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[54] **CONNECTION SYSTEM FOR CONCRETE AND STEEL STRUCTURES**
9 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** ..... **52/295,** 52/459, 287/189.36 F, 52/584
[51] **Int. Cl.** **E04b 1/41**
[50] **Field of Search** ..... 52/295, 296, 580, 582, 584, 587, 285, 459, 461, 463, 467; 287/189.36 C, 189.36 F

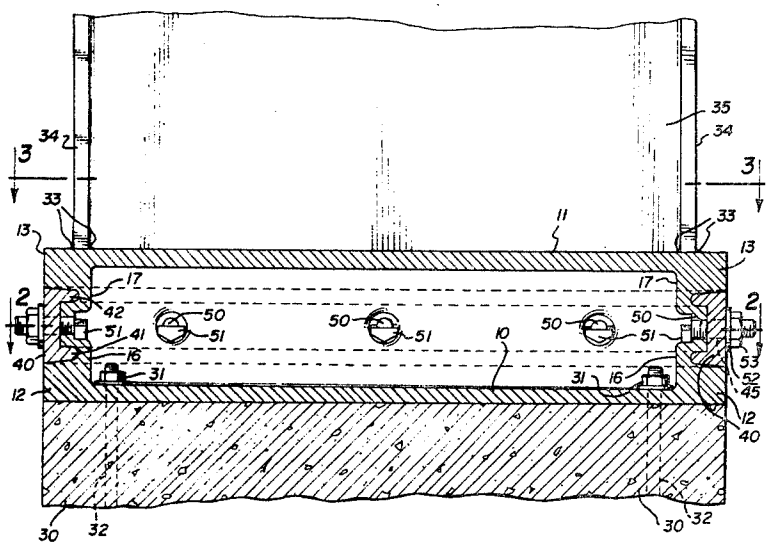
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ABSTRACT: A connection system for concrete and steel structures comprising a pair of frame plates which face each other when fastened to the structures to be connected, each frame plate having a thickened marginal portion provided with an outwardly opening peripheral longitudinally extending recess, a longitudinal groove communicating with the recess, and spaced apart notches on the face of the marginal portion abutting the other frame plate; tongue strips formed to fit in the recesses of abutting frame plates and provided with tongues which enter the grooves of the frame plate, said strips having holes registering with the notches of a pair of abutting frame plates; and a fastener extending through registering notches in the frame plates and a hole in the tongue strip to connect the pair of frame plates together and thereby connect the structural members to which the frame plates are fastened. The same system can be achieved by providing tongues in the marginal portion of the frame plates, and grooves in the strips attaching the pair of frame plates.



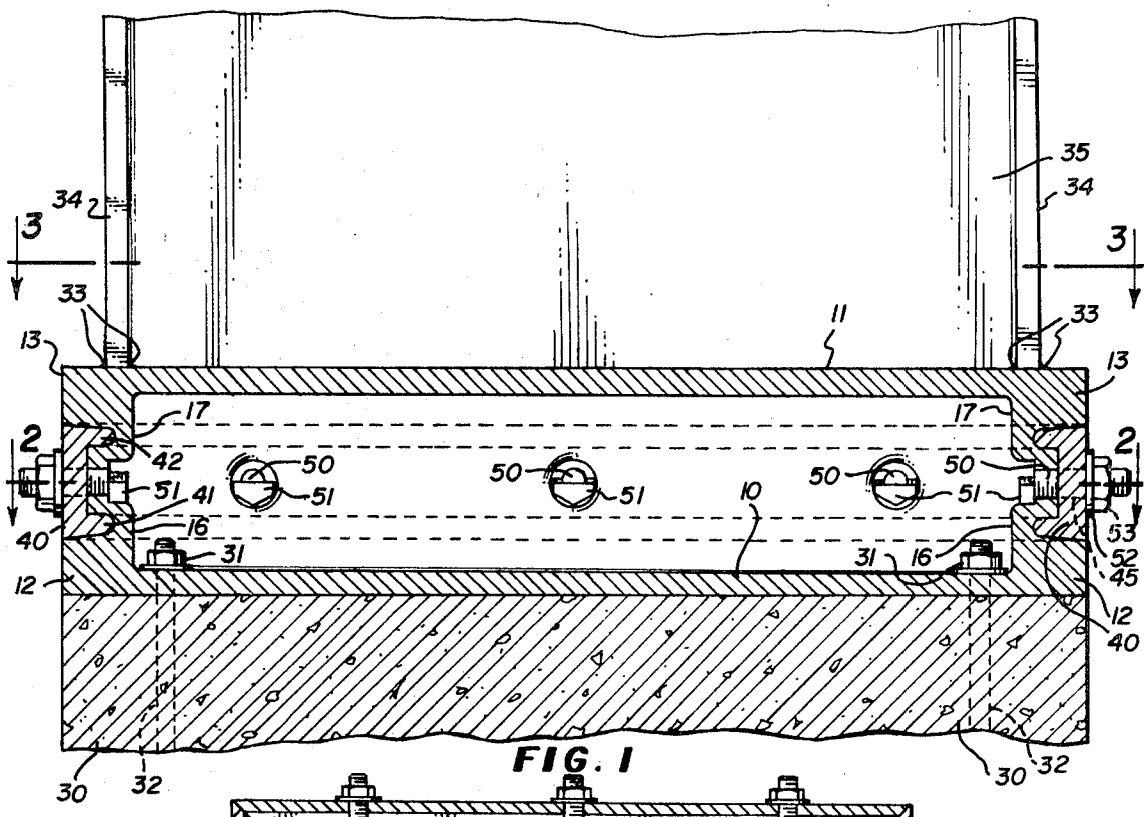


FIG. 1

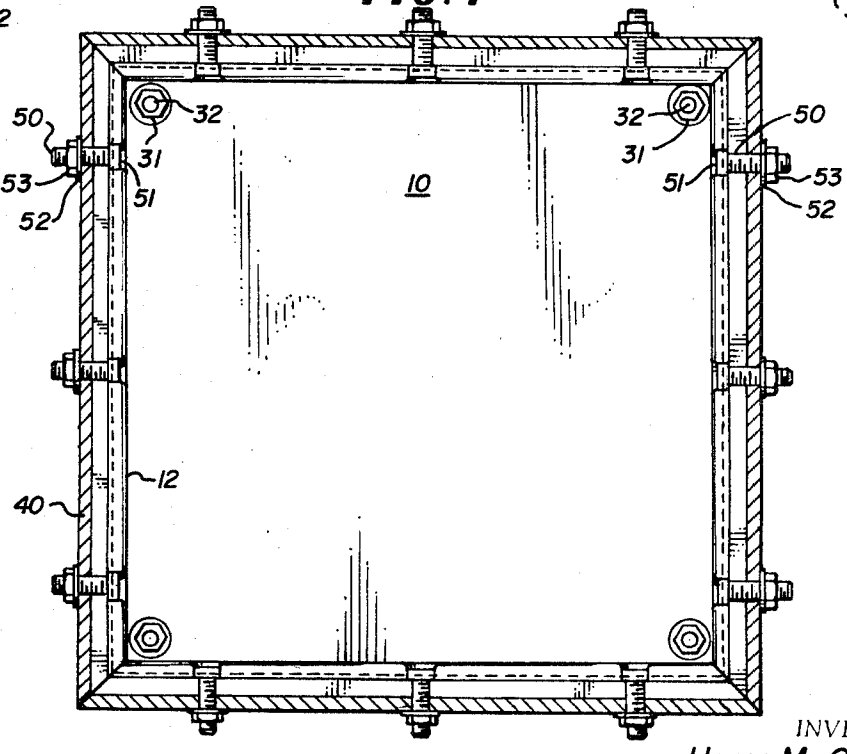


FIG. 2

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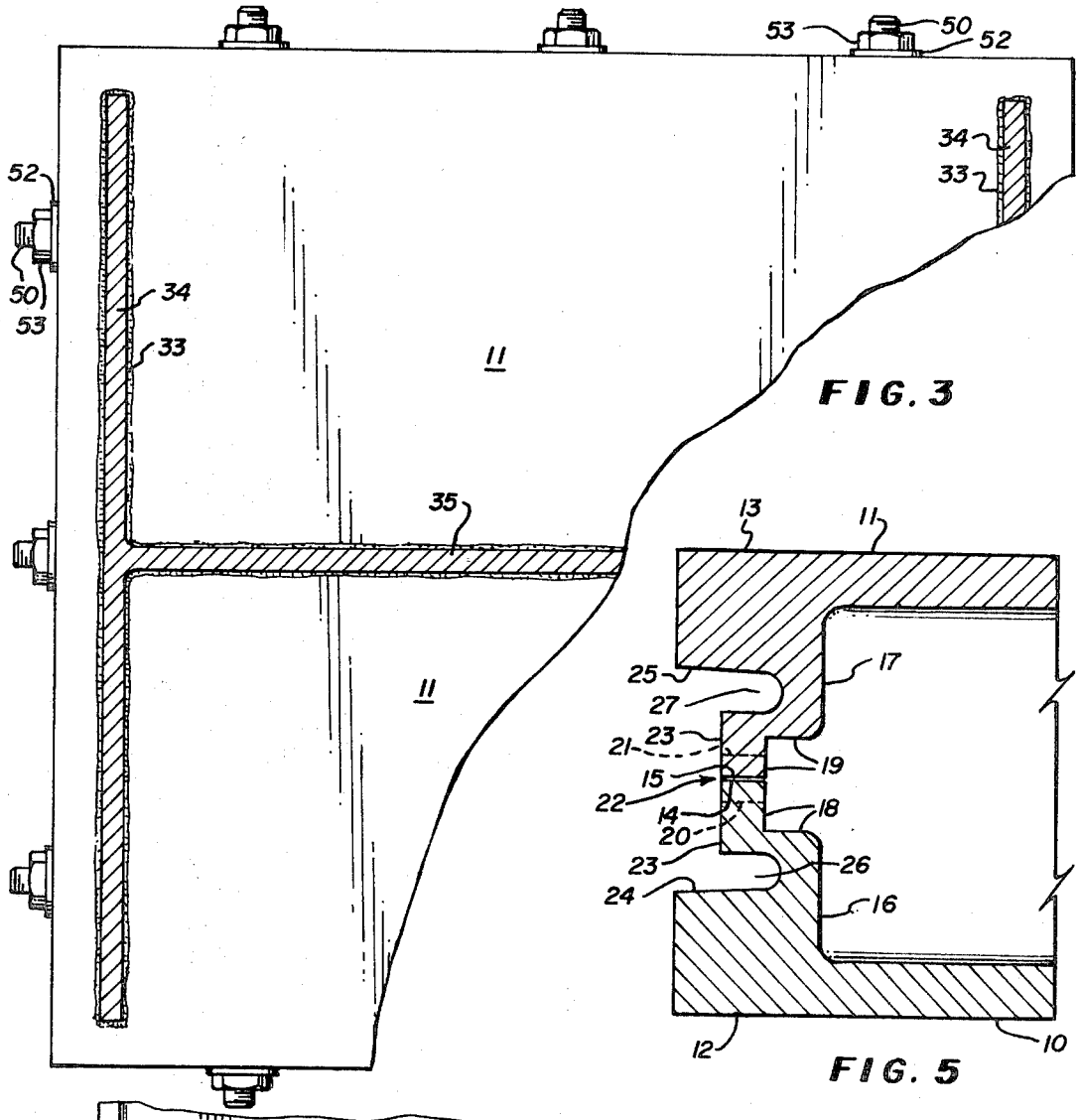


FIG. 3

FIG. 5

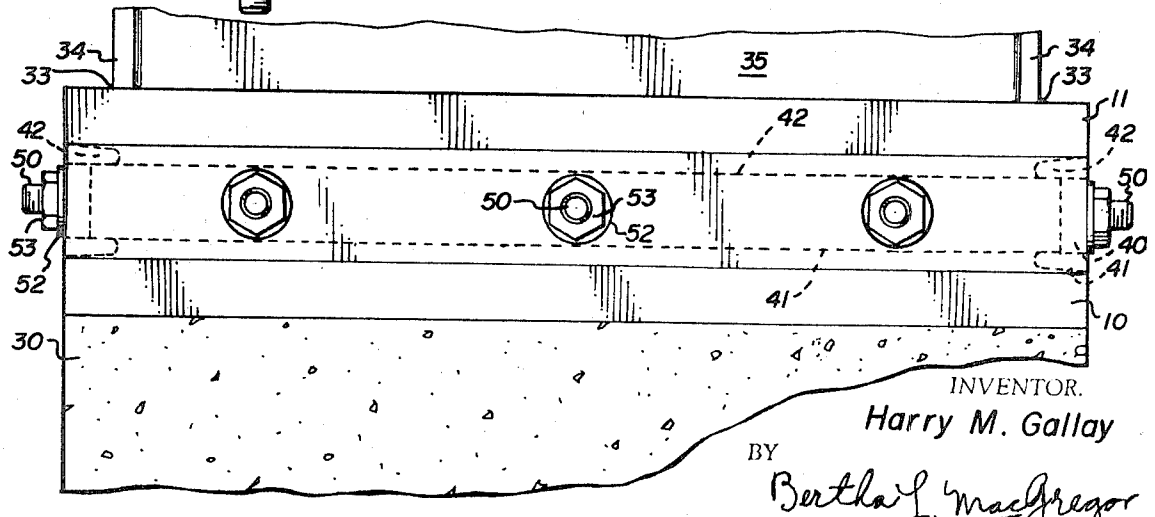


FIG. 4

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CONNECTION SYSTEM FOR CONCRETE AND STEEL STRUCTURES

This invention relates to structural connectors for joining structural concrete members to each other, or to steel members, or for joining steel members to each other.

One of the objects of the invention is to provide structural connectors which may be standardized, which facilitate erection, and provide continuity of load transfer including moment.

Structural connectors embodying my invention comprise three essential elements, namely, a pair of facing frame plates each fastened to one of two structural members intended to be connected together, elongated relatively narrow tongue strips surrounding the facing frame plates, and fasteners which engage both frame plates, and tongue strips and securely connect them together.

Each frame plate is relatively flat and may be of varying shapes though usually rectangular, provided with thickened marginal portions which are recessed and grooved longitudinally to different depths inwardly from their peripheral surfaces, and provided with widely spaced notches in the face of the thickened marginal portion extending from the recessed surface to the inner edge of the marginal portion of the plate. The thickened marginal portion may be integral with the flat plate or may consist of four pieces mitered and assembled like a picture frame and attached to the plate near its outer edges.

If the frame plates are rectangular, four tongue strips are used with each pair of frame plates, each strip as long as one edge of the plate. Each strip comprises a relatively flat strip of metal adapted to seat in the outwardly opening recesses of two facing frame plates, and provided with spaced apart parallel tongues adapted to seat in the grooves of the two facing frame plates. The tongue strip is provided with holes extending therethrough midway between the tongues, and registering with the semicircular indentations or notches in the facing surfaces of the thickened marginal portions of the frame plates.

The fastener elements of the combination are headed bolts which extend through the registering notches of the thickened portions of the frame plates and the holes of the tongue strips. The fasteners are preferably tack-welded to one of the two frame plates of a pair, with the head of the bolt adjacent the inner edge of the thickened portion of the frame plate, and the threaded end protruding from the tongue strip, in readiness to receive a washer and nut on said end.

The combination of a pair of frame plates, tongue strips and fasteners provides means for quickly and easily connecting two structural members together. One of the two frame plates of a pair may be attached to the reinforcing bars of a concrete pedestal or other member and the other of the two frame plates may be attached by welding a beam such as a wide flange steel beam or a column, or the frame plates of a pair may be fastened to reinforcing bars or anchor bolts of two concrete structures, or be welded to two steel structures.

In the drawings:

FIG. 1 is a vertical sectional view of a steel beam or column and a concrete member connected together by the structural connector system embodying my invention.

FIG. 2 is a horizontal sectional view on a reduced scale, in the plane of the line 2–2 of FIG. 1, looking downwardly on the lower of the two frame plates, as indicated by the arrows.

FIG. 3 is a horizontal sectional view in the plane of the line 3–3 of FIG. 1, looking downwardly on top of the upper of the two frame plates, as indicated by the arrows.

FIG. 4 is an elevational side view showing the connector of my invention and parts of the structural members to which it is connected.

FIG. 5 is a vertical sectional view, on an enlarged scale, through the thickened marginal portions of a pair of facing frame plates.

In the embodiment of the invention shown in the drawings, frame plates 10, 11, are flat square-shaped plates provided with thickened marginal portions 12, 13, respectively, which

extend around the plates adjacent their outer edges. The abutting faces of the thickened portions 12, 13, are designated 14, 15, respectively, as best shown in FIG. 5. The inner edge surfaces 16, 17, of the frame plates are cut away or recessed adjacent their abutting faces as indicated at 18, 19, respectively. The abutting faces 14, 15, are notched as shown by the broken lines 20, 21, in FIG. 5. The notches may be semicircular or angular in cross section. The thickened portions 12, 13, are recessed on their outer faces to provide an outwardly opening cavity 22 defined by the surfaces 23, 24 and 25. The cavity 22 communicates with longitudinally extending grooves 26, 27, respectively, in the thickened portions of the frame plates.

As shown in FIG. 1, the frame plate 10 is connected to a concrete pedestal 30 by a nut 31 engaging the threaded end of a reinforcing bar or an anchor bolt 32 in the concrete. The mating frame plate 11 is connected by welding 33 to the flanges 34 of a steel I-beam 35. The frame plates constituting a pair of plates may be connected by any suitable means to either concrete or steel structural members. For example, one plate may be welded to the web of a steel column and the other frame plate to the end of a crossbeam, respectively, for ultimate connection for the two structural members. The combination of a pair of mating frame plates, tongue strips and fasteners functions as a standardized connector regardless of variations in materials of the structures being connected and methods of attachment of the frame plates to said structures.

When the frame plates 10 and 11 of a pair are attached, respectively, to structures to be connected, such, for example, as 30, 35, the surfaces 14, 15 of the thickened marginal portions 12, 13, respectively, face each other, and the notches 20, 21 register to form a circular or other shaped opening extending from the surface 23 of the cavity 22 to the inner edge surfaces 18, 19 of the marginal portions of the frame plates.

Tongue strips 40 are elongated relatively narrow flat strips provided with longitudinally extending tongues 41, 42, which are complemental to the grooves 26, 27, respectively, of the frame plates 10, 11. The thickness of the tongue plates 40 is equal to the depth of the cavity 22 so that when the tongue strips are seated in the cavity 22 and grooves 26, 27, the outer peripheral surfaces of the frame plates 10, 11, and of the tongue strips 40 are flush. The tongue strips 40 are provided with holes 45 spaced apart longitudinally of the strips and located to register with the semicircular or other shaped registering notches 20, 21, in the frame plates. The shape of the holes 45 conforms to the cross-sectional shape of the registering notches 20, 21 in the facing surfaces of the marginal portions of the frame plates.

When the frame plates and tongue strips are assembled as shown in FIG. 1, the notches 20, 21 of the frame plates register with each other to form transversely extending openings which register with the holes 45 in the tongue strips. The openings 20, 21, 45 are adapted to receive fasteners 50 (round or other shape to conform to the openings) which connect the frame plates to each other and thereby connect the structural members 30 and 35 to which the frame plates are connected.

The fasteners 50 are headed screw-threaded bolts in which half of the heads 51 are milled off as shown in FIG. 1, or threaded rods welded into place. The fasteners 50 are tack-welded or otherwise held in place in one of the two frame plates, as shown in frame plate 10, so that the head 51 fits within the recess formed by inner surfaces 18 of the thickened portion 12 of the frame plates. The body of the bolt 50 rests in the notch 20. After the frame plate 11 has been placed in position to abut the plate 10, the tongue strip 40 is installed by causing the strip holes 45 to receive the bolts 50 as the tongue strips are seated in the cavity 22 and grooves 26, 27. Then the washers 52 and nuts 53 are applied to the threaded shanks or fasteners 50 and tightened to draw the tongue strips 40 against the frame plate.

The attachment of the frame plates to the structures intended to be connected to each other may be performed on the site of a building, or in the case of steel structures the

frame plates may be welded or otherwise preattached to said structures. After the frame plates have been fastened to the structural members, and the latter have been placed into their intended positions with the frame plates of a pair facing each other, then the connection is completed by merely inserting the tongue strips on the peripheral sides of the abutting frame plates, with the fasteners 50 extending through the holes 45 of the tongue strips, and applying the washers 52 and nuts 53 to the protruding ends of the fasteners 50.

The structural members, such as 30 and 35, for example, may be in axial alignment with each other or they may extend at an angle to each other. The frame plates of a pair are attached to the structural members on the appropriate surfaces so that the frame plates face each other as described and shown herein.

The same system can be achieved by reversing the positions of tongues and grooves. The tongues 41 and 42 could be incorporated in the marginal portions 12 and 13 of the frame plates 10 and 11, and the grooves 26 and 27 could be incorporated in the peripheral strips 40.

I claim:

1. A connection system for concrete and steel structures comprising

a. a pair of frame plates which face each other when each plate is fastened to one of the structures to be connected,

b. thickened marginal portions on the frame plates abutting each other, each marginal portion being provided with an outwardly opening peripheral longitudinally extending cavity and a longitudinal groove communicating with the cavity, and spaced apart notches on the face abutting the other frame plate,

c. peripheral tongue strips which fit in the cavity of the abutting marginal portions of the frame plates and have tongues which enter the grooves in the said portions, and holes in the tongue strips registering with the notches of the frame plates when in abutting positions, and

d. a fastener extending through the registering notches in a pair of frame plates and a hole in the tongue strip to connect the pair of frame plates together and thereby connect the structural members to which the frame plates are fastened.

2. The connecting system defined by claim 1, in which the outer face of each tongue strip is parallel and approximately flush with the peripheral surface of the thickened portions of the frame plates.

3. The connection system defined by claim 1, in which the fastener is a headed bolt having its head bearing on the inner face of the thickened portion of the frame plates, and its shank protruding beyond the peripheral surface of the frame plates for reception of a washer and nut for holding the frame plates of a pair together.

4. The connection system defined by claim 1, in which the fastener is a threaded member welded to one of the frame plates of the pair.

5. The connection system defined by claim 1, in which the notches in the abutting faces of the frame plates are semicircular and the holes in the tongue strips are circular and the same diameter as the openings formed by registering notches in the abutting faces of the frame plates.

6. The connection system defined by claim 1, in which the frame plates are rectangular in shape, the thickened marginal portions extend around the four edges of each frame plate, and each of the tongue strips is equal in length to an edge of the frame plates.

7. The connection system defined by claim 1, in which the inner surfaces of the thickened portions of the frame plates are recessed, and the fasteners are headed bolts, the heads of the bolts being located in the recesses on the inner surfaces of the thickened portions and the shanks of the bolts protrude outwardly through the thickened portions and the tongue strips.

8. A connection system for connecting a reinforced concrete structure and a steel structure, comprising

a. a reinforced concrete structure which has threaded members protruding therefrom,

b. a steel structure to be connected to the concrete structure,

c. a pair of frame plates which face each other when each plate is fastened to one of the structures to be connected,

d. means connecting one of the plates to the members of the concrete structure,

e. means connecting the other of the plates to the steel structure,

f. thickened marginal portions on the frame plates abutting each other, each marginal portion being provided with an outwardly opening peripheral longitudinally extending cavity and a longitudinal groove communicating with the cavity, and spaced apart notches on the face abutting the other frame plate,

g. tongue strips which fit in the cavity of the abutting marginal portions of the frame plates and have tongues which enter the grooves in said portions, and holes in the tongue strips registering with the notches of the frame plates when in abutting positions, and

h. a fastener extending through the registering notches in a pair of frame plates and a hole in the tongue strip to connect a pair of frame plates together and thereby connect the structural members to which the frame plates are fastened.

9. The connection system defined by claim 8, in which one of the frame plates is welded to the steel structure.