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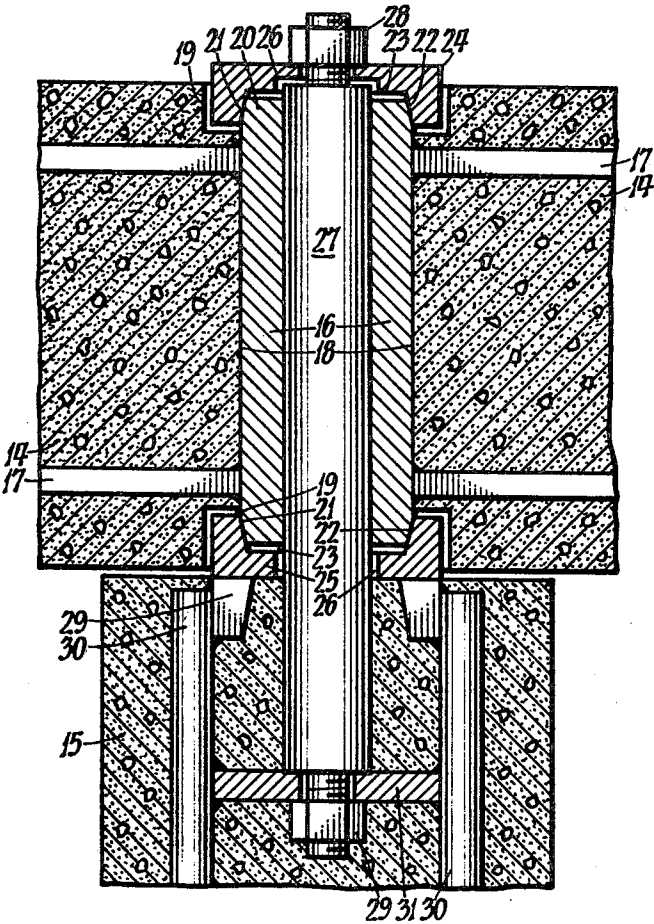
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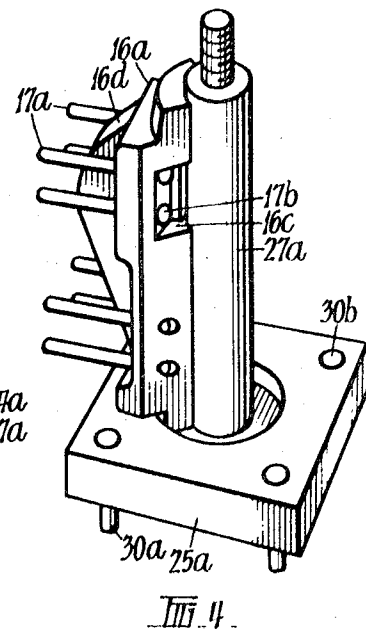
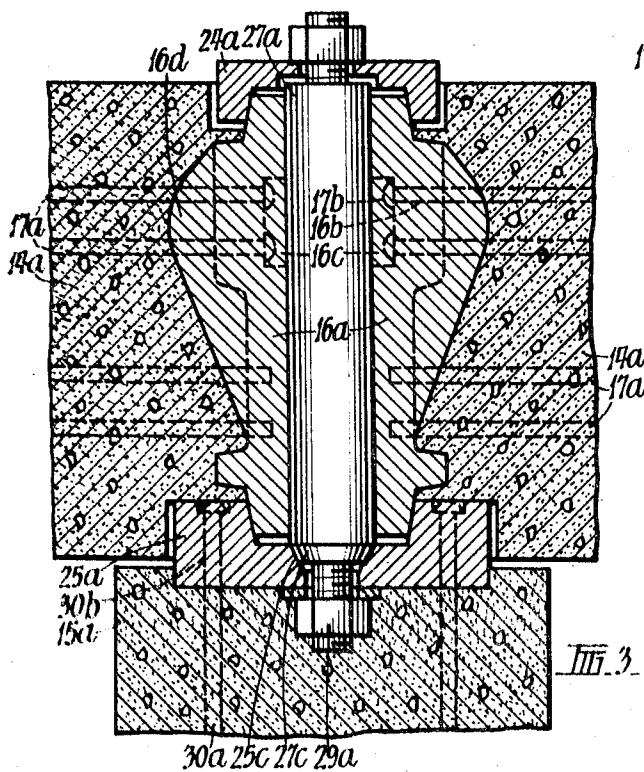
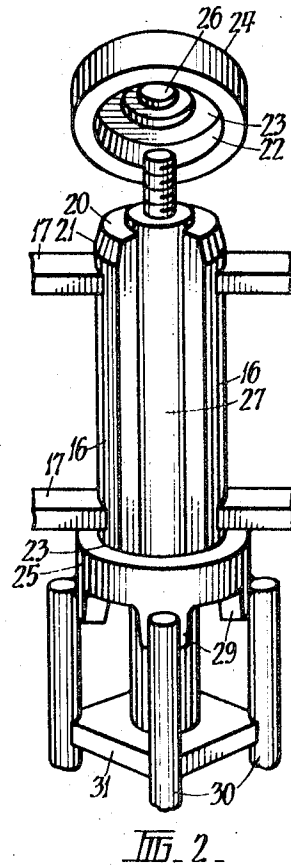
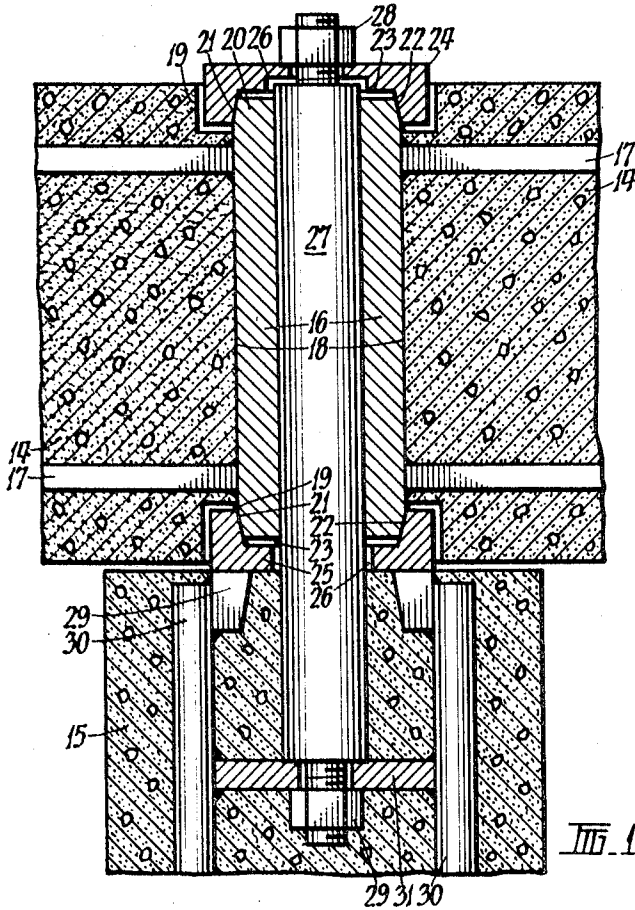
[54] **CONNECTING PRECAST CONCRETE
STRUCTURAL MEMBERS**
10 Claims, 13 Drawing Figs.

[52] U.S. Cl..... 52/251,
52/583, 52/584, 287/189.36
[51] Int. Cl..... E04b 1/40,
E04b 1/41
[50] Field of Search..... 52/583,
584, 726, 693, 253, 251, 260, 280, 295, 300, 225,
223, 587; 287/111, 118, 189.36 C

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ABSTRACT: This invention is directed to a connection as-
sembly for joining precast structural members together
wherein metal members are provided on the structural mem-
bers and which are attached to reinforcements in the said
structural members, said metal members having taper forma-
tions thereon engaging corresponding formations in end
clamp members adapted to be drawn together to effect en-
gagement of outer faces of the metal members with a central
shaft passing through the connection assembly and cooperat-
ing with the end clamp members, the arrangement providing
for a column supported or unsupported connection through
which the whole of the moment forces are transferred.





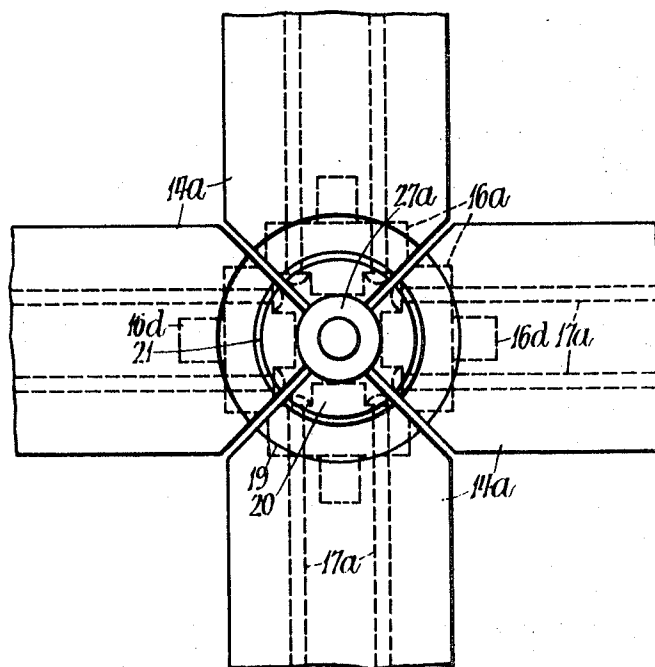


FIG. 5

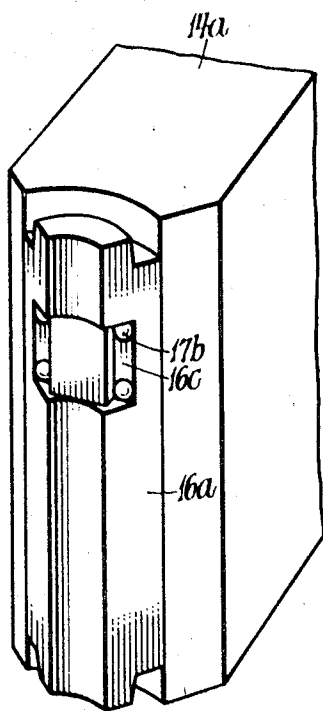


FIG. 6

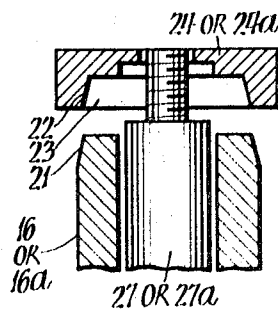


FIG. 7

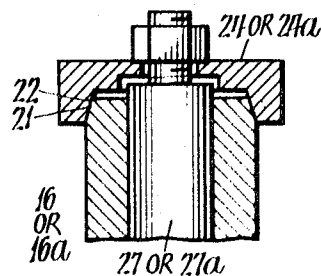


FIG. 8

SHEET 3 OF 3

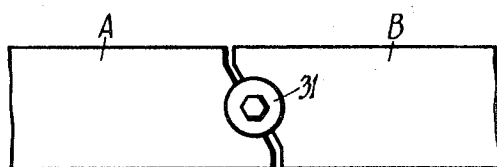


FIG. 9.

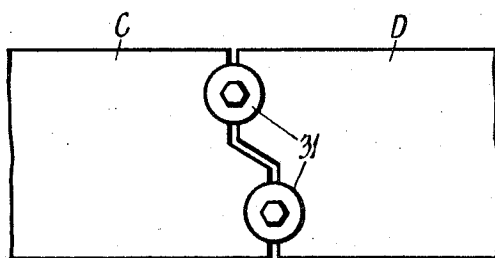


FIG. 10.

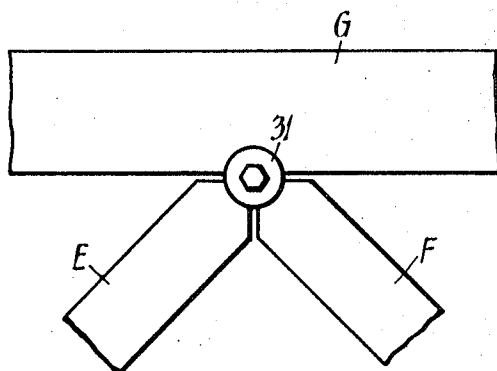


FIG. 11.

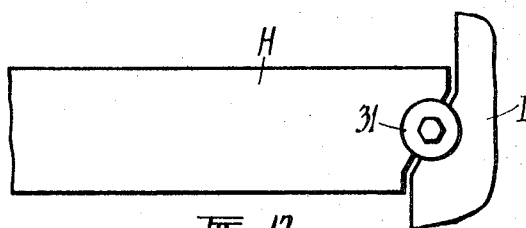


FIG. 12.

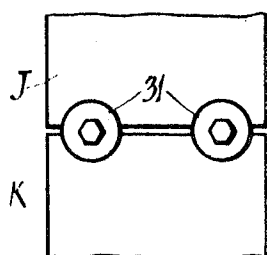


FIG. 13.

CONNECTING PRECAST CONCRETE STRUCTURAL MEMBERS

This invention relates to connecting precast reinforced concrete structural members, particularly though not specifically, for use in the building industry.

The use of precast reinforced concrete structural members in buildings has been restricted by the difficulties involved in readily making satisfactory joints capable of transferring moment forces between such members. A number of known methods adopted for this jointing include leaving gaps in the concrete to enable spliced reinforcements to be provided at the joints, or the bolting or site welding of steel sections cast into the concrete at or near the junction points between the structural members. Another known means of locking beams to a column support involves the use of clamping dogs which engage plates attached to beam reinforcements to hold members in conjunction against a spacer block. This method cannot be used to transfer full moment forces through the connection and the connection may be made only at points of support. Known methods usually require subsequent grouting or encasing the connection with concrete and once erected, members cannot be readily dismantled for reerection.

Reinforced concrete structural beams or columns are hereinafter referred to as beams or columns or collectively as structural members. Reinforcements may be metal bars or prestressing wires or tendons and are hereinafter referred to as reinforcements.

The principal object of the present invention is to provide a relatively simple and economical means of effecting a connection between two or more beams or between two or more beams and a column, which is capable of transferring the whole of the moment forces through the connection, which permits subsequent disconnection and which involves a minimum of onsite work for either operation.

According to the invention, a connection for structural members includes the provision of metal sections at the ends or within recesses formed in the members, said sections being attached to the reinforcements in the members by welding or anchoring and having formations thereon to engage upper and lower clamp members adapted to draw out surfaces of the metal sections of the structural members connected into engagement with a central clamp shaft passing through the connection assembly.

The outer surfaces of the metal sections are formed as segments of a shape to match that of the central shaft passing through the connection assembly. The clamp members are provided with holes through which the clamp shaft passes and said clamp members may be drawn together by means of a nut or nuts engaging with a screw thread or threads at one or both ends of the shaft. Alternatively, they may be drawn together by a bolt through a hole in the shaft.

The engaging surfaces of the metal sections and clamp members are inclined to the direction of the clamp pressure to provide an initial tolerance for the engagement of the ends of metal sections with the clamp members. As the clamp members are drawn together, the metal sections are forced inwardly together and locked to the central shaft when the clamp members are fully engaged.

When a connection of one or more beams to a supporting column is required, the lower clamp member of the central shaft are attached to the column reinforcements which are welded or anchored to said clamp member.

Where a simple connection is required between two beams away from a point of support, one or more connectors may be used in a horizontal or vertical position with the metal sections projecting at the sides of the beam ends.

The clamp connection may be employed for the transfer of stress from a diagonal member to another diagonal member or members or to a horizontal or vertical member or members as may be required in a braced structure.

A column junction may be formed by locating two or more connectors in a horizontal position at right angles to the column axis.

In one arrangement, the reinforcements of the beams are welded at their ends to metal sections adapted to form with other metal sections, segments of a hollow round bar, tapered externally at each end. The segments are positioned against a central shaft matching the internal diameter of the hollow round bar. The projecting ends of the segments engage in a circular recess in each of the clamp members which matches the external diameter and taper at the ends of the hollow round bar of which the segments form part. The ends of the central shaft are provided with threads and the clamp members are drawn closer together by means of nuts engaged on the threads.

In another arrangement, where the reinforcements comprise prestressing tendons, the latter pass through apertures in the metal sections into which they are anchored. In this case, the external faces of the metal sections are shaped to provide sufficient area to spread compressive forces due to tensioning and subsequent loading, so that these are within the designed compressive strength of the concrete.

The profile of the metal section is shaped to provide sufficient strength to transfer bending stresses from the prestressing tendons to the upper and lower clamp plates.

In order that the invention may be more readily understood reference will now be made to the accompanying drawings illustrating practical embodiments of connections for structural members constructed according to the present invention. In these drawings:

FIG. 1 is a vertical section through a clamp connection between two opposite beams, and a column cast in reinforced concrete;

FIG. 2 is a fragmentary perspective connection assembly as it would appear without concrete encasement;

FIG. 3 is a vertical section through a clamp connection between two opposite beams, and a column in which the beams and column are in one form of prestressed concrete;

FIG. 4 is a fragmentary perspective of one segment engaged in a lower clamp plate to further illustrate FIG. 3;

FIG. 5 is a plan showing four beams with connection as shown in FIG. 3 with clamp plate removed;

FIG. 6 is a fragmentary perspective of the end of a concrete beam showing a segment, the ends of which project to engage in recesses in the clamp plates;

FIG. 7 is a section through one end of the connection showing a clamp plate at point of engagement with one end of a segment;

FIG. 8 is a similar section showing a clamp plate fully engaged and locked with a nut;

FIGS. 9 and 10 are diagrammatic elevations of end connections between beam ends employing one or more connectors as illustrated in FIGS. 1 to 8;

FIG. 11 is a diagrammatic elevation of a connection between a beam and two diagonal members;

FIG. 12 is a diagrammatic elevation of a connection between a beam and a continuous column; and

FIG. 13 is a diagrammatic elevation of a column connection.

FIGS. 1 and 2 illustrate the connection between the ends of two beams 14 on a supporting column 15. The connection assembly comprises metal sections 16, in the form of segments of a hollow round bar, and which are attached, by welding, to the ends of reinforcing bars 17 cast in the beams 14. Said sections 16 are positioned at the ends of the beams 14 and extend centrally for the major portion of the end face 18 in which they are cast to form upper and lower stepped portions 19 at the ends of the beams. The ends 20 of the sections 16 extend past the stepped portions 19 and have tapered formations 21 adapted to engage a corresponding tapered face 22 in recesses 23 in upper and lower clamp plates 24 and 25 which are accommodated within the stepped portion 19 of abutting ends of beams to be connected together.

The clamp plates 24 and 25 are each provided with a central aperture 26 to receive a clamp rod or bar 27 which is threaded at least at the outer end to receive a clamp nut 28. The other or inner end of the clamp rod 27 is shown as threaded to receive a securing nut 29 for fixing the rod 27 in the column 15. Where the connection assembly is to be used to connect the ends of two beams together both ends of the clamp rod 27 are threaded to receive clamp nuts for closing the clamp plates 25 and 26 onto the sections 16.

As illustrated in FIGS. 1 and 2 the connected ends of beams 14 are supported on the lower clamp plate 25 which is formed with projections 29 which are welded to the reinforcements 30 in the column. The inner end of the clamp rod 27 extends into the concrete at the top of the column and is bolted by nut 29 to a securing plate 31 which is also welded to the reinforcements 30.

It will be noted that the inner, exposed faces of the metal sections 16 bear on the surfaces of the clamp rod 27 throughout a substantial portion of the length of the rod, thereby to provide an effective transfer of the moment forces.

The clamp rod 27 may be of rectangular or hexagonal cross section instead of circular as illustrated and in these cases the faces of sections 16 engaging the clamp rod are correspondingly shaped to bear on the clamp rod. In another arrangement (not shown) the clamp rod may be provided with a sleeve, the outer faces of the sections 16 being adapted to bear upon the sleeve.

The faces 22 of the recesses 23 in the clamp plates 24 and 25 engage the tapered formations 21 of the extending ends 20 of the sections 16 on the beams 14 to be connected together so that when the clamp plates are drawn together by tightening the nuts at one or both ends of the clamp rod compression forces are transferred through the connection by the inner faces of the sections bearing on the clamp rod or sleeve thereon. Tension forces are transferred by the inner faces of the extending ends of the sections bearing on the recesses in the clamp plates. Where the clamp rod forms part of a column, continuity is provided in the connection between the beams and the column.

FIGS. 3 and 4 are views similar to FIGS. 1 and 2 illustrating a similar connection assembly parts of which are modified to enable prestressed reinforcements tendons to be anchored thereto. In this arrangement the beams 14a have incorporated therein prestressed tendons 17a which pass through apertures 16b in the metal sections 16a, recesses 16c therein being provided to accommodate the anchoring heads 17b of the tendons 17a.

In order to compensate for the weakening of the metal sections 16a by the apertures 16b and recesses 16c, the sections are shouldered as at 16d or provided with reinforcing webs to spread compressive forces due to tensioning and subsequent loading and to resist bending moments within the lengths of the section 16a.

The lower clamp plate 25a is provided with recessed apertures 25b to receive the ends and anchoring heads 30b of prestressed reinforcing tendons 30a in column 15a.

The clamp rod 27a in this arrangement is directly secured to the lower clamp plate 25a by nut 29a engaging a threaded end on rod 27a. To provide rigidity between the clamp rod and clamp plate, the shoulder end of the clamp rod 27a is tapered as at 27b to seat in a corresponding tapered recess 25c in the clamp plate 25a.

The upper clamp plate 24a is the same as that illustrated in FIGS. 1 and 2 and is secured in a similar manner to that previously illustrated.

It will be apparent that beams or column having reinforcements bars 17 and 30 may be joined to beams or columns having prestressing tendons 17a or 30a, that is reinforced or prestressed structural members may be used and connected together in any arrangement required.

Furthermore, holding down bolts (not shown) may be cast in beams to project from the upper faces thereof to secure thereto the baseplates (not shown) of columns supporting upper floor or roof structures.

FIG. 6 is a view illustrating the metal section 16a at one end of a beam 14a the end of which is shaped to nest with and be connected to other similar beams on a supporting column as shown in plan in FIG. 5.

To effect a connection between beams and a column, the ends of the beams are positioned with the lower tapered ends of the segments engaged within the matching tapered recess in the lower clamp plate which is attached to the top of the column. The weight of the beam causes the segments to drop into the recess and the taper forces the outer faces of the segments into close contact with the lower end of the clamp shaft.

Under normal conditions compressive forces will act at the lower end of the connection and tensile forces will be transferred through the upper clamp plate. However, under some design conditions a reversal of loading will induce tension through the lower clamp plate.

FIG. 7 shows an upper clamp plate 24 or 24a which is used to complete the connection, and is shown in a position to engage the upper ends of the sections 16 or 16a. Due to deflection or inaccuracies, the latter may not be in close initial contact with the upper end of the clamp shaft 27 or 27a. However, the taper on the upper ends of the sections 16 or 16a and within the recess in the upper clamp plate 24 or 24a are designed to provide sufficient tolerance to enable the lower edge of the clamp plate recess to fit over the upper ends of the sections 16 or 16a if these are slightly displaced. The clamp plate is then forced downward by means of the clamping nuts on the threaded upper end of the clamp shaft 27 or 27a, forcing the ends of the section tightly against the shaft.

FIG. 8 shows the upper clamp plate fully engaging the upper ends of the segments which have been forced laterally against the clamp plate and locked in this position.

If necessary the clamp plates may be forced closer together by hydraulic or mechanical pressure means and then locked with the nut.

FIGS. 9 to 13 diagrammatically illustrate typical arrangements for connecting various structural members together by clamp assemblies as illustrated in FIGS. 1 to 3, the clamp assemblies in these views being diagrammatically represented as 31 in each Figure.

FIG. 9 illustrates the unsupported connection of the ends of two beams A and B by one clamp assembly 31. FIG. 10 illustrates the unsupported connection of two deeper section beams C and D by two clamp assemblies 31.

FIG. 11 shows the connection of two bracing members E and F to a beam G by a clamp assembly 31. FIG. 12 shows the connection of a beam H to a shouldered column I by a clamp assembly 31 and FIG. 13 shows a connection by two clamp assemblies 31 between two column sections J and K.

In all views FIGS. 9 to 13 the clamp assemblies 31 are shown as being located in a horizontal plane, however, the assemblies in FIGS. 9 and 10 may be disposed in a vertical plane. The metal sections forming part of the clamp assemblies, when located in the side of a structural member, as shown in FIGS. 11 and 12 are located in recesses in the member and are attached to the reinforcements in the associated member.

What I claim is:

1. A connection assembly for concrete precast structural members comprising

- metal sections positioned at the adjoining ends of at least two structural members and rigidly secured thereto, said metal sections extending substantially through said structural members and being formed with tapered end portions,
- clamp members adapted to be disposed over said tapered end portions of said metal sections, said clamp members being formed with tapered portions corresponding to said tapered end portions of said metal sections and adapted to engage the same when the structural members are clamped together,
- a clamp shaft passing through the assembly between said metal sections and contiguous thereto throughout at least a substantial portion of the length of said shaft, said shaft having opposed ends extending beyond said clamp members, and

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d. means associated with the opposed ends of said shaft for clamping said clamp members to said metal sections to draw the same together thereby effecting locking engagement of the outer surfaces of said metal sections to said clamp shaft.

2. The connection assembly of claim 1 wherein at least one of the clamp members is provided with an opening through which the clamp shaft passes and a thread on at least one end of the clamp shaft to receive a nut for drawing the clamp members together.

3. The connection assembly of claim 2 wherein the end clamp members have recesses therein to receive and engage matching formations on the metal sections and with the engaging surfaces on the clamp members metal sections being inclined to the direction of clamping pressure so as to effect engagement of the metal sections and the clamp shaft.

4. The connection assembly of claim 1 wherein the outer surfaces of the metal sections are formed as segments of a shape to engage that of the clamp shaft.

5. The connection assembly of claim 1 for providing a connection of at least one beam to a supporting column including column reinforcements wherein one clamp member is fixed to the column reinforcements and the clamp shaft is attached to the column reinforcements.

6. The connection assembly of claim 5 wherein the clamp

shaft is indirectly attached to the column reinforcements by being fixed to the clamp member attached to said column reinforcements.

7. The connection assembly of claim 5 wherein the one clamp member is welded to the column reinforcements and the clamp shaft is bolted to a securing plate welded to said reinforcements.

8. The connection assembly of claim 5 wherein the one clamp member is provided with recessed apertures to receive anchored ends of the column reinforcements and the said clamp member is provided with a tapered recess to receive a correspondingly tapered shoulder end on the clamp shaft which is secured to said clamp member by a nut on a threaded extension in the clamp shaft.

9. The connection assembly of claim 1 wherein the metal sections are provided with recessed apertures in which prestressed reinforcements are anchored, said metal sections being provided with reinforcing shoulders to spread compressive forces due to tensioning and subsequent loading and to resist bending movements within the length of the section.

10. The connection assembly of claim 1 further including reinforcement members in said structural members, said metal sections being rigidly secured to said reinforcement members.

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