United States Patent

McManus

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[54] **COMPOSITE END CONNECTION FOR STEEL JOISTS**

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[52] **U.S. Cl.**.....**52/334,** 52/336
[51] **Int. Cl.**.....**E04b 1/16,** E04b 5/29
[58] **Field of Search**.....52/334–336, 340, 52/421

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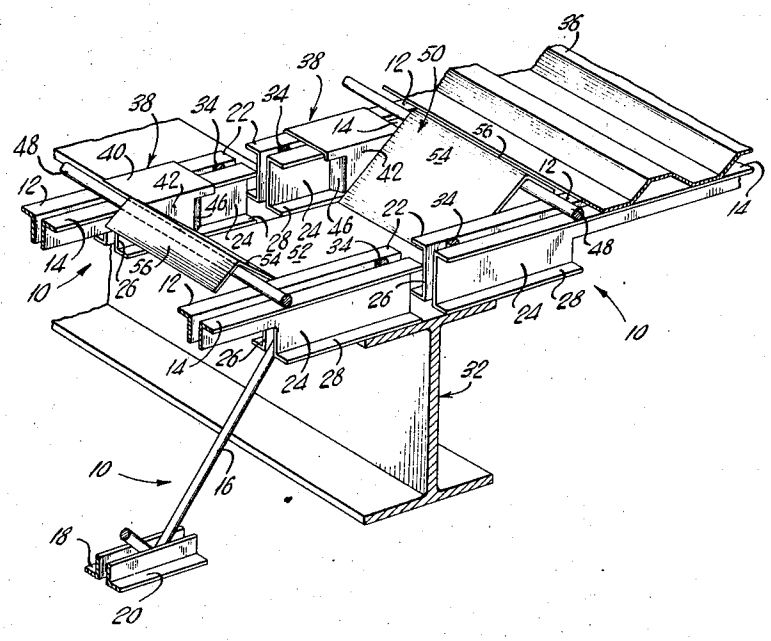
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Primary Examiner—Henry C. Sutherland
Attorney—James J. Cannon

[57] **ABSTRACT**

A joist end connection providing composite action between a supporting beam and a concrete slab when the bearing end of the joist is encased in the concrete slab whereby the encased joist end is employed as a shear connector. This is accomplished by employing metal formwork and anchoring means for keying the supporting beam to the concrete at the bearing end of the joist.

8 Claims, 8 Drawing Figures



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SHEET 1 OF 3

Fig. 1.

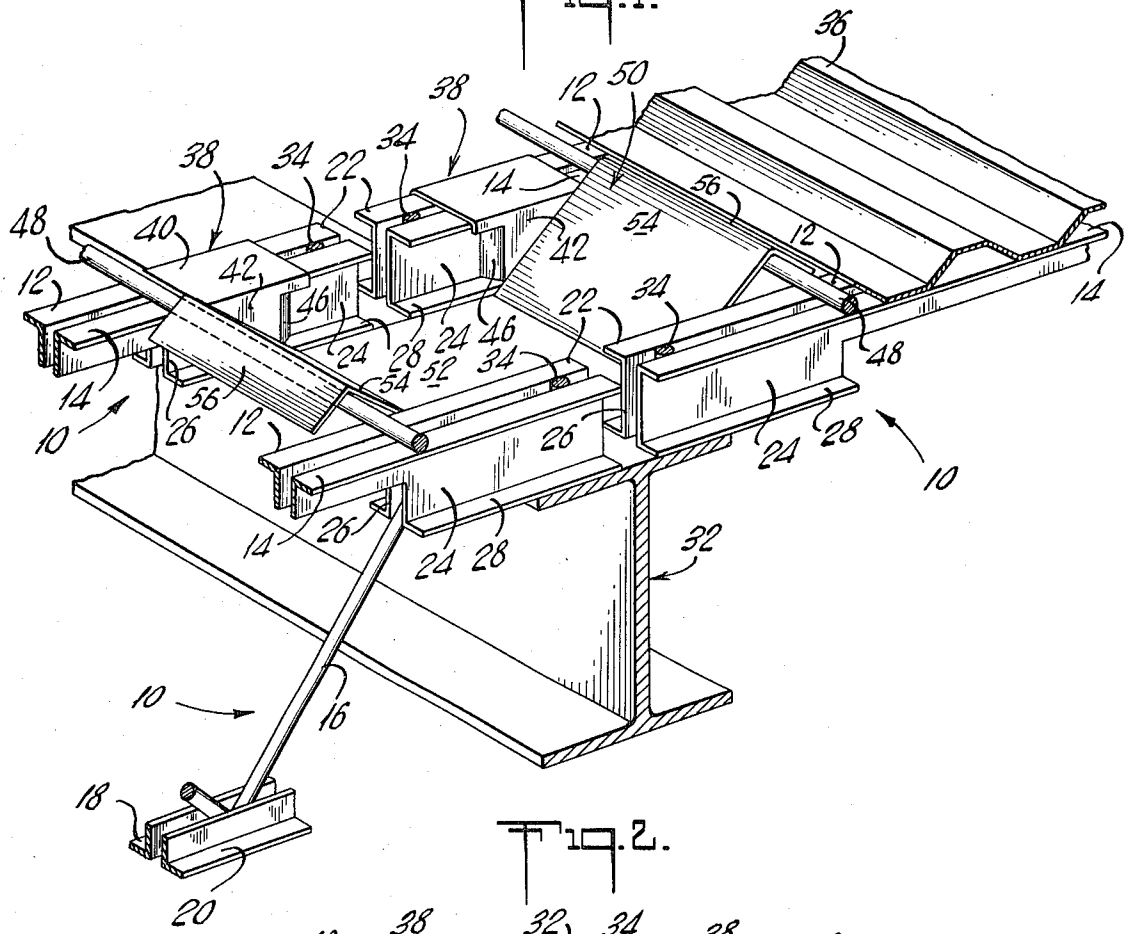
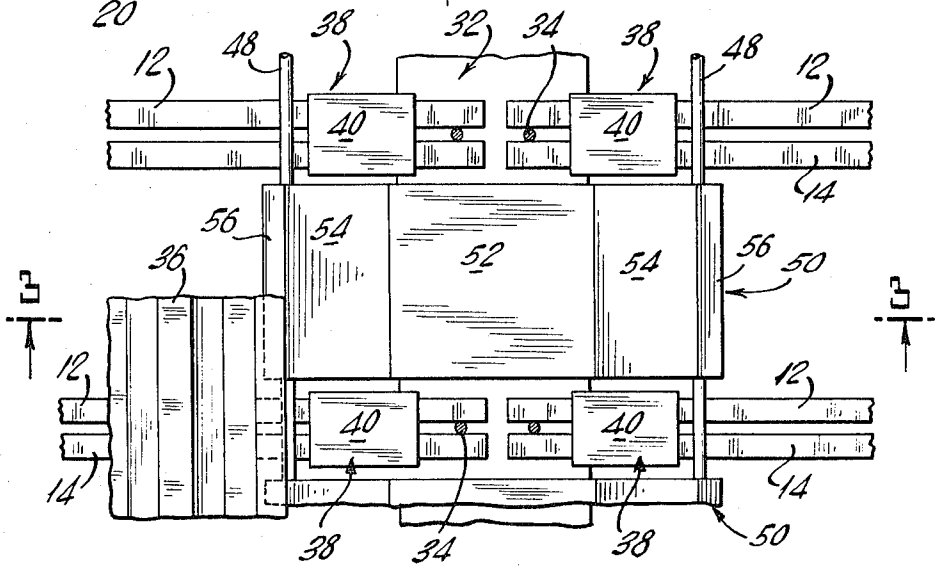


Fig. 2.



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Fig. 3.

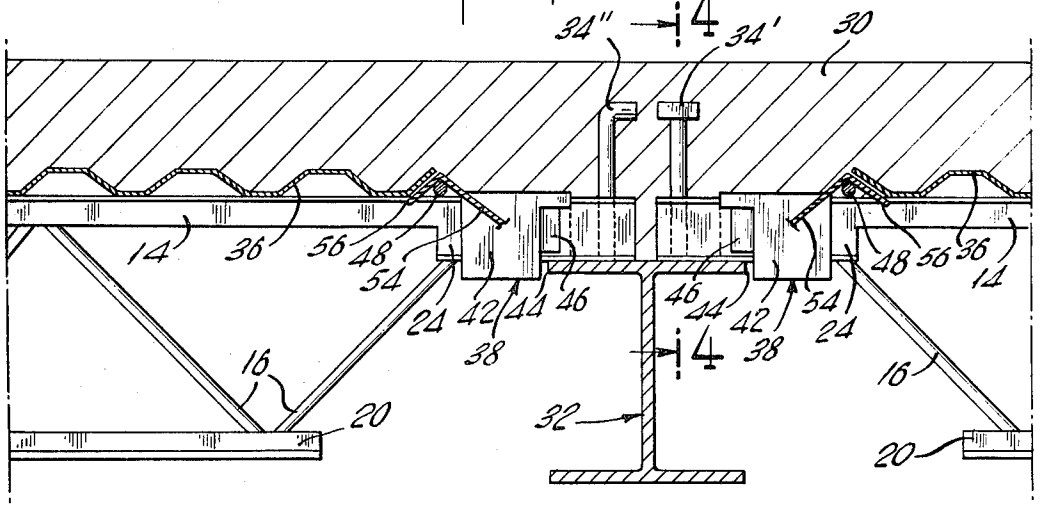


Fig. 4.

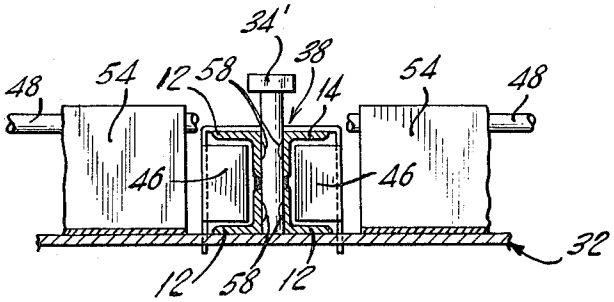
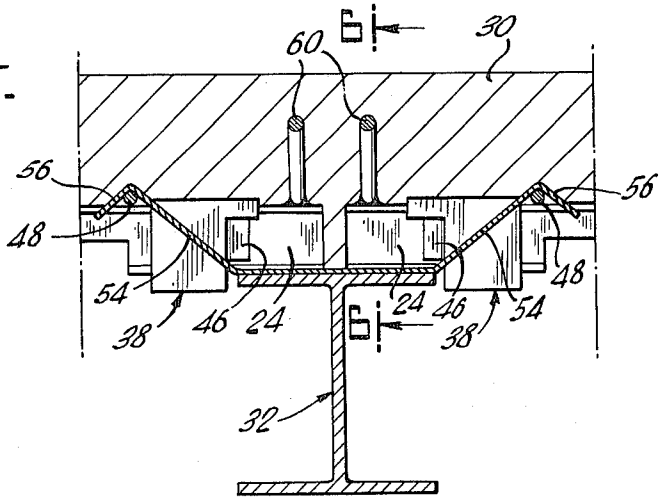


Fig. 5.



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FIG. 6.

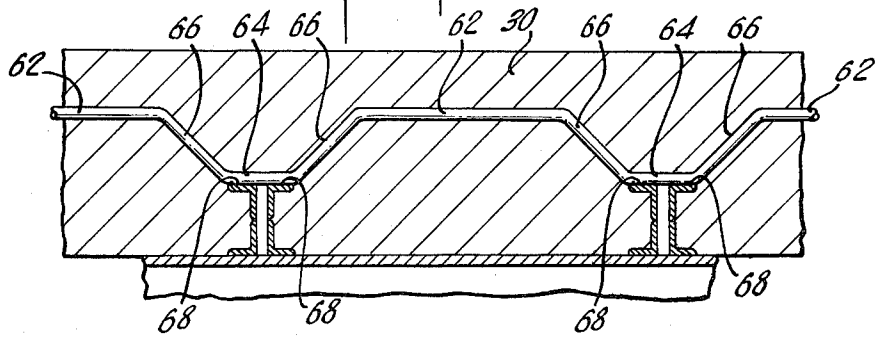


FIG. 7.

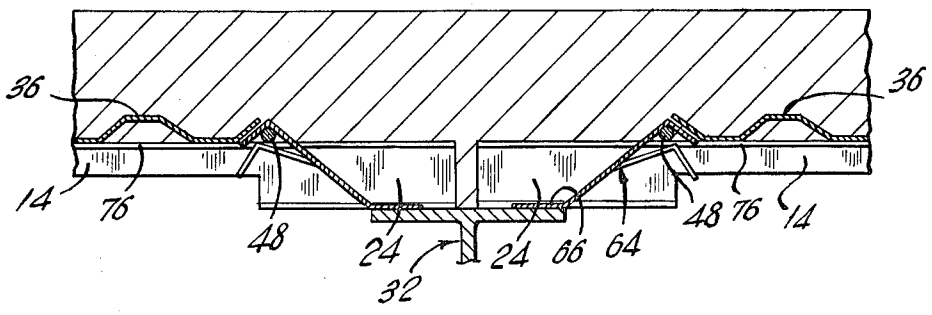
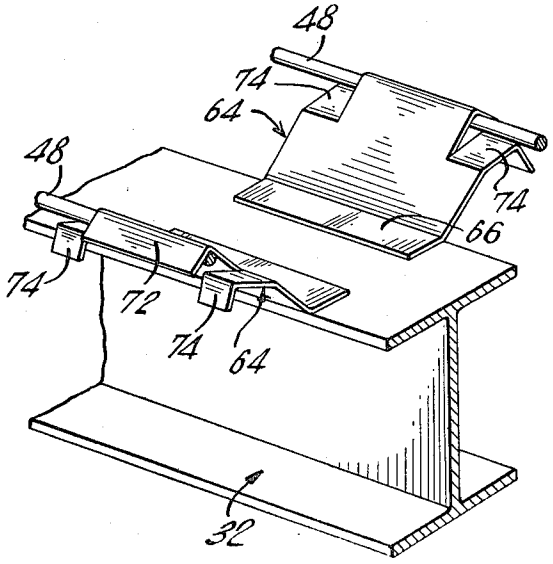


FIG. 8.



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COMPOSITE END CONNECTION FOR STEEL JOISTS

CROSS-REFERENCE TO RELATED APPLICATIONS

In my U.S. Pat. No. 3,392,499, issued July 16, 1968, and co-pending U.S. Pat. applications, Ser. No. 751,930, filed Aug. 12, 1968, now U.S. Pat. No. 3,527,007 and Ser. No. 10,399, filed Feb. 11, 1970, now U.S. Pat. No. 3,624,980 there are disclosed various novel improvements relating to end connections between open-web steel joists and steel beams or girders supporting them such that there is obtained composite action between the supporting beam or girder and a concrete slab poured over the joists so as to completely encase the bearing ends of the joists. The present invention is directed toward improvements over the steel joist end connections disclosed therein.

SUMMARY OF THE INVENTION

The present invention relates to a novel and improved end connection for steel joists where at the bearing ends of the joists there there is provided in one embodiment a unitary metal pan including a flat bottom surface and outwardly sloping sides extending upward above the top chord of the joist to provide support at the bearing ends of the joist for the concrete to be poured thereover, and anchoring means secured at one end to the joists and extending upward into keying relationship with the main body of the concrete.

Accordingly, it is a primary object of the present invention to provide a novel and improved end bearing connection for steel joists whereby there is obtained composite action between the supporting steel beam or girder and the concrete encasing the joist end.

Another object of the present invention is to provide a novel and improved end connection for open-ended steel joists wherein at the bearing end of the joists there is provided smooth-surfaced metal pan means for receiving concrete to be poured into encasing relationship with the joists.

A further object of the present invention is to provide a novel and improved end bearing connection for steel joists wherein the desired composite action between the supporting member and encasing concrete is effected by means of a unitary metal form or separate opposed metal forms disposed at the bearing ends and anchoring means operably keying the supporting member to the concrete through the steel joists.

Various other objects, features and advantages of the present invention will become apparent from the following detailed description of the invention when read in connection with accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a perspective view of a joist end connection constructed and arranged according to the present invention;

FIG. 2 illustrates a top plan view of the joist end connection of FIG. 1;

FIG. 3 is a cross-sectional view taken substantially along the line 3—3 in FIG. 2 showing the end connection encased in a concrete slab;

FIG. 4 is a cross-sectional view taken substantially along the line 4—4 in FIG. 3;

FIG. 5 is an elevational view, substantially like FIG. 3, but showing an alternate embodiment of the joist end connection;

FIG. 6 is a cross-sectional view taken substantially along the line 6—6 in FIG. 5;

FIG. 7 is a cross-sectional view, substantially like FIG. 3, but showing a further alternate of this invention; and

FIG. 8 illustrates a perspective view of the embodiment shown in FIG. 7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Having reference to the accompanying drawings wherein like reference numerals designate similar parts, there is shown in FIGS. 1 through 4 a first embodiment of the invention comprising standard open-web steel joists **10**, each of which comprises top pairs of opposed angle irons **12** and **14** secured by conventional means such welding along their apices at upper extremity of a zig-zag shaped bar web **16** to form the top chord of each of the joists, and a bottom pan of opposed angle irons **18** and **20** (only one pair being partially shown) similarly secured at the bottom extremity of the bar web **16** to form the bottom chord of each joist **10**. At the bearing end of the top chord of each joist there is provided a pair of opposed seat angles **22** and **24**, which either may be separate from or integrally formed with the top chord of the joist. These seat angles **22, 24** extend below the top chord for a predetermined distance whereupon the angles are formed with laterally outward extending flanges **26, 28**, respectively, to form a substantially U-shaped member or channel. These seat angles, which are encased in a concrete slab **30** (see FIG. 3), as hereinafter described in detail, seat upon a supporting composite beam or girder **32** and are secured thereto by suitable means, such as welding, to provide the necessary shearing strength in the direction of the longitudinal axis of the supporting beam **32** (which axis is perpendicular to that of the joists) by rigidly connecting the concrete slab **30** to the beam or girder **32**. The U-shaped construction of the joist end seat angles enhance encasement of the concrete to the support beam through the joist end connection.

At each joist bearing end there is provided anchoring means **34**, which may take the form of a headed stud or bolt **34'** or a hooked rod **34''**, and which is snugly fitted between and secured to the opposed angle irons **12, 14** and the seat angles **22, 24** as by welding designated **58** or the like as shown in FIG. 4. The anchors **34**, as best shown in FIG. 3, extend upward above the top chord of each joist into keying relation with the main portion of the concrete slab **30** poured over, such that the anchor is solidly embedded therein whereby the slab securely is interconnected with the supporting beam or girder **32** through the joist end connection.

Corrugated sheet metal form plates **36**, as shown in FIGS. **1, 2** and **3**, are placed along the top chords of adjacent parallel joists between the ends thereof to form a bottom support for the concrete slab **30** to be poured over. These forms **36** extend between the seat angles **22, 24** provided at each joist end (see FIG. 3). To prevent any leakage of the concrete when poured along the sides of the joist ends there is provided over each

joist end a substantially U-shaped notched metal closure plate **38**. Each plate **38** comprises a top surface or bright portion **40** and a pair of similar notched vertical sides or legs **42**, the notches being formed as at **44** so that a forward portion **46** of each side **42** may be bent inwardly toward the corresponding vertical side of the joist end to prevent any leakage of the concrete beyond the desired area at the joist end, which could detract from the desired connection between the beam or girder **32** and the concrete **30**.

On top at each joist end there is provided a continuous support rod **48**, which rod extends continuously between adjacent parallel joists and is securely connected thereto by means of welding. These rods in the preferred embodiment of FIGS. **1** to **4** support the ends of a unitary or single metal pan **50** situated at each joist end connection. The pan **50** comprises a flat bottom **52**, upwardly outward sloping sides **54** and marginal downward sloping sides **56**, and is of sufficient width to fit snugly between adjacent parallel closure plates to prevent leakage of concrete. The metal pan **50** is supported at its ends by the support rod **48** disposed directly below the bend formed between **54** and **56**. The bottom **52** is supported by the top flange of the supporting beam. The extremities of the corrugated metal formwork **36** are supported by the marginal ends **56** of the pan **50**.

As described heretofore, in order to obtain the desired composite action between the concrete slab **30** and supporting beam **32** there is provided an anchor **34** in the form of a headed stud or bolt **34'** or hooked rod **34''** secured between the back-to-back top chord angles **12**, **14** and the seat angles **22**, **24**, respectively, forming the joist bearing end and secured thereto by welding shown as **58** to obtain the necessary keying of the concrete to the joist end. Other alternates for obtaining the desired keying action are shown in FIGS. **5** and **6**, where there is illustrated a continuous rod **60** including top keying members **62** (see FIG. **6**) and bottom support members **64** interconnected by sloping sides **66**. The rods **60** are welded as at **68** in the field, preferably to the top chords of the joists. The keying members **62** of each rod **60** are sufficiently spaced vertically above the top chords within the main body of the concrete **30**, that is, above the center line of the concrete slab **30**, to effect the desired composite action.

As illustrated in FIGS. **7** and **8**, in lieu of the previously described metal pan **50** and metal closure plates **38**, there is provided pan of separate notched metal plates **64** which are designed to fit snugly between the vertical sides of the joist bearing ends to prevent any concrete leakage. These notched plates **64** each comprise a flat bottom surface **66** secured by welding to the top flange of the supporting beam or girder **32**, a side wall **68** which slopes upward away from the longitudinal center line of the supporting beam **32** and a central bent marginal member **70** having a terminal downward sloping side **72**. The continuous rod **48** supports the end of the plates **64** by engaging the sides **70** and **72** at their bend. A pair of notched downwardly bent corner members **74** are disposed on either side of the central member **70** so as to be located below the horizontal laterally extending flanges **76** of the top chord angles **12** and **14** (only **14** being shown in FIG. **7**). To place these metal plates **64** properly in position the plate is slid horizontally toward the supporting beam or girder between the lateral flanges **76** of the joist top chords past the support rod **48**. The central bent member **70** then is raised into its supported position by the rod **48** (see FIG. **8**) with the notched corners **74** being disposed below the flanges **76** of the top chord (see FIG. **7**). However, for convenience these corners may be removed completely before installation of the plates **64**.

While there have been disclosed herein various forms of the present invention, it is to be understood that such forms are preferred only and should not be construed as limited of this invention in any sense. Thus, while there has been disclosed steel joists comprising angle members, the novel features of this invention may be employed with other types and configurations of joist ends. Accordingly, reference should be made to the following appended claims to determine the full extent of the scope of protection afforded by the present invention.

Having thus set forth the nature of the invention, what is claimed herein is:

1. In a steel joist construction and end connection therefor, the combination comprising, first and second pairs of parallel steel joists, anchor means extending upwardly from the ends of each pair of steel joists, each of said joists having a top chord, a bottom chord and means for securing said top and bottom chords in vertically spaced relation, said top chord having a seating angle provided at its ends extending below said top chord and being supported by a beam running in a direction substantially perpendicular to the direction of said steel joists, closure form means of inverted U-shape seated on the top chords of each joist adjacent the ends thereof, each closure form means having a bight portion seated on the top of each top chord and pairs of legs extending from the bight portion to the upper surface of said beam between said joist seat angles, a sealing plate form means disposed between the parallel joists of each pair, each sealing plate form means including flat bottom means supported by said beam and oppositely outward sloping sides supported at its ends by rods extending between parallel ones of said steel joists, said sealing plate having its edges in contact with the legs of said closure form means, whereby when a concrete slab is poured over said concrete form means in the vicinity of said steel joist end connection into encasing relation with said end connection there is obtained composite action therebetween.

2. A steel joist end connection according to claim **1** wherein said anchor means extends upwardly from the end of said steel joists above said top chords to enhance the interlocking action between the concrete slab and the joist end connection.

3. A steel joist end connection according to claim **2** wherein said anchor means comprises a continuous member extending between parallel ones of said steel joists and having lower portions secured to the top of said steel joists and upper portions adapted to be embedded within said concrete slab.

4. A steel joist end connection according to claim **3** wherein the legs of said closure means have a portion thereof nearest said steel joist end bent inwardly into contact with the vertical sides of said steel joists.

5. A steel joist end connection according to claim 1 wherein said plate form means comprises a unitary pan comprising a continuous bottom and sides for providing a receptacle for the concrete slab in the vicinity of said end connection.

6. A steel joist end connection according to claim 5 wherein said sides each slope outwardly and have bent outer portions to facilitate supporting said second concrete form means by said supporting rods.

7. A steel joist end connection according to claim 1 wherein said sealing plate form means comprises a pair of opposed separate metal members extending between adjacent one of said parallel pairs of steel joists.

8. A steel joist end connection according to claim 7 wherein said metal members each have notched marginal corner portions underlying the supporting rod and a centrally disposed bent member which overlies and is supported by said supporting rod.

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