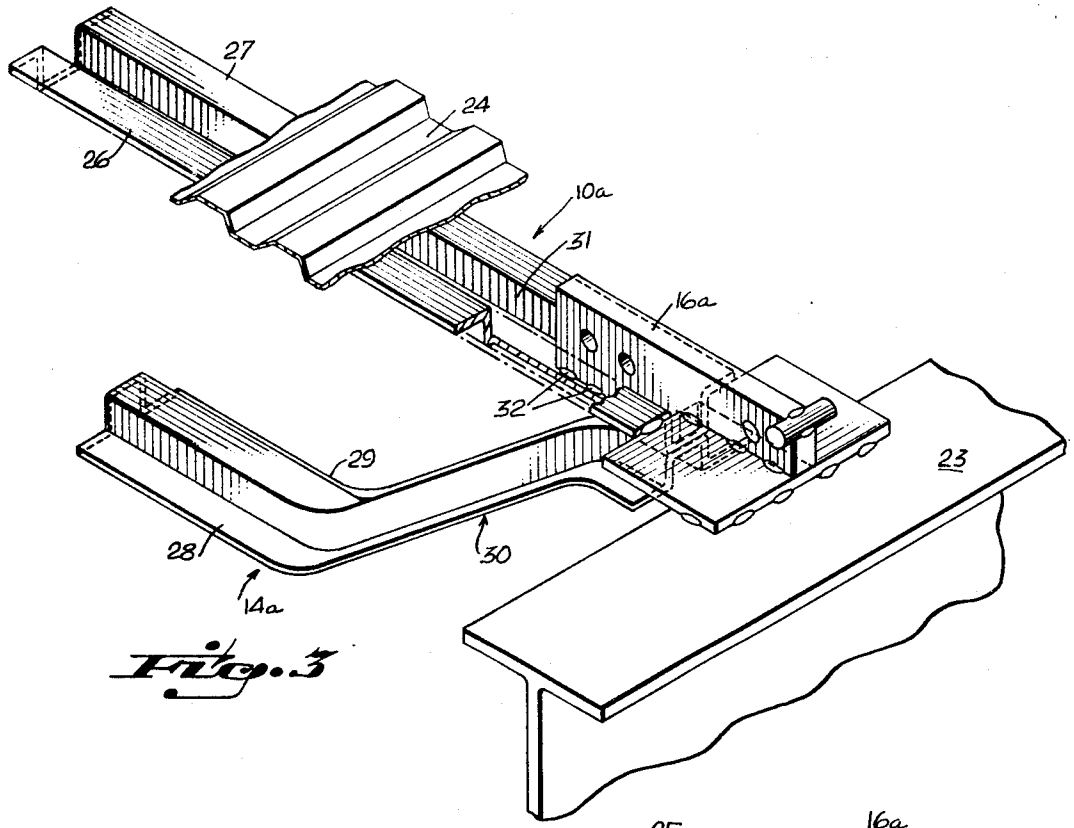


Fig. 3

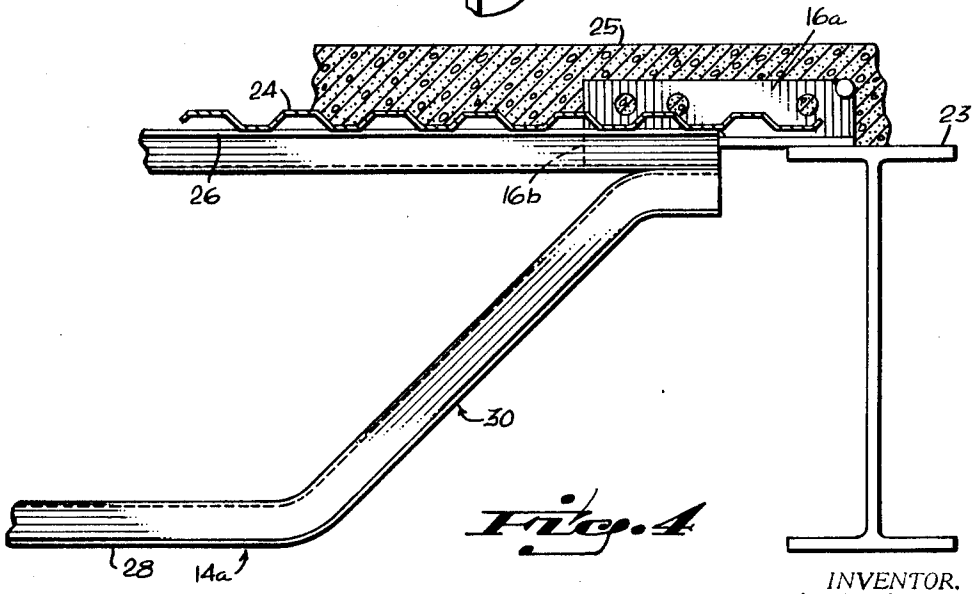


Fig. 4

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July 16, 1968 I. J. McMANUS 3,392,499

STEEL JOIST CONNECTION

Filed May 2, 1966 5 Sheets-Sheet 3

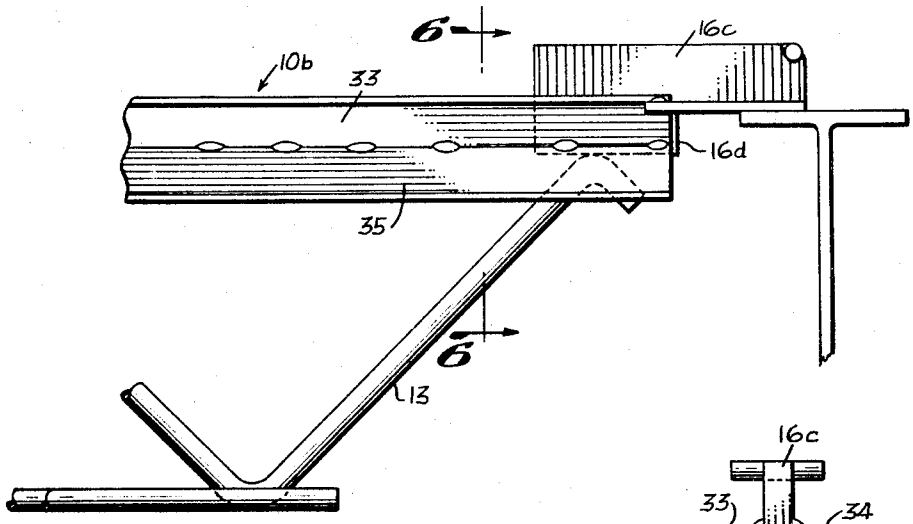


Fig. 5

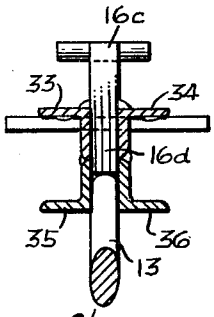


Fig. 6

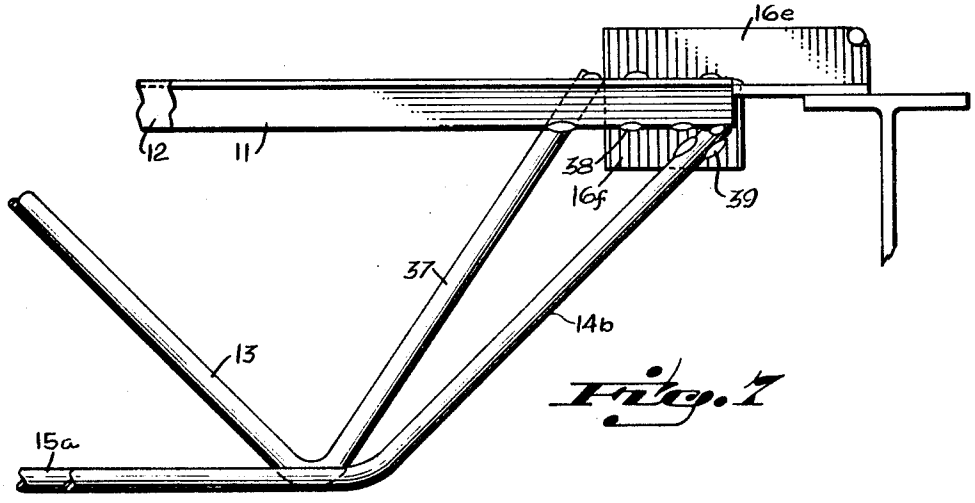


Fig. 7

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United States Patent Office

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STEEL JOIST CONNECTION

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ABSTRACT OF THE DISCLOSURE

A steel joist end connection for a building structure to provide an improved joist keying end construction when said joist is welded to a supporting girder and subsequently encased by a concrete slab.

My invention relates generally to steel joists used in the construction of steel and concrete buildings and is directed particularly to improvements in end connections of standard open-web steel joists where they join supporting steel beams.

Open-web steel joists are commonly fabricated of a pair of angle-iron flanges welded in opposed relation along the apices at one side of a zig-zag bar web, to form a top chord, and a pair of longitudinal bars or the like welded along the apices at the other side of the bar web to form the bottom chord. Such joists are generally welded between steel framework beams or girders to provide the supporting structure for concrete slab floors and the like. In ordinary construction, the top chords of the steel joists are joined to the top flange of framework girders or beams by horizontal extension bars, flanges or the like welded between end portions of the joist web somewhat below the upper chord, and the top flanges of the associated girder or beam. The concrete slab is poured upon forms placed on top of the joists, whereby the bottom of the slab is supported in vertically spaced relation above the top of the supporting beam or girder.

It is accordingly one of the principal objects of this invention to provide an improved joist end construction that, when welded to the supporting girder or beam top flange and subsequently encased by the concrete slab, allows the concrete slab and the supporting girder or beam to act together in composite action, resulting in economies due to savings in weight of the supporting girder or beam.

It is another object to provide an improved end connection for open-web steel joists wherein the top chord of the joists will be substantially at the level of the top flange of the supporting girders or beams, thereby readily permitting marginal portions of a concrete floor to be placed in bearing relation upon top portions of supporting girders or beams. With such construction, the concrete floor slab is in rigid connection with supporting girder or beam steel to act in unison therewith and increasing the rigidity of the floor or roof system.

Another object is to provide an end connection for open-web steel joists that can readily be pre-fabricated in the shop, for the most part, requiring only a few easily-performed welding operations on the job, thereby effecting composite action with further economies in time and labor.

Another object is to provide an end connection of the character described a major portion of which will extend up into a concrete slab or floor it supports so as to be encased therein.

Yet another object is to provide an end connection of the character described that raises the supporting steel relative to the top of the concrete floor in steel framework building construction, thereby permitting a reduction in floor-to-floor heights for given ceiling heights.

A more particular object is to provide an end connection for open-web steel joists comprising a vertical shear plate welded to and extending outwardly and upwardly of the end portion of a top chord of a steel joist, and a horizontally-extending bed plate welded or otherwise secured against the underside of the shear plate at the outwardly-extending end thereof and adapted to seat upon the top flange or other surface of a supporting framework girder.

Yet another object is to provide an end connection of the character described and further including a short, horizontally-extending bar secured to the outer end of the shear plate near the upper end thereof to enhance the locking action of a concrete floor slab or the like poured over said end connection.

Other objects, features and advantages of the invention will be apparent from the following description when read with reference to the accompanying drawings. In the drawings, wherein like reference numerals denote corresponding parts throughout the several views:

FIG. 1 is an oblique view, as seen from the top of a steel joist end connection embodying the invention shown connected to a support girder, partially shown;

FIG. 2 is a side elevational view of the end connection illustrated in FIG. 1, illustrating the use of form plates therewith for forming a concrete floor slab over a series of steel joists;

FIG. 3 is a modified form of the invention illustrating, in oblique view as seen from the top, an end connection for use with steel joists having single top and bottom chords formed of sheet steel bent into channel shape;

FIG. 4 is a side elevational view of the end connection illustrated in FIG. 3, illustrating the use of form plates therewith for forming a concrete floor slab over a series of joists;

FIG. 5 is a side elevational view of a modified form of the end connection illustrated in FIGS. 1 and 2;

FIG. 6 is a vertical cross-sectional view taken along the line **6—6** of FIG. 5 in the direction of the arrows;

FIG. 7 is a side elevational view of another modified form of the end connection illustrated in FIGS. 1 and 2.

Referring now in detail to the drawings and considering first the embodiment of the invention illustrated in FIGS. 1 and 2, **10** designates a typical open-web steel joist comprised of a pair of angle irons **11, 12** welded opposedly along the apices at one side of a zig-zag bar web **13**, to form the top chord of the joist, and a pair of steel rods **14, 15** welded opposedly along the apices at the other side of the bar web **13** to form the bottom chord of the joist. The end connection embodying the invention comprises an elongated steel vertical shear plate **16**, about 10 inches long for example, one end of which is welded edgewise to the top of the joist top chord angle irons **11, 12** so that the other end of said shear plate extends outwardly of the joist to an extent of about one-half its length. Preferably, the thickness of the shear plate **16** is such as to just fit between the opposed surfaces of the top chord angle irons **11, 12** to facilitate welding thereat as is best illustrated at **17** in FIG. 1. Welded against the lower edge of the shear plate **16**, as indicated at **18**, is a rectangular steel bearing plate **19**. The upper corner at the outer end of the shear plate **16** is notched to receive a short, transversely-extending bar **20**, welded in place therein as indicated at **21**. The bar **20** serves as additional means for keying the end connection in a concrete slab as is hereinbelow more fully described.

It is to be understood that the above-described end connection for the joist **10** is preferably fabricated in the shop so that the assembly need merely be set in place between the supporting structure steel and welded. FIG. 1 illustrates how an end connection at one end of the joist **10** is joined by welding as at **22** to the top flange of a girder **23**.

The usual sheet metal form plates **24** placed upon the erected joist form the bottom of the concrete slab **25** (see FIG. 2). In use of the end connection, the form plates **24** are placed to extend over the top of the supporting girder, as illustrated in FIG. 2, so that the slab **25**, when poured, will have marginal portions bearing upon the supporting structure, and so that the concrete slab will at the same time encase the end connections.

FIGS. 3 and 4 illustrate a modified form of the invention wherein the top chord **10***a* and bottom chord **14***a* are each comprised U-shaped channel members integrally formed with opposed, outwardly-extending flange portions **26, 27** and **28, 29** respectively. The top and bottom chords **10***a*, **14***a* are arranged with their flange portions **26, 27** and **28, 29** at the outside, or top and bottom, respectively, and the end portions of the bottom chord **14***a* are bent upwardly as indicated at **30** in FIGS. 3 and 4 to join the top chord **10***a* at the ends of the joists, whereat they are welded. The shear plate **16***a* has a downwardly-extending rear portion **16**^{b} which fits within the channel recess **31** in the top chord **10***a*, whereat it is welded as indicated at **32**. The construction and operation of the end connection illustrated in FIGS. 3 and 4 is otherwise the same as that of FIGS. 1 and 2 described above.

FIGS. 5 and 6 illustrate another modified form of the invention wherein the two angles comprising the top chord is reinforced by two additional angles which are arranged and welded together in upper and lower spaced pairs **33, 34** and **35, 36** respectively, the side flanges of which extend outwardly from the tops and bottoms of said angle-iron pairs respectively. The upper apices of the zig-zag bar web **13** extend upwardly midway between the composite top chord, whereat they are welded in place. The shear plate **16***c* differs from the shear plate **16** of the embodiment illustrated in FIGS. 1 and 2 only in that it has a downwardly-extending rear portion **16***d* which fits down between the upper spaced pair of angle irons **33, 34** at the end of the joist, whereat it is welded in place. The construction and operation of the end connection illustrated in FIGS. 5 and 6 is otherwise the same as that of FIGS. 1 and 2.

FIG. 7 illustrates still another embodiment of the invention intended for heavier loadings which differs from the embodiment illustrated in FIGS. 1 and 2 only in that the shear plate **16***e* is formed with a downwardly-extending rear portion **16***f* which projects below the top chord angle irons **11, 12**. In addition, the upwardly-extending end portion **37** of the web bar **13** terminates between the angle irons **11, 12** just behind the shear plate **16***e* whereat it is welded as indicated at **38**; and the ends **14***a*, **15***a* of the bottom chord rods **14, 15** are bent upwardly to terminate in abutment with the opposed sides of the downwardly-projecting portion of the shear plate **16***e*, against which they are welded as indicated at **39**. The construction and operation of the end connection illustrated in FIG. 7 is otherwise the same as that of FIGS. 1 and 2.

Referring again to FIGS. 1 and 2, it is contemplated that the shear plate **16** could be cross-drilled in three or more positions as indicated at **40** to provide keyways for enhancing the keying action of the concrete floor slab to the end connection.

While I have illustrated and described herein only four forms in which my invention can conveniently be embodied in practice, it is to be understood that these forms are presented by way of example only and not in a limiting sense. The invention, in brief, includes all the

forms and embodiments coming within the scope and spirit of the following claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a steel joist end connection for steel joists of the type having an elongated top chord and a bottom chord fixed in spaced relation below and along said top chord, the combination comprising a vertical shear plate welded to and extending outwardly and upwardly above the end portion of the steel joist top chord, a horizontally-extending bed plate secured against the underside of the shear plate at the outwardly-extending end thereof, and a transversely extending bar keying means at the top of the vertical shear plate, and form plate means lying below the top surface of said shear plate, whereby a concrete slab portion encasing said shear plate engages the form plate means and said keying means.

2. A steel joist end connection as defined in claim **1** wherein said keying means comprises a steel bar fixed to said shear plate and extending outwardly of each side thereof.

3. A steel joist end connection as defined in claim **1** wherein said top chord of said steel joist comprises a pair of elongated U-shaped channel members secured in upper and lower back-to-back relation, each channel member having integrally formed at its outer ends outwardly-extending opposed flange portions, said shear plate having a downwardly-extending portion seated and secured within the recess defined at the end of the upper of said U-shaped channel members.

4. A steel joist end connection as defined in claim **1** wherein said top chord of said steel joist comprises a pair of elongated angle iron members arranged in spaced parallel relation, said shear plate having a downwardly-extending portion fixed between the end portions of said angle iron members, said downwardly-extending portion projecting below said angle iron members, said bottom chord being comprised of a pair of steel rods secured in spaced parallel relation, outer end portions of said steel rod being bent upwardly to terminate at one side of each of said projecting portion of said shear plate and being welded thereat.

5. A steel joist end connection as defined in claim **4** including a zig-zag bar extending along and between said top and bottom chords, the apices along the top of said zig-zag bar being welded between said angle iron members, and the apices along the bottom of said zig-zag bar being welded between said steel rods.

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