

[54] **STRUCTURAL ARRANGEMENT**
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[58] Field of Search 52/633, 637, 638,
52/690-694, 584, 643, 731, 721, 726;
211/182; 182/178, 222

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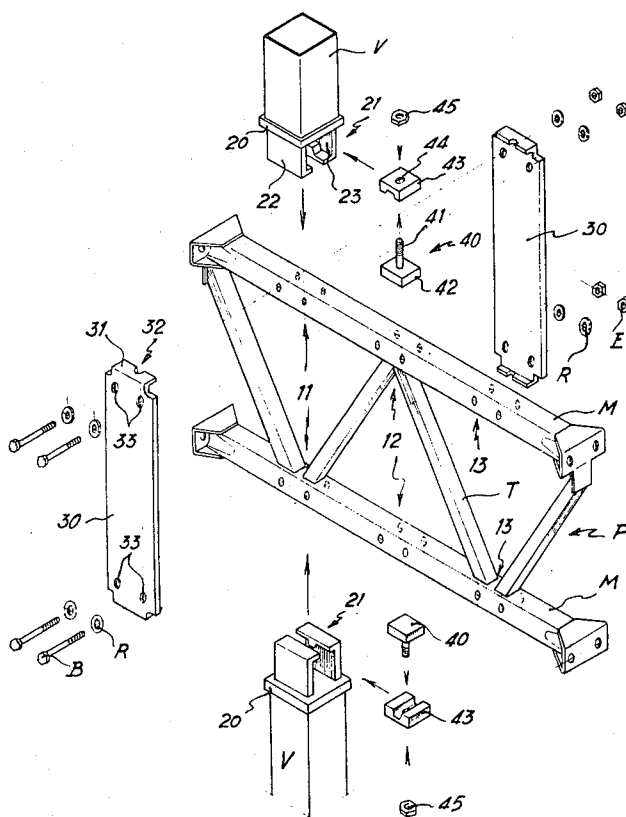
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[57] **ABSTRACT**

A structural arrangement for connecting one or more vertical posts to a horizontal girder. A connection is fixed to the end of the vertical post and designed so as to transmit the compressive forces resulting from axial loading. Two ties are mounted on the girder at opposite sides thereof and have their ends adapted to provide bearing surfaces for the vertical post connection. Means are provided for locating the connection in alignment with the ends of the ties to prevent lateral disengagement.

9 Claims, 14 Drawing Figures



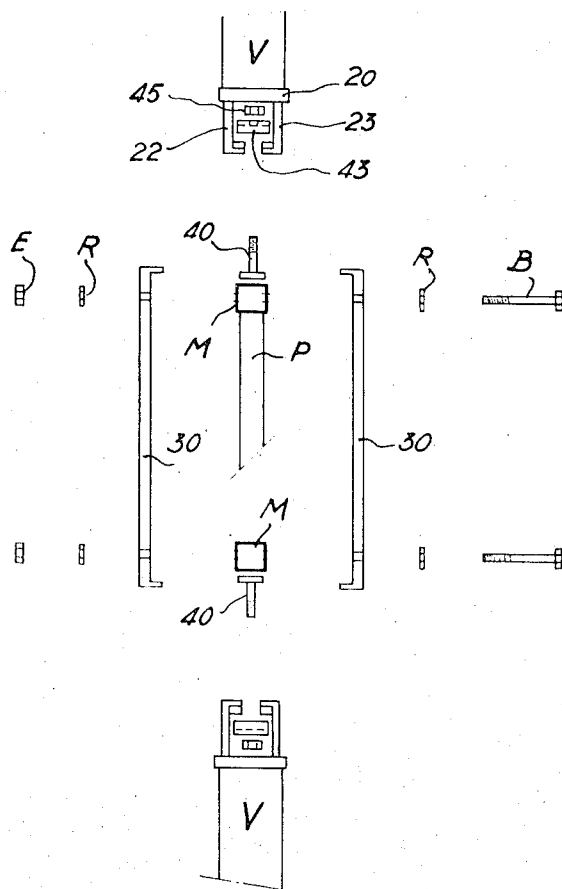


FIG. 2

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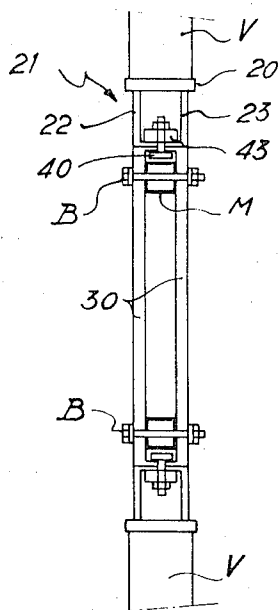


FIG. 3

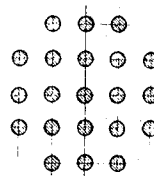


FIG. 4a

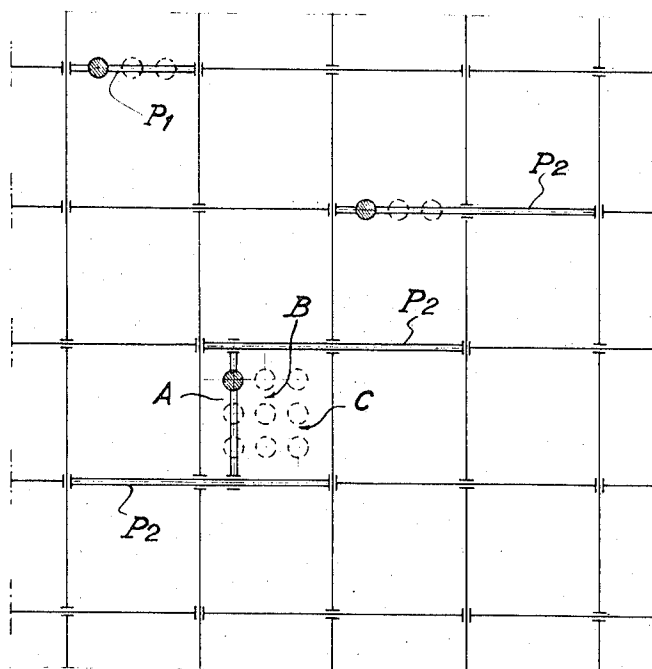


FIG. 4

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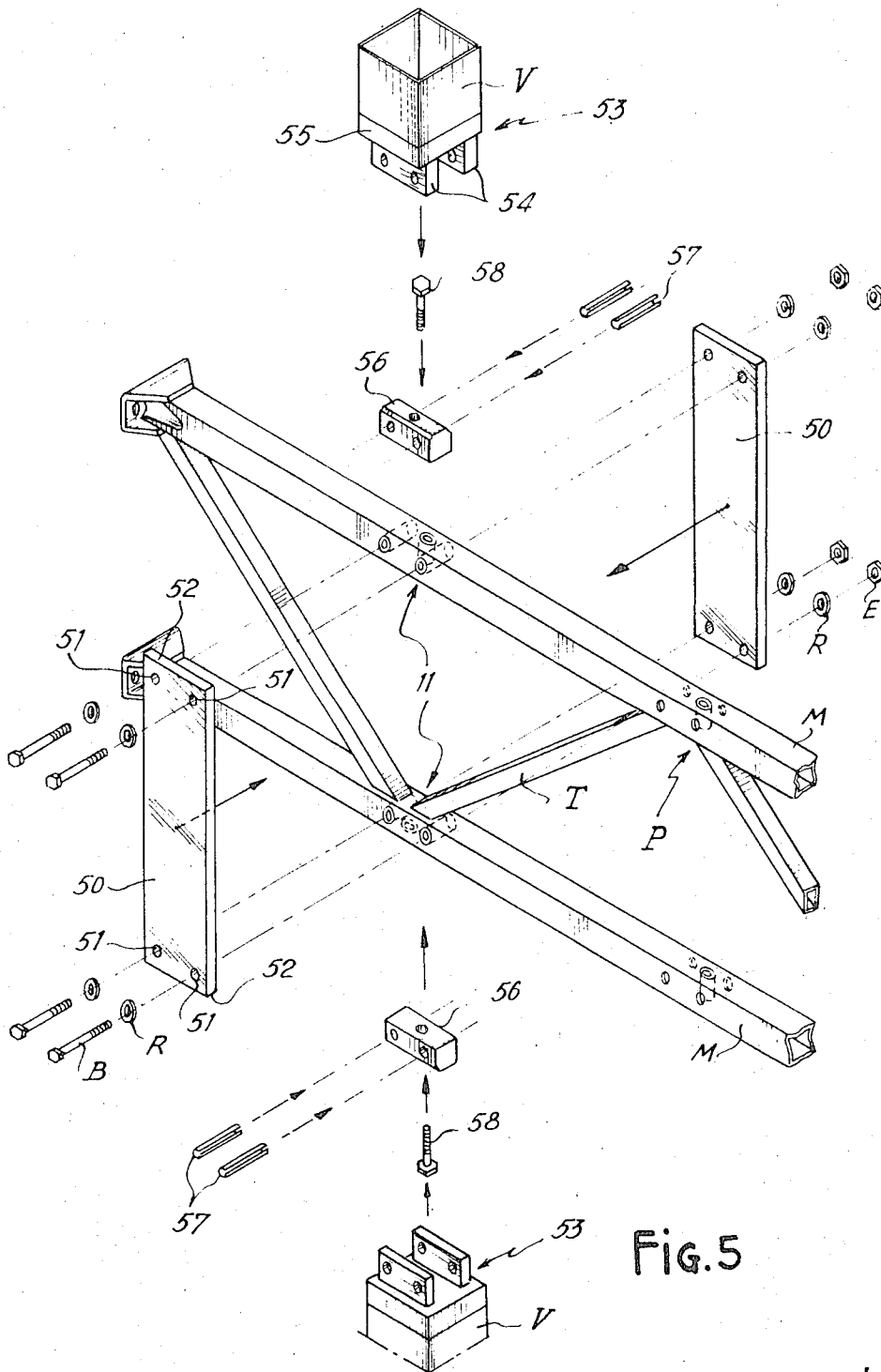


FIG. 5

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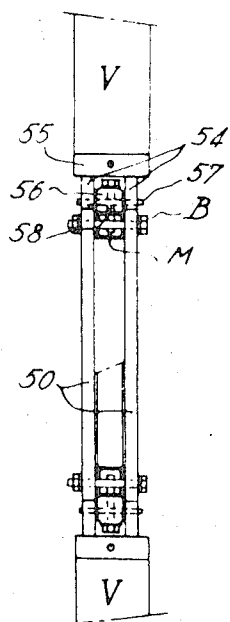


Fig. 6

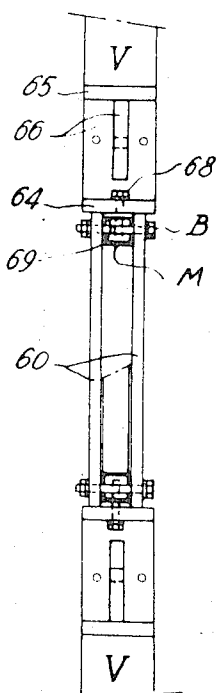


Fig. 8

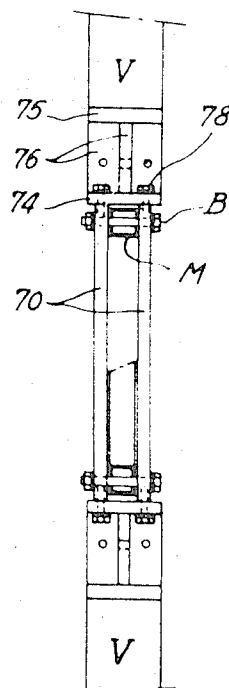


Fig. 10

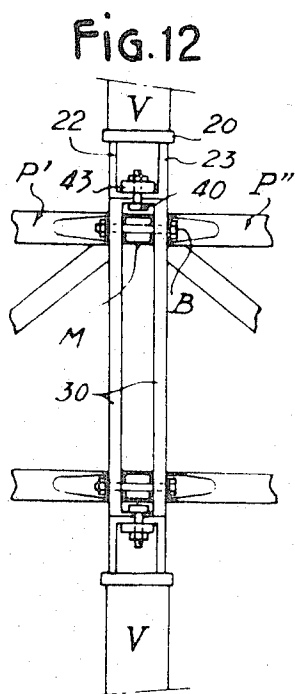


Fig. 12

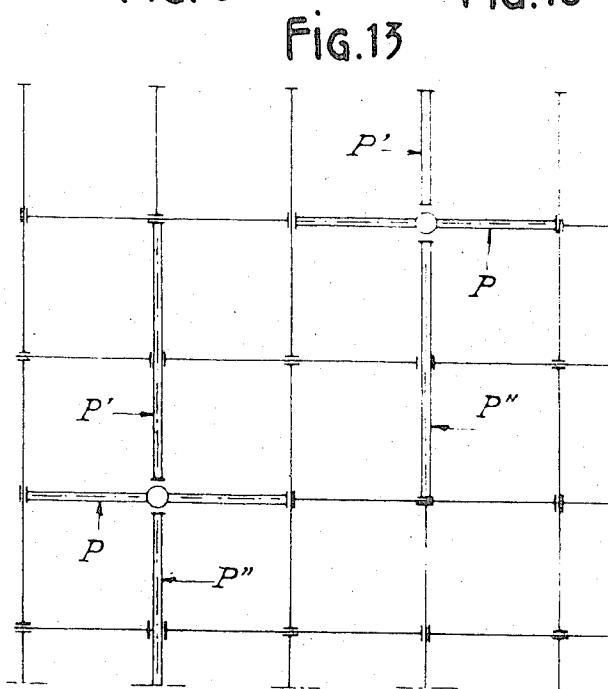


Fig. 13

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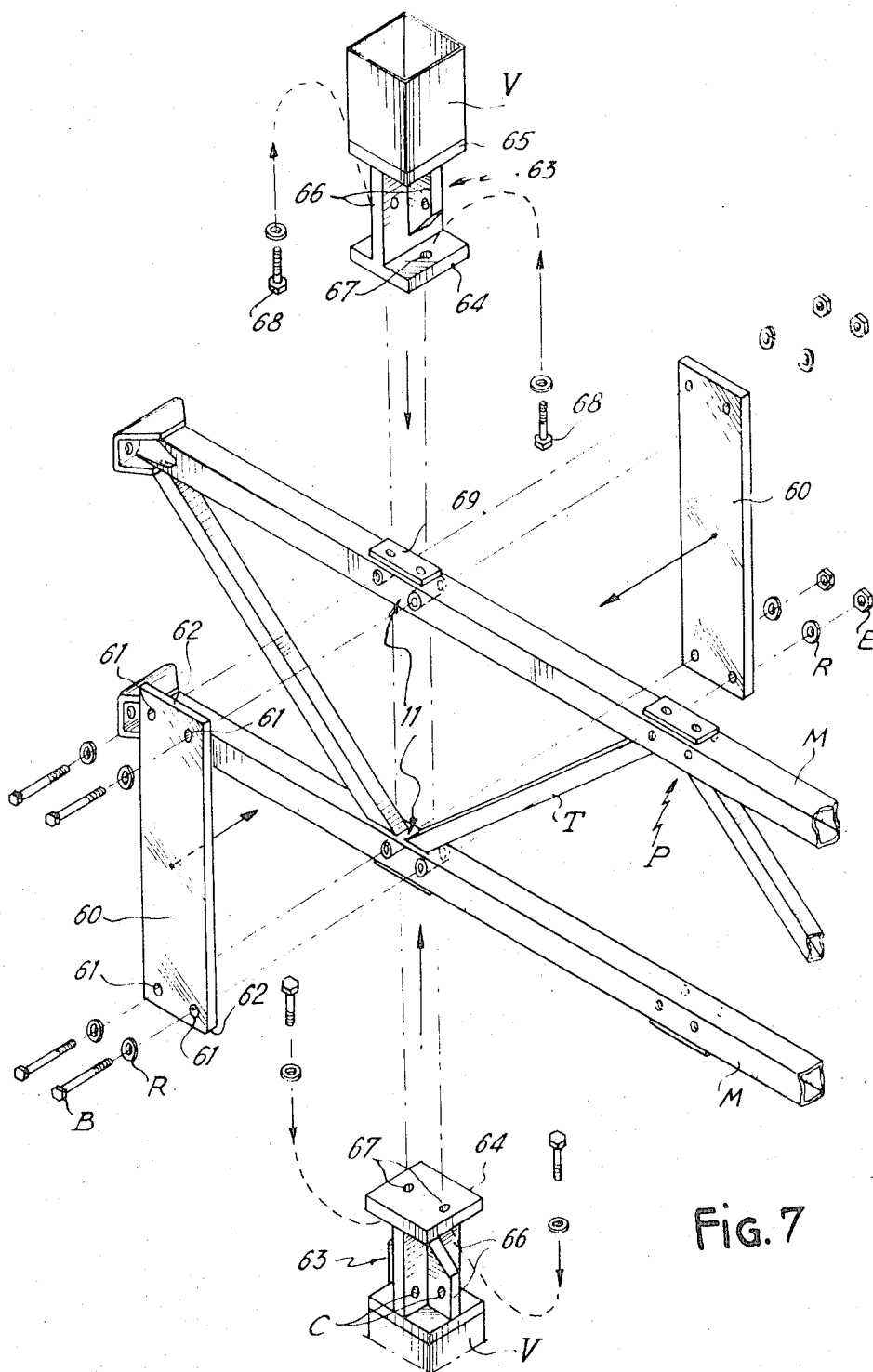


FIG. 7

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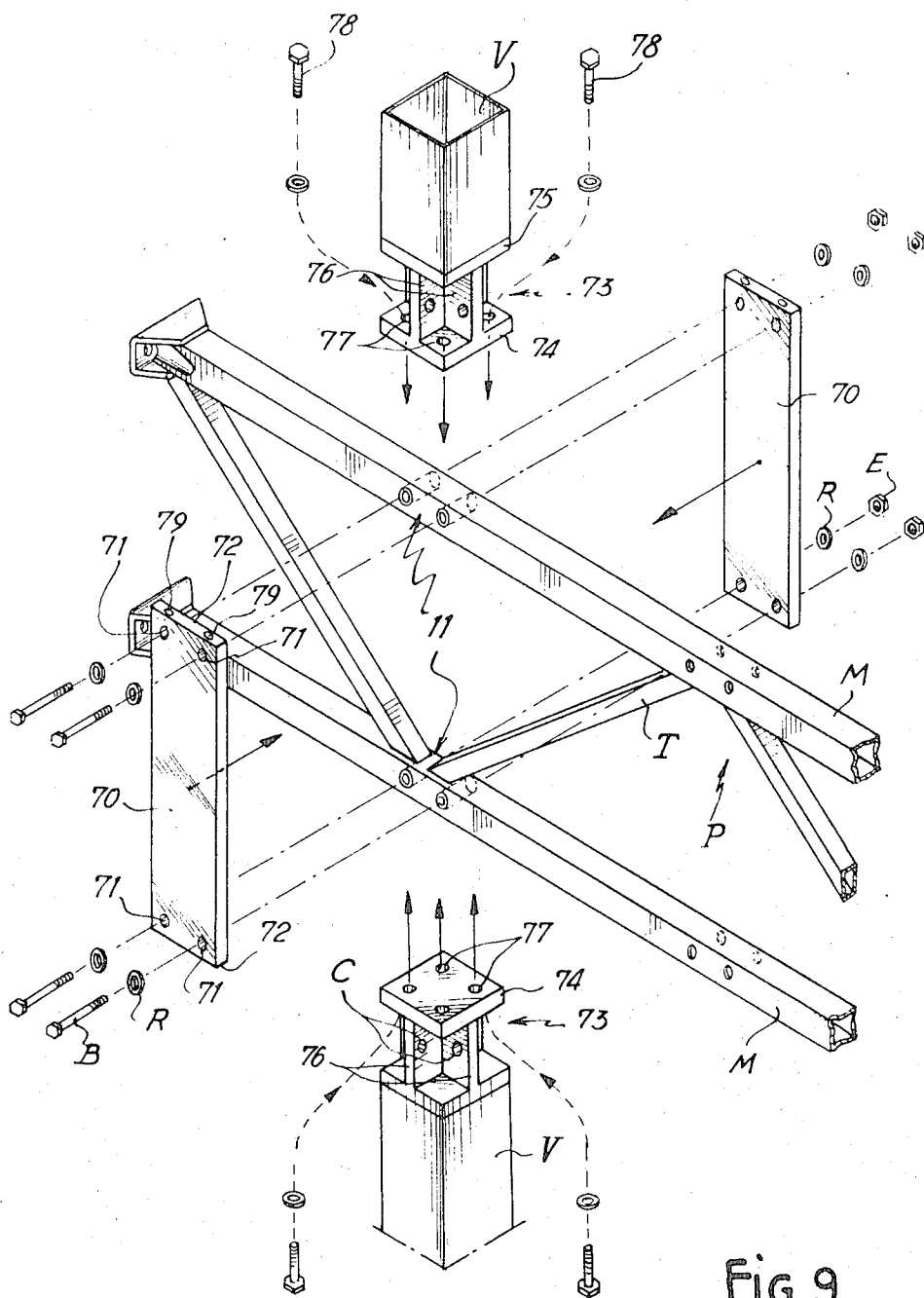


FIG. 9

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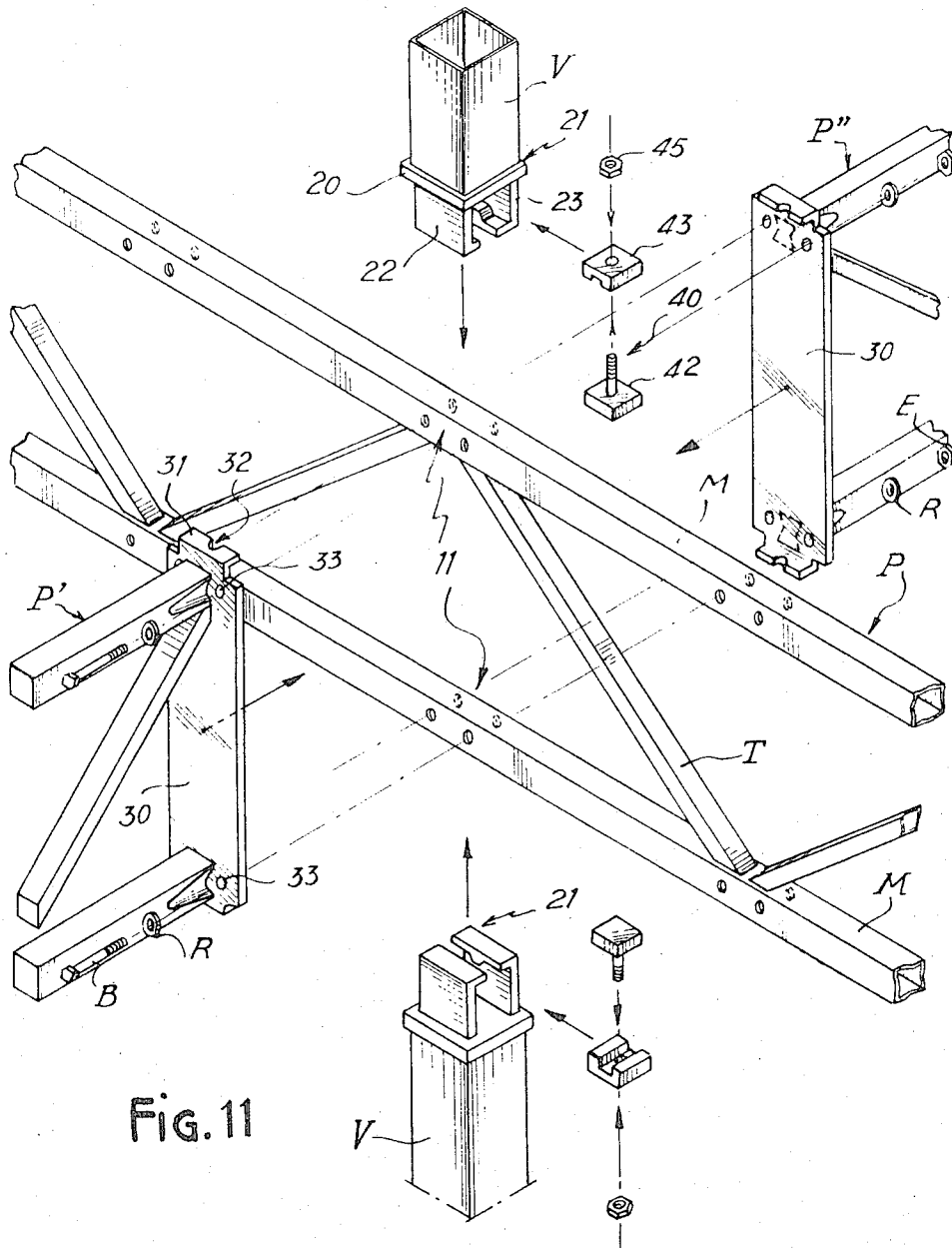


Fig. 11

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STRUCTURAL ARRANGEMENT

The present invention relates to metal structures used as the framework of buildings and similar constructions.

More specifically, the invention relates to so-called "spatial" metal structures, of the type having intersecting girders, in which various metallic elements are connected in order to constitute a two-way network, the joints of the network constituting the connecting and assembly points of the elements.

In this context, the invention relates more precisely to the connection of vertical posts to a series of horizontal girders, arranged in one or more layers of a structure.

Generally, this problem has existed for a long time and, classically, the connection of a post to a framework is realised by connecting the main elements (girders, beams, joists) constituting the framework to the post by the intermediary of connecting members (gussets, angle-irons, cleats).

In this traditional technique, the relative position of each post and of the framework is strictly determined, in general as a function of the intended purpose of the structure. On the other hand, it is practically impossible to move a post after the structure is completed, without having to modify the entire structure.

An object of the present invention is to provide a method of assembly of a post allowing a variable installation of the post in a large number of possible positions.

In particular, the object of the invention is the installation of a vertical post relative to a horizontal structure of girders which are orthogonal and define a main structure with a square mesh.

In this case, there is preferably defined, according to the invention, an installation system according to a modular distribution, the module of which is a submultiple of the main module, the installation locations corresponding to a secondary grid, the basic element of which is obtained by dividing the element of the main structure.

The connecting arrangement according to the invention, intended for connecting a vertical post to a horizontal girder comprising at least one chord, is characterised in that it includes, in combination, a connection fixed to the end of the vertical post and designed so as to transmit the compressive forces resulting from axial loads, two ties mounted on the girder on either side of each chord by means of bolts or other equivalent means passing through holes provided in each chord, the two ties being spaced apart and having their ends formed such that the latter may serve as support faces for the connection of the vertical post, and fixing means designed to retain the connection of the vertical post in alignment with the ends of the ties in order to prevent any lateral disengagement.

In order to facilitate a varied installation of the post relative to the girders of the structure, the holes provided in the chords of the latter are distributed to correspond to the chosen installation distribution, in particular to correspond to the module of the secondary distribution grid. The mounting of the post, which is remarkably simple, also provides the advantage of a great flexibility of installation, since the latter is possible at each place where assembly holes have been provided in the chords of each girder of the structure.

According to another feature of the invention, which is particularly applicable when the horizontal girder has two superimposed chords which are connected to each other for example by means of a latticework of small inclined girders, each tie has two groups of holes for its connection to the two chords, and the connection of the ties to the girder thus defines two support faces or groups of support face which make it possible to connect to the girder two aligned vertical posts forming with the ties a continuous line for the transmission of loads. In this case the structure of horizontal girders does not participate in the transmission of loads but continues to fulfill its function as an installation support relative to the vertical posts.

In a first embodiment of the connecting arrangement according to the invention, the connection of the vertical post is in the form of a frame with parallel sides which are bent over towards each other and the two ties also extend beyond each chord so as to define with it at least one retaining cage, this frame and this cage being connected end to end and kept in abutment one against the other by the intermediary of securing means comprising a bolt, a shim and a lock-nut, the head of the bolt and the shim being retained in the cage and in the frame or vice versa.

In a second embodiment of the connecting arrangement according to the invention, the connection of the vertical post is in the form of a stirrup with two parallel sides and having the same spacing and same cross section as the ends of the ties against which they bear, and the connection takes place by means of a centering shim connected and secured to a horizontal face of the chord of the girder, this shim engaging for this connection between the sides of the stirrup and cotter pins or equivalent means then being introduced into the aligned apertures in the sides and the shim in order to complete the assembly.

In a third embodiment of the connecting arrangement according to the invention, the connecting mouthpiece of the vertical post comprises a square or rectangular plate forming a support base-plate and connected by rigid legs to a connecting collar and the connection takes place by screws or equivalent means engaged in the holes of this plate and making it possible to connect it to a horizontal face of the chord of the girder and/or to the ends of the two ties against which they bear.

According to an additional feature of the invention and in order to increase still more the installation flexibility of the vertical girders on the structure of the horizontal intersecting girders, making it possible even at the joints of this structure, i.e., at the intersections of the component girders, the ties of the connecting arrangement may be rigidly connected to the ends of certain of the horizontal girders used for forming the structure.

The invention is further described by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is an exploded perspective view of a first embodiment of a connecting arrangement according to the invention, comprising a girder, two aligned vertical post members and the elements for their connection,

FIG. 2 shows diagrammatically this same arrangement in side view;

FIG. 3 shows in side view this same arrangement in the assembled state;

FIG. 4 shows diagrammatically a structure constituted by a grid of horizontal girders;

FIG. 4a, is the installation diagram of a vertical post member in the basic unit of this grid;

FIG. 5 is an exploded perspective view, similar to that of FIG. 1 of a second embodiment of a connecting arrangement between a horizontal girder and two vertical post members;

FIG. 6 shows in side view this same arrangement in the assembled state;

FIG. 7 shows in exploded perspective view a third embodiment of the connecting arrangement;

FIG. 8 shows this same arrangement in the assembled state in side view;

FIG. 9 shows a variation of the preceding embodiment,

FIG. 10 shows this variation in the assembled state in side view,

FIG. 11 is an exploded perspective view of an embodiment of the connecting arrangement such as that of FIGS. 1 to 3, but adapted with a view to allowing the installation of vertical posts at a joint of the structure;

FIG. 12 shows in side view the preceding embodiment in the assembled state; and

FIG. 13 illustrates diagrammatically an example of the installation of vertical posts at the joints of a structure of horizontal girders with a square mesh.

The metal girder P of FIG. 1 is in the standard form, as constituted by two chords M connected by a metal latticework T.

As will be seen hereafter, in order to establish a structure of horizontal girders with a square mesh, it is advantageous to have two lengths of girder P₁ and P₂.

On the girder P, there are provided in the two chords, several series of four horizontal holes 11, 12 and 13. The series of holes 11, 12 and 13 are regularly distributed in distinct vertical planes. The end of each vertical post member V has a collar 20 supporting a frame 21 constituted by two sides 22 and 23, each side having an edge which is bent over to render the side L-shaped.

In the example shown, there is an ascending section of post and a descending section of post. It should be understood that this is only an example.

The arrangement uses two ties 30, of drop-forged steel, of generally elongated rectangular shape. At each of its ends, each tie 30 comprises an edge 31 which is bent over and has a notch 32. In the vicinity of its two ends, each tie 30 comprises through holes 33, the distribution of which is identical to that of the holes of each of the aforesaid series 11, 12 and 13.

Bolts B, washers R and nuts E serve, as will be seen hereafter, for connecting the ties on either side of the girder P.

For the assembly of the vertical elements V, there is used a bolt 40 provided with a shank 41 and a square head 42, a locking plate 43 provided at its centre with an aperture 44 and a locking nut 45.

The connection of the various elements is easy to understand (FIGS. 2 and 3). The ties 30, arranged opposite each other, are mounted on the girder P by means of bolts B and washers R. The bend edges 31 trap the heads 42 of the bolts 40, the shanks 41 of these bolts 40 being placed between the notches 32.

The shank 41 of each bolt 40 is connected to the corresponding frame 21 by means of a locking plate 43 engaged without being able to turn between the sides 22 and 23 of the frame and having a tapped central hole

44 which engages the shank 41, the nut 45 locking the arrangement.

It can be seen that the installation of the two vertical elements V is realised very easily at any of the series of holes 11, 12 or 13.

A vertical post may thus be connected to a girder at all points where the chords of the girder are provided with appropriate holes.

FIG. 4 shows a grid of assembled horizontal girders, made from girders P₁ and P₂ of the aforesaid type, the girders P₂ being twice as long as the girders P₁. Thus a network with a square mesh is defined.

Due to the fact that it is possible to interpose a girder of the type P₁ in three positions A.B.C in each mesh opening, and due to the fact that each girder P₁ has three series of installation holes (FIG. 4), there are nine installation positions regularly distributed in each mesh opening, the installation points defining a secondary grid, the mesh size of which is division of the mesh size of the grid of girders. Of course, vertical posts can also be mounted on the girders constituting the basic grid, outside of the main connecting joints. This possibility is illustrated in FIG. 4a, in which there can be seen the nine possibilities of internal installation and the twelve possibilities of peripheral installation.

FIGS. 5 and 6 illustrate a second embodiment of the connecting arrangement according to the invention. It is different from those shown in FIGS. 1 to 3 in that the two ties 50 are constituted by simple rectangular metal sheets with straight edges, and the securing members B, R, E make it possible to assemble the ties 50 on either side of the girder P by engaging them in the holes 51 provided at the corners of the ties so in alignment with the holes 11.

The upper and lower edges 52 of the ties 50 are in alignment in order to serve as support faces for the assembly sockets 53 located at the ends of the vertical post members V. As shown in particular by FIG. 5, each socket 53 is in the form of a stirrup comprising two sides 54 which are parallel and spaced apart, these sides being connected to a connecting collar 55 having the same spacing and the same cross section as the upper and lower edges 52 of the ties 50. The ties 50 being assembled on either side of the chords of the girder P by means of bolts B, washers R and nuts E, the positioning of the vertical post member V is effected by previously fixing to the horizontal face of the chord M a centering shim 56, of oblong shape and advantageously provided with chamfered edges, this shim having a width slightly less than the space between the sides 54, then by arranging the vertical post element V such that the sides 54 of its assembly mouthpiece 53 overlap the shim 56 in order to bear directly on the edges 52 of the ties 50. The assembly is completed by the introduction of two cotter-pins 57 into aligned openings in the sides 54 and the shim 56. FIG. 6 shows the connection arrangement constituted in this way in the assembled state. Advantageously, the edges 52 of the ties 50 can define a slight projection relative to the horizontal face of the chord M; they thus lock the shim 56 against any undesirable rotation and make it possible to assure its securement by means of a single screw 58 passing through a central vertical aperture in the shim and engaged in a screw-threaded hole previously provided in the chord M between the holes 11 intended for mounting the ties 50.

In the example shown in FIGS. 5 and 6, it will be noted that the transmission of vertical loads takes place from the upper post to the lower post exclusively through the intermediary of ties 50, and practically without making use of the horizontal girder P to which these posts are connected. However, by means of the centering shims 56 and the fixing parts which are associated therewith, the chords of the girder P ensure the lateral immobilization of the connecting sockets 53 of the vertical posts which are thus effectively retained to bear against the co-operating surfaces of the ties 50.

FIGS. 7 and 8 illustrate a third embodiment of the connecting arrangement according to the invention. The latter differs substantially from the preceding embodiment by the constitution of the connections 63 of the vertical post members V and by their method of being secured and retained in alignment with the ends of the ties 60, the latter being exactly like those of FIGS. 5 and 6. The connection 63 here comprises a square plate 64 of external dimensions substantially identical to those of the vertical post V, this plate which forms a support base-plate being connected to the connecting collar 65 by the intermediary of two rigid, intersecting legs 66. The plate 64 has two holes 67 located substantially in a median plane of symmetry of the post V, one of the two intersecting legs 66 being preferably shortened and chamfered to provide access to the holes 67. In these holes are engaged the fixing screws 68 which co-operate with threaded holes in a rectangular mounting plate 69 connected and secured by any appropriate means, for example welding, to the horizontal face of the chord M. The screws 68 thus immobilize the connection 63 relative to the chord M and thus also relative to the ties 60 on the ends 62 of which the plate 64 bears.

FIGS. 9 and 10 illustrate a variation of the preceding embodiment, in which the plates 74 of the connections of the vertical posts V are held in alignment with the ends 72 of the ties 70, not by being secured to the chord M of the girder P, but by being secured directly to the ties 70. For this purpose the plates 74 have four holes 77, one at each corner, coinciding with the position of the threaded holes 79 provided at the ends of the ties 70. The connecting screws 78 thus directly fasten the plates 74 of the connections 73 to the bearing faces constituted by the aligned edges 72 of the ties 70. With respect to the preceding arrangement, this arrangement offers the advantage of not weakening either of the two intersecting legs 76 connecting the plate 74 to the connecting collar 75. However, this method of securement obviously could comprise numerous variations, particularly in the form of a mixed securement relative to the chord as well as to the ties.

One of the advantages of the embodiment illustrated in two variations in FIGS. 7 to 10 consists in that it is possible to use the rigid legs 66 or 76 connecting the plates of the connections to their connecting collars for the securing and anchorage of oblique wind-bracing tie-bars, not shown in the drawings. It is for this purpose that the legs 66 and 76 are each provided with an aperture C. The connecting arrangement according to the invention is thus able to fulfill an additional function by making it possible to save on special anchoring means.

Finally, FIGS. 11 and 12 of the accompanying drawings illustrate a variation of the embodiment of a connecting arrangement such as that shown in FIGS. 1 to

3. All the constituent parts of this connecting arrangement are identical to those of the said figures and consequently have the same reference numerals. The only difference consists in that the ties 30, instead of constituting independent parts, are rigidly connected by an appropriate means, for example by welding, to the ends of two horizontal girders P' and P'' intended to be aligned in a direction at right angles to that of the girder P in order to form with the latter a joint of the squared structure with horizontal girders. Due to this, it becomes possible, by the same means as those previously described to effect the installation of one or two aligned vertical posts V at a joint of the basic grid of the structure.

It is quite clear that this possibility, which it has been chosen to show in the framework of only one embodiment exists similarly with any one of the other embodiments described, although no illustration of it is given in the accompanying drawings so as not to overload the illustrations.

FIG. 13 shows a basic grid of horizontal girders P, P', P'' assembled so as to define a network with a square mesh. As is shown diagrammatically at two parts in this diagram, the girders P' and P'' provided at their ends with ties of any of the aforesaid types (30, 50, 60, 70) are aligned perpendicularly to the girders P of the large module which they intersect at their centre. The corresponding joints of the structure are thus in a position to serve as installation points for the vertical posts.

By appropriately combining the use of long and short module girders, it is naturally possible to install a vertical post at each of the joints of the basic grid of the same structure. It is also possible to combine this ability with those which were described above relating to the installation of vertical posts according to a secondary grid, the mesh of which is a division of the basic mesh of the structure.

Finally, it should be understood that the scope of the invention is not limited to the above-described examples which are illustrated in the accompanying drawings, but that, on the contrary, it extends at all technological variations based on the same principles. Similarly the term "vertical post" should be understood in its widest sense, i.e., that of a structural member able to support and transmit a vertical load; the meaning covers, in particular, the case where the lower post is reduced to a side-piece or other similar means for connection to the foundation courses.

What is claimed is:

1. An arrangement for interconnecting two vertically aligned post members with a horizontal girder between them, comprising:

- a. a plurality of holes in the girder spaced along the length of the girder,
- b. said post members having connecting ends defining opposed spaced apart contact faces,
- c. a pair of rigid vertical ties on opposite sides of the girder, said ties having holes which can be brought into alignment with different selected ones of the holes in the girder, said ties having contact faces at their upper and lower ends,
- d. means connecting said ties to any one of various points along the length of the girder defined by said holes in the girder, and
- e. means connecting and maintaining the contact faces of said post members in engagement with the upper and lower contact faces of said ties, respec-

tively, so that said ties extend between said post members and transmit axial loads from each post member to the other.

2. An arrangement as defined in claim 1 wherein the girder includes two spaced apart horizontal chords, said girder holes being formed in each of said chords, and each of said ties has holes near its upper and lower ends for registry with the holes in said two chords, respectively.

3. An arrangement as defined in claim 1 wherein the ties are rigidly connected to the ends of horizontal elements aligned in a direction at right angles to that of the girder, thereby providing a grid having a quadrangular mesh.

4. An arrangement as defined in claim 1, further including a metal structure having a grid of horizontal girders with a quadrangular basic mesh, the girder having at least one chord being coupled to the mesh to provide a secondary mesh.

5. An arrangement as defined in claim 1 wherein the connecting end of each post member has the shape of a frame; wherein the two ties extend beyond each chord to define at least one retaining cage, and wherein the connecting means (e) comprises a bolt, a shim, and a locking nut, the frame and cage being connected end to end by the connecting means, the head of the bolt and the shim being retained in the cage and in the frame.

6. An arrangement as defined in claim 1 wherein the connecting end of each post member is in the form of a stirrup with two parallel sides and having the same spacing and same cross section as the contact faces of the ties against which they bear; and wherein the connecting means (e) comprise a centering shim connected and secured to a face of the girder, and cotter pins engageable with apertures in the sides and the shim to complete a connection.

7. An arrangement as defined in claim 6 wherein said centering shim is fixed to the chord by a screw, and wherein the ties include projecting edges for preventing rotation of the screw.

8. An arrangement as defined in claim 1 wherein the connecting end of each post member comprises a connecting collar, a quadrangular plate, forming a support base-plate connected by rigid legs to the connecting collar; and wherein the connecting means (e) comprises screws, the screws being engaged with holes in the plate for fastening it to a face of the girder and to the contact faces of the two ties.

9. An arrangement as defined in claim 8 wherein two of said screws are arranged in a median plane of symmetry of one of the posts and engage threaded holes, in the quadrangular mounting plate secured to the face of the girder.

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