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(54) A scaffolding system

(57) A scaffolding system comprising a plurality of elongate structural tubes (16) and a plurality of node members (18). Each node member has three or more mating portions that each extend along one of three mutually perpendicular axes that pass through the respective node member. End portions of the structural tubes (16) can be releasably secured to the mating portions to provide a framework of vertical columns that extend between pairs of node members (18) and horizontal beams that extend between pairs of node members (18). The scaffolding system further comprises a plurality of tie members (20) that can each be releasably secured at opposing ends to a node member such that the respective tie member is inclined relative to the vertical columns or the horizontal beams, such that the scaffolding system, when assembled, is capable of supporting structural loads.

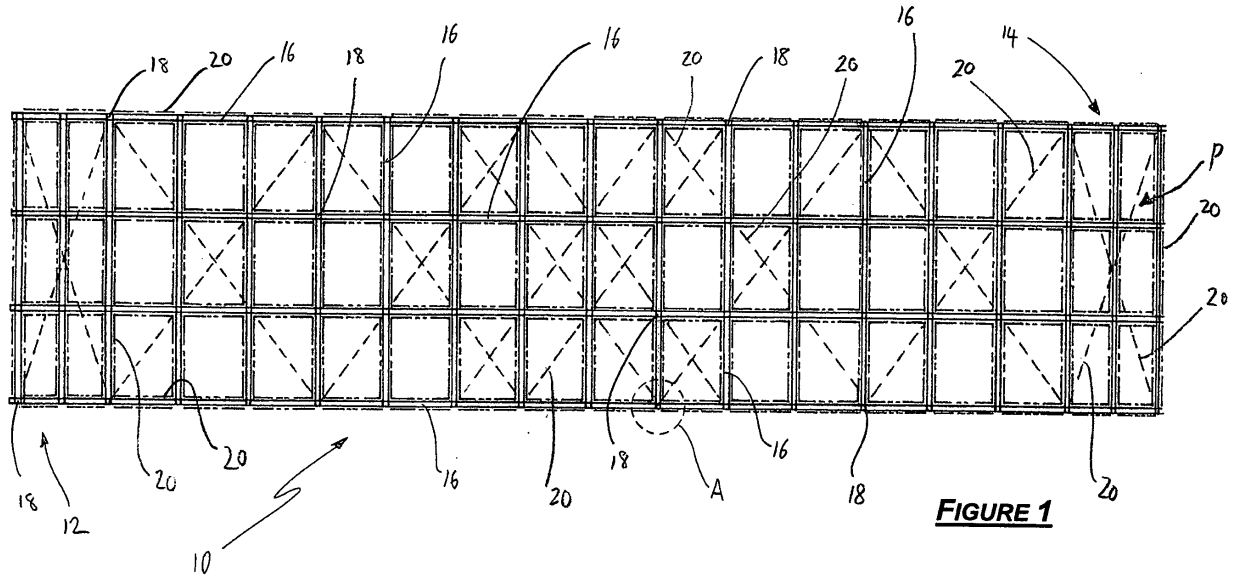

FIGURE 1

EP 2 141 306 A1

Description

Field of the invention

[0001] The present invention relates to a scaffolding system.

Background

[0002] It is known to construct scaffolding systems that have a number of light-weight scaffold tubes that are provided with interlocking members for releasably securing one scaffold tube to another. The scaffold tubes and other component parts of the scaffolding system are sufficiently light that operators can carry the component parts to or from the desired location for construction or disassembly of the structure.

[0003] Such scaffolding systems are ideally suited to light load applications and can be readily adapted to suit the necessary application. In addition, such scaffolding systems can be arranged for higher load applications. However, one disadvantage of using this type of scaffolding system in higher load applications is that a large number of component parts are required to ensure the structure is sufficiently stable and rigid.

[0004] It is also known to fabricate a purpose built structure for use in high load and/or large span applications. The structure is often discarded once it is no longer required.

[0005] In addition, it is also known to provide structural support systems that use pre-fabricated component parts, such as trusses and column supports that are interlocked to form a larger structure. An example of this type of system is the well known "Bailey Bridge" system. One disadvantage of such a system is that the component parts are large and heavy in order to provide the desired structural strength. Consequently, the components of these structural support systems are difficult, if not impossible, to handle as they are heavy and cumbersome.

Summary of the invention

[0006] The present invention relates to a scaffolding system comprising:

a plurality of elongate structural tubes;

a plurality of node members, each node member having three or more mating portions that each extend along one of three mutually perpendicular axes that pass through the respective node member, end portions of the structural tubes can be releasably secured to the mating portions to provide a framework of vertical columns that extend between pairs of node members and horizontal beams that extend between pairs of node members; and

a plurality of tie members that can each be releasably secured at opposing ends to a node member such that the respective tie member is inclined relative to the vertical columns or the horizontal beams, such that the scaffolding system, when assembled, is capable of supporting structural loads.

[0007] Preferably, the mating portions are sleeves that each define a cavity for receiving an end portion of the structural tubes.

[0008] Preferably, each sleeve of the node member comprises a plurality of walls that define the cavity. More preferably, the structural tubes have a square cross-section and the sleeves of the node members comprise four walls that define a square cavity for receiving the end of a structural tube.

[0009] Preferably, the scaffolding system further comprises a plurality of fasteners for releasably securing the structural tubes within the sleeves.

[0010] Preferably, the sleeves are provided with holes such that one of the fasteners can extend transversely through the sleeve to secure a structural tube within the respective sleeve. More preferably, the structural tube also comprises one or more holes adjacent each end such that a respective one of the fasteners can extend transversely through both the sleeve and a structural tube.

[0011] Preferably, each fastener can extend through opposing sides of a respective sleeve and structural tube such that the respective fastener is in double shear when employed in a structure constructed using the scaffolding system.

[0012] In one embodiment, the tie members are in the form of tie rods that are each tensioned to provide a tensile force between the node members to which the respective tie rod is secured.

[0013] In some embodiments, the plurality of fasteners can each releasably secure the one or more of the tie rods to the node members.

[0014] Preferably, the plurality of fasteners include pins having transverse holes through which ends of the tie rods can pass.

[0015] Alternatively or additionally, the scaffolding system can further comprise a plurality of clevis units that can be releasably secured to the node members, wherein one of the plurality of tie rods can be releasably secured to each clevis unit.

[0016] Preferably, the end portions of each tie rod are provided with an external thread such that an internally threaded nut can be threaded onto the external thread to tension the tie rod.

[0017] Alternatively or additionally, the tie members are in the form of a rigid braces.

[0018] Preferably, the scaffolding system further comprises a plurality of brace plates that can be releasably secured to the node members, wherein one or more of the plurality of braces can be releasably secured to each brace plate.

[0019] Each brace plate can comprise node member attachment holes that facilitate attachment of the respec-

tive brace plate to a respective node member. More preferably, each brace plate comprises brace attachment holes that facilitate attachment of one or more of the plurality of braces to the respective brace plate.

[0020] Preferably, the plurality of brace plates include:

a first set of brace plates that have brace attachment holes to facilitate attachment of one brace to the respective brace plate;
a second set of brace plates that have brace attachment holes to facilitate attachment of two braces to the respective brace plate; and
a third set of brace plates that have brace attachment holes to facilitate attachment of four braces to the respective brace plate.

[0021] Preferably, each structural tube is provided with mounting holes intermediate of the ends of the structural tube for mounting attachments to the structural tubes.

[0022] Preferably, the attachments are selected from the list comprising: cleats for attaching joists to the structural tubes, transom units for supporting the scaffold boards on structural tubes, brackets for attaching scaffold tube to structural tubes, mounting brackets for mounting rails to structural tubes.

[0023] The scaffolding system can further comprise components that can be releasably secured to the end of a structural tube, the components being selected from the list comprising: sole plates, end caps, and jacking devices.

[0024] The plurality of fasteners can comprise a set of first pins that are longer than the width of the sleeve, such that both ends of the first pins protrude from the sleeve when installed. Each first pin can have a transverse hole adjacent each end of the first pin, such that an end of a tie rod can pass through each transverse hole to secure the respective tie rod to the respective node member.

[0025] The plurality of fasteners can comprise a set of second pins that are longer than the width of the sleeve, and having at one end a head that is broader than the holes in the sleeves, and having a transverse hole adjacent the opposing end such that a securing device can be passed through the second pin. Preferably, the securing device is in the form of a split pin.

[0026] Preferably, each wall of the sleeves of the node member is provided with two holes that are spaced along the length of the respective sleeve such that a fastener can be passed through either of the two holes.

[0027] Each end of the structural tubes can comprise two or more holes adjacent the ends of the respective tube, the holes being spaced in the longitudinal direction of the tube such that when a structural tube is inserted into the sleeve of a node member the holes in the sleeve can be aligned with the holes in the structural tube. Preferably, each of the four surfaces at each end of the structural tubes is provided with two holes that can be used to secure the structural tube within a sleeve.

[0028] Preferably, the plurality of node members includes a plurality of first node members that each have three sleeves. More preferably, the first node members have three end faces that each extend between two of the three sleeves.

[0029] Preferably, the plurality of node members includes a plurality of second node members that each have four sleeves. More preferably, the second node members have two end faces that each extend between two of the four sleeves.

[0030] Preferably, the plurality of node members includes a plurality of third node members that each have five sleeves. More preferably, the third node members have an end face that extends between two of the five sleeves.

[0031] Preferably, the plurality of node members includes a plurality of fourth node members that each have six sleeves.

[0032] Preferably, the mounting holes are provided in pairs that are longitudinally spaced from other pairs of mounting holes along a respective surface of the structural tube, the two holes within a pair being laterally spaced on a respective surface of the structural tube.

[0033] Preferably, pairs of mounting holes are provided on each surface of the structural tube.

[0034] The cleats for attaching joists to the structural tube can each comprise two plates that are joined to form a right-angle section, each plate being provided with a pair of holes for receiving fasteners to mount the cleat to one of a structural tube or a joist.

[0035] Preferably, the scaffolding system further comprises a plurality of scaffold boards.

[0036] The transom units for supporting the scaffold boards on the structural tubes can each comprise one or more longitudinal supports for supporting ends of scaffold boards, and an upwardly extending, longitudinal abutment for preventing scaffold boards moving transversely with respect to the longitudinal direction of the transom unit.

[0037] Preferably, in use, the transom units can be mounted to a top surface of a horizontally disposed structural tube.

[0038] The transom unit can comprise two supports that are separated by the abutment.

[0039] Preferably, the upper surface of the supports is approximately level with the upper surface of the sleeves to which the respective structural tube is secured. More preferably, the transom unit comprises two or more packing plates that space the supports above the respective structural tube.

[0040] Preferably, two packing plates are provided adjacent the ends of supports. The transom unit can have holes that extend through the supports and the packing plates adjacent the ends of the supports, such that a fastener can be passed through each hole to secure the transom unit to a structural tube.

[0041] In some embodiments, one or more packing plates are also provided intermediate of the ends of supports.

[0042] Preferably, the abutment protrudes longitudinally beyond the longitudinal ends of the supports. Accordingly, when the transom unit is attached to a structural tube the abutment can extend along a sleeve at each end of the respective structural tube.

[0043] The brackets for attaching scaffold tube to a structural tube can each comprise a support plate that can be fastened to a structural tube, and a tube holder that can receive the scaffold tube. More preferably, the bracket further comprises a fastener for releasably securing a scaffold tube within the tube holder.

[0044] Preferably, the tube holder is arranged on the support plate such that the scaffold tube extends transversely with respect to the longitudinal direction of the structural tube.

[0045] The sole plates can be secured to a footing to support a structure on a ground surface. Preferably, each sole plate comprises a substantially flat base with a sleeve portion that extends upwardly from the base for receiving an end of a structural tube.

[0046] The end caps that each receive an end of a structural tube can each comprise a plurality of walls and an end surface that define a cavity for receiving the end of the structural tube.

[0047] The end caps can be releasably secured to the end portion of one of the structural tubes.

[0048] Each end cap can be used to provide a support for a jacking device. The jacking device can be used to jack formwork above the structure, or for levelling a gantry structure.

Brief description of the drawings

[0049] In order that the invention may be more easily understood, embodiments will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1: is a schematic plan view of a gantry constructed using a scaffolding system according to an embodiment of the present invention;

Figure 2: is a side view of the gantry of figure 1;

Figure 3: is an end view of the gantry of figure 1;

Figure 4: is a perspective view of a portion of a first node member in accordance with an embodiment of the present invention;

Figure 5: is a side elevation view of a first structural tube in accordance with an embodiment of the present invention;

Figure 6: is a side elevation view of a second structural tube in accordance with an embodiment of the present invention;

Figure 7: is a side elevation view of a third structural tube in accordance with an embodiment of the present invention;

Figure 8: is an enlarged side view of detail A shown in figures 1 and 2;

Figure 9: is an enlarged plan view of detail A shown in figures 1 and 2;

Figure 10a: is a plan view of a second node member in accordance with an embodiment of the present invention;

Figure 10b: is a side view of the second node member shown in figure 10a;

Figure 11a: is a plan view of a third node member in accordance with an embodiment of the present invention;

Figure 11b: is a side view of the third node member shown in figure 11a;

Figure 12a: is a plan view of a fourth node member in accordance with an embodiment of the present invention;

Figure 12b: is a side view of the fourth node member shown in figure 12a;

Figure 13a: is a plan view of the first node member shown in figure 4;

Figure 13b: is a plan view of the first node member shown in figure 4;

Figure 14: is a side view of a double-ended pin member shown in figure 9;

Figure 15: is an end view of the double-ended pin member of figure 14;

Figure 16: is a side view of a single-ended pin member shown in figure 9;

Figure 17: is a side view of a tower base in accordance with an embodiment of the present invention;

Figure 18: is a side view of the sole plate shown in figure 17;

Figure 19: is a side view of an end cap in accordance with an embodiment of the present invention;

Figure 20: is a cross section view of the end cap of figure 19, as seen along the line C-C;

Figure 21: is an perspective view of a cleat in accordance with an embodiment of the present invention;

Figure 22: is a top view of a cleat, structural tube and joist in accordance with an embodiment of the present invention;

Figure 23: is a side view of the cleat, structural tube and joist of figure 22, shown with a form board;

Figure 24: is a further side view of the cleat, structural tube, joist and form board shown in figure 23;

Figure 25: is an end view of a transom unit in accordance with an embodiment of the present invention, shown with a scaffold board, and a structural tube;

Figure 26: is a side view of the transom unit of figure 25;

Figure 27: is a plan view of the transom unit of figure

25;

Figure 28: is a further side view of the transom unit of figure 25, shown with scaffold boards, a structural tube and a node member;

Figure 29: is a side view of a tube support bracket in accordance with an embodiment of the present invention;

Figure 30: is a further side view of the tube support bracket of figure 29;

Figure 31: is a plan view of the tube support of figure 29;

Figure 32a: is a side elevation of an alternative transom unit in accordance with an embodiment of the present invention, shown with a structural tube and node members;

Figure 32b: is a plan view of the transom unit of figure 32a;

Figure 32c: is an end view of the transom unit of figure 32a, shown attached to a structural tube;

Figure 33: is a side elevation of a joining plate in accordance with an embodiment of the present invention;

Figure 34: is a partial side elevation of a structure according to an embodiment of the present invention, the structure incorporating the joining plate of figure 33;

Figure 35: is a side elevation of a tower constructed using a scaffolding system according to an embodiment of the present invention;

Figures 36 to 38: show schematically alternative tower bases according to embodiments of the present invention;

Figure 39: is a perspective partial view of a walkway constructed using a scaffolding system according to an embodiment of the present invention;

Figure 40a: is a side elevation of a brace and first brace plate according to an embodiment of the present invention, shown connected to a node member;

Figure 40b: is a plan view of the brace and first brace plate of figure 40a;

Figure 41a: is a plan view of a bridge constructed using a scaffolding system according to the present invention;

Figure 41b: is a side elevation of the bridge of figure 41a;

Figure 42: is a side elevation of a second brace plate in accordance with an embodiment of the present invention;

Figure 43: is a side elevation of a third brace plate in accordance with an embodiment of the present invention;

Figure 44: is a side elevation of a clevis unit and tie rod in accordance with an embodiment of the present invention; and

Figure 45 is a plan view of the clevis unit and tie rod of figure 44.

Detailed description

[0050] Figures 1 to 3 show a gantry 10 constructed using a scaffolding system in accordance with an embodiment of the present invention. The gantry 10 can be arranged to span a large distance. In the embodiment shown in figures 1 to 3, the gantry 10 is approximately 30 metres in length, 9 metres in width, and 2.5 metres in depth. The gantry 10 can be simply supported at each end section 12, 14 by, for example, a tower (not shown) that is also constructed using the scaffolding system in accordance with an embodiment of the present invention.

[0051] The gantry 10 is formed by a plurality of structural tubes 16, node members 18 and tie members, which in this embodiment are in the form of tie rods 20. Each of the structural tubes 16 extend between two node members 18 in one of the length, width or depth directions with respect to the gantry 10. For clarity, the node members 18 have been shown schematically as squares, and the tie rods 20 have been shown schematically as broken lines.

[0052] When the top of the gantry 10 is generally horizontal, some structural tubes 16 within the gantry 10 will be arranged substantially vertically to provide vertical columns that extend between node members 18. Similarly, other structural tubes 16 within the gantry 10 will be arranged substantially horizontally to provide horizontal beams that extend between node members 18.

[0053] Each of the tie rods 20 extend between two node members 18 in a direction that is inclined to one of length, width or depth directions with respect to the gantry 10. In the arrangement in which the top of the gantry 10 is horizontal, each of the tie rods 20 will be inclined horizontally and/or vertically.

[0054] However, it will be appreciated that a structure constructed of the scaffolding system, such as the gantry 10, will flex due to self-weight and applied loads. Accordingly, in this context the terms "horizontal" and "vertical" indicate general directions and may not be con-incident with true vertical or horizontal.

[0055] A first set of tie rods 20 rods are tensioned to provide plan bracing (as indicated by arrow P in figure 1), which provides bracing in a horizontal direction within the gantry 10. A second set of tie rods 20 are also tensioned to provide vertical bracing (as indicated by arrow V in figure 2). A third set of tie rods 20 are tensioned to provide lateral bracing (as indicated by arrow L in figure 3).

[0056] Steel scaffold boards (not shown) are provided across the top surface of the gantry 10 to provide a decking on which workers can operate, and on which equipment or materials can be placed. The gantry 10 is arranged to support loads within the range that is structural.

[0057] Figure 4 shows a perspective view of a portion of a node member 18 in accordance with an embodiment

of the present invention. The node member 18 has five mating portions that are aligned along one of three mutually perpendicular axes. In this embodiment, the mating portions are in the form of sleeves 22. Each sleeve 22 has four walls 24 that define a cavity 26 with a square cross section into which a structural tube 16 can be inserted. In addition, each wall 24 has two holes 28 disposed along a centre line of the respective wall 24. The node member 18 further has an end face 30, which extends between four of the sleeves 22. The end face 30 has a single hole 32 defined centrally within the end face 30.

[0058] Figure 5 shows a structural tube 16a in accordance with an embodiment of the present invention. The structural tube 16a is of hollow square cross-section, with an outer width that is less than the width of the cavity 26 of the sleeves 22 on the node member 18. Accordingly, each of the two opposing ends 34a, 36a can be received within a sleeve 22 of a node member 18. Each end 34a, 36a of the structural tube 16a is provided with two holes 38a on each of the four surfaces 40a. When an end 34a, 36a of the structural tube 16a is inserted into the sleeve 22 of a node member 18, the holes 38a can be aligned with the holes 28 in the respective node member 18.

[0059] Two pairs of mounting holes 42a are provided on each of the four surfaces 40a of the structural tube 16a. Each of the holes 40a with a pair are laterally spaced across the respective surface 40a. Various attachments and/or components (not shown) can be secured to the structural tube 16a using the mounting holes 42a.

[0060] In one embodiment, the cross-sectional shape of the structural tube 16a has an external width and height of 100mm, and a wall thickness of 6mm. However, it will be appreciated that alternative cross-sectional shapes may be employed. Similarly, alternative dimensions of the cross-sectional shape may also be employed.

[0061] Figure 6 shows a structural tube 16b in accordance with another embodiment of the present invention. Features of the structural tube 16b that are similar to that of the structural tube 16a have been given the same reference numeral with the suffix 'b'.

[0062] The structural tube 16b is provided with five pairs of mounting holes 42b on each of the four surfaces 40b. Adjacent pairs of mounting holes 42b are separated by a common distance, which is equal to the separation of the two pairs of mounting holes 42a of the structural tube 16a. Similarly, various attachments and/or components (not shown) can be secured to the structural tube 16b using the mounting holes 42b.

[0063] Figure 7 shows a structural tube 16c in accordance with another embodiment of the present invention. Features of the structural tube 16c that are similar to that of the structural tube 16a have been given the same reference numeral with the suffix 'c'.

[0064] The structural tube 16c is provided with nine pairs of mounting holes 42c on each of the four surfaces 40c. Adjacent pairs of mounting holes 42c are separated by a common distance, which is equal to the separation of the two pairs of mounting holes 42a of the structural tube 16a. Similarly, various attachments and/or components (not shown) can be secured to the structural tube 16c using the mounting holes 42c.

[0065] As indicated in figures 5 to 7, the structural tubes 16a, 16b, 16c (hereinafter referred to collectively as "structural tubes 16") may be provided in any desired length. For convenience, the scaffolding system may be provided with structural tubes in five to seven nominal lengths. The longest structural tube may be selected such that the length and weight are easily managed by no more than two users at one time.

[0066] In one preferred system, the structural tubes 16 can be provided in the following nominal lengths: 0.75 metres, 1.2 metres, 1.5 metres, 1.8 metres, 2.1 metres, 2.4 metres, and 3.0 metres. However, it will be appreciated that in some applications or systems, different nominal lengths may be used.

[0067] Figures 8 and 9 show an enlarged view of detail A in figures 1 and 2. The node member 18 has structural tubes 16 inserted in to the sleeves 22. The holes 38 at respective ends 34 of the structural tubes 16 are aligned with the holes 28 in the respective sleeve 22. Double-ended pins 44, and headed pins 46 are provided that each extend through a sleeve 22, and thus also the respective structural tube 16.

[0068] A double-ended pin 44 is shown in further detail in figures 14 and 15. The double-ended pins 44 have identical ends that each have a bevelled edge 48 to facilitate insertion through the holes 28, 38 of the aligned sleeve 22 and structural tube 16. In addition, a transverse hole 50 is provided adjacent each end of the pin 46.

[0069] When the double-ended pins 44 are installed in the scaffolding system of the present invention, a tie rod 20 can be passed through one of the transverse holes 50, as shown in figures 8 and 9.

[0070] A headed pin 46 is shown in further detail in figure 16. The headed pins 46 are provided with a head 52 at one end and a transverse hole 54 at the opposing end. A securing device, such as a split pin (not shown), can be inserted through the transverse hole 54 to prevent unintentional removal of the headed pin 46. In addition, the end nearest the transverse hole 54 is provided with a bevelled edge 56 to facilitate insertion through the holes 28, 38 of the aligned sleeve 22 and structural tube 16.

[0071] When used in to secure structural tubes 16 within sleeves 22 of a node member 18, each of the pins 44, 46 is in double shear. This provides the benefit of the shear forces supported by the respective double-ended pin 44, or headed pin 46 being divided between two shear planes.

[0072] In assembly of a structure using the scaffolding system, a structural tube 16 is inserted into a sleeve 22 of a node member 18 such that the holes 28 in the sleeve 22 and the holes 38 in the structural tube 16 overlap. A headed pin 46 is passed through holes 28, 38 in the sleeve 22 and structural tube 16 that are closest to the centre of the node member 18. A securing device is sub-

sequently passed through the double-ended pin 44.

[0073] The use of two pins 44, 46 in each sleeve 22 facilitates locating of structural tubes 16 with the sleeve 22 of a node member 18. The two pins 44, 46 also provide additional strength and rigidity to the structure formed using the scaffolding system of the present invention. The two pins 44, 46 assist in keeping the structure square by minimizing movement of the structural tubes 16 with the node members 18.

[0074] A double-ended pin 44 is then inserted through the holes 28, 38 in the sleeve 22 and structural tube 16 that are furthest from the centre of the node member. The two transverse holes 50 are positioned externally of the sleeve 22.

[0075] The end of a tie rod 20, which has an externally thread portion 58, is passed through a respective one of the transverse holes 50 in each of the double-ended pin 44. A cup washer 60 is fitted over the tie rod 20, and an internally threaded nut 62 is subsequently wound onto the threaded portion 58 of the tie rod 20. At a desired time, the nut 62 can be further wound onto the threaded portion 58 of the tie rod 20, such that the tie rod 20 is held in tension.

[0076] In a structure that is constructed of the scaffolding system according to the present invention, the structural tubes 16 support compressive loads and shear forces. However, the structural tubes 16 support minimal tensile forces.

[0077] Figures 10a and 10b show a node member 18a in accordance with an first embodiment. The node member 18a has three sleeves 22a that are aligned along mutually perpendicular axes. Each sleeve 22a has two holes 28a provided on each of the four walls 24a that define a cavity within the sleeve 22a, as previously described. The node member 18a further has three end faces 30a, that each extend between two of the sleeves 22a. Each of the end faces 30a have a single hole 32a that is positioned centrally within the respective end face 30a.

[0078] Figures 11a and 11b show a node member 18b in accordance with a second embodiment. The node member 18b has four sleeves 22b that are aligned along mutually perpendicular axes. Each sleeve 22b has two holes 28b provided on each of the four walls 24b that define a cavity within the sleeve 22b, as previously described. The node member 18b further has two end faces 30b, that each extend between three of the sleeves 22b. Both of the end faces 30b have a single hole 32b positioned centrally within the respective end face 30b.

[0079] Figures 12a and 12b show a node member 18b in accordance with an third embodiment, which is also shown in figure 4. As previously described the node member 18c has five sleeves 22c that are aligned along mutually perpendicular axes. Each sleeve 22c has two holes 28c provided on each of the four walls 24c that define a cavity within the sleeve 22c, as previously described. The node member 18c further has an end face 30c, that extends between four of the sleeves 22c. The end face 30c has a single hole 32c defined centrally within the end face 30c.

[0080] Figures 13a and 13b show a node member 18d in accordance with an fourth embodiment. The node member 18d has six sleeves 22d that are aligned along mutually perpendicular axes. Each sleeve 22d has two holes 28d provided on each of the four walls 24d that define a cavity within the sleeve 22d, as previously described.

[0081] When constructing a structure using the scaffolding system of the present invention, the users select node members 18a, 18b, 18c, 18d (hereinafter referred to collectively as "node members 18") such that all the sleeves 22 of the node members 18 are provided with a structural tube 16. Accordingly, each node member 18 would not contribute unnecessary weight to the structure.

[0082] Figure 17 shows a side view of the base of a tower 64. The tower 64 includes four sole plates 66, two of which can be seen in figure 17. Each sole plate 66 secured to a footing F using any conventional means. The footing F may be formed of any suitable material, such as grout.

[0083] The sole plate 66 is shown in further detail in figure 18. The sole plate 66 includes a substantially flat base 68, and a sleeve 70 that extends upwardly from the base 68. The sleeve 70 has four walls 72 that define a cavity for receiving a structural tube 76 of the tower 64. Each wall is provided with a hole 74 for receiving a pin, such as either the double-ended pin 44 or the headed pin 46.

[0084] The structural tube 76 has holes 78 adjacent the ends such that a pin 44, 46 can pass through both the sleeve 70 and also the structural tube 76.

[0085] As shown in figure 17, the ground surface G may not be level. The length of the structural tubes 76 is selected such that the upper ends of the structural tubes in the tower 64 are level. In this regard, it will be appreciated that the structural tubes 76 may each need to be a one-off item that is of the required length.

[0086] The tower 64 further includes node members 18b (which are shown in figure 11a and 11b) each receiving an upper end of a respective one of structural tubes 76. The tower 64 further includes tie rods 20, which for clarity are illustrated schematically by broken lines. The tower 64 is built upwardly using structural tubes 16, node members 18 and tie rods 20 in manner previously described in connection with the gantry 10.

[0087] Figures 19 and 20 show an end cap 80 that can be placed over the upper end of a structural tube 16. The end cap 80 has four walls 82 and an end face 84 that together define a cavity 86 into which an end of a structural tube 16 can be inserted. Two opposing walls 82 are each provided with hole 88. When the end cap 80 is placed over the upper end of a structural tube 16, the holes 88 align with holes 38 in the structural tube 16. A pin 44, 46 can be passed through both the end cap 80 and the structural tube 16.

[0088] The end face 84 is provided with a hole 90,

which provides a surface on which components can be supported. For example, the end face 84 can be used in a jacking application to provide support for a jacking device (not shown).

[0089] Figures 21 to 24 show a cleat 92 for use in attaching components to mounting holes 42 in a structural tube 16. The cleat 92 has two plates 94 that are joined to form a right-angle section. Each plate 94 has a two holes 96 that can receive a fastener 98. Accordingly, the cleat 92 can be secured to a structural tube 16 and/or another component of the scaffolding system, such as a joist 100 for supporting formwork 102.

[0090] Figures 25 to 28 show a transom unit 104 according to an embodiment of the present invention. Ends of scaffold boards 106 can be supported on the transom unit 104. The transom unit 104 is secured to the upper surface of a structural tube 16 using fasteners 106. The transom unit 104 extends between node members 18 that support the respective structural tube 16, such that the transom unit 104 is parallel to the respective structural tube 16.

[0091] In this embodiment, each transom unit 104 has two supports 108 that each support ends of scaffold boards 106. To prevent longitudinal movement of scaffold boards 106, the transom unit 104 also has an upwardly extending abutment 110 that extends longitudinally along the length of the transom unit 104.

[0092] As shown in figure 28, in some instances scaffold boards 106 can also be supported on the node members 18. The abutment 110 protrudes longitudinally beyond the supports 108, in both directions, by a distance that is slightly shorter than the length of the sleeves 22. Thus, as shown in figure 26, the abutment 110 extends along the sleeves 22 of the node members 18, while the supports 108 extend between the ends of the sleeves 22.

[0093] The upper surface of the supports 108 are approximately level with the top surface of the sleeves 22 to which the structural tube 16 is connected. The transom unit 104 is provided with packing plates 112a, 112b that ensure the supports 108 are supported on the respective structural tube 16. In the embodiment shown in the figures, the transom unit 104 is provided with two packing plates 112a that are adjacent the ends of the supports 108. The supports 108 and the packing plates 112a have holes 114 that extend therethrough such that fasteners (not shown) can be used to secure the transom unit 104 to the structural tube 16. An intermediate packing plate 112b is provided intermediate of the longitudinal ends of the supports 108.

[0094] It will be appreciated that additional intermediate packing plates 112b may be provided for longer transom units 104. Furthermore, for a transom unit 104 that is short, there will be no need for providing an intermediate packing plate 112b.

[0095] Figures 29 to 31 show a bracket 116 for attaching a scaffold tube 126 to a structural tube 16. The bracket 116 has a support plate 118 provided with holes 120 for receiving a fastener (not shown) to secure the bracket 116 to a structural tube 16. The bracket 116 further includes a tube holder 122 that can receive a scaffold tube 126. A fastener 124 extends transversely through the tube holder 122. The scaffold tube 126 can be provided with holes at a desired location, such that scaffold tube 126 can be passed through the tube holder 122 and the fastener 124 can be passed through the tube holder 122 and the scaffold tube 126 to secure the scaffold tube 126 to the bracket 116.

[0096] As shown in the figures, the bracket 116 is arranged such that the scaffold tube 126 is secured perpendicular to the structural tube 16 to which the bracket 116 is attached. However, it will be appreciated that alternative brackets may be provided in which the scaffold tube 126 is secured in other orientations relative to the structural tube 16.

[0097] Figures 32a to 32b show a transom unit 128 according to an embodiment of the present invention. The transom unit 128 is an alternative to the transom unit 104 shown in figure 28. The transom unit 128 is secured to the side walls of a structural tube 16 using fasteners 130, as shown in figure 32c. The transom unit 128 extends between node members 18 that support the respective structural tube 16, such that the transom unit 128 is parallel to the respective structural tube 16.

[0098] In this embodiment, each transom unit 128 has two supports 132 that each support ends of scaffold boards (not shown). To prevent longitudinal movement of scaffold boards, the transom unit 128 also has an upwardly extending abutment 134 that extends longitudinally along the length of the transom unit 128.

[0099] The transom unit 128 has two side walls 136 that each extend downwardly from the supports 132. Holes extend through the side walls 136 to facilitate connection of the transom unit 128 to structural tubes 16 using the fasteners 130.

[0100] The upper surface of the supports 132 are approximately level with the top surface of the sleeves 22 to which the structural tube 16 is connected. The transom unit 128 is provided with packing plates 138 that ensure the supports 132 are supported on the respective structural tube 16.

[0101] Figure 33 shows a joining plate 140 according to an embodiment of the present invention. The joining plate 140 facilitates connection of two structural tubes 16 between node members.

[0102] The joining plate 140 has two large holes 142 that have the same diameter as the holes 38 at the ends of the structural tubes 16. The joining plate 140 also has two small holes 144 that have the same diameter as the mounting holes 42 intermediate the ends of the structural tubes 16.

[0103] Accordingly, the small holes 144 enable the joining plate 140 to be secured to mounting holes 42 of a structural tube. The large holes 142 enable the joining plate 140 to be secured to holes 38 at the end of another structural tube 16.

[0104] The function of the joining plate 140 is illustrated

in figure 34, which shows a side elevation view of a part of a structure 146. The structure 146 includes two structural tubes 16 and two joining plates 140. A further structural tube 16 is mounted to structural tubes 16 by the joining plates 140. For ease of understanding, fasteners to secure the joining plates 140 to the structural tubes 16 at the small holes 144 have been omitted from figure 34.

[0105] Figure 35 shows a tower 148 constructed using a scaffolding system according to an embodiment of the present invention. The tower 148 includes sole plates 66, structural tubes 76, node members 18, structural tubes 16, pins 44 and tie members, which are in the form of tie rods 20.

[0106] The tower 148 also has end caps 80 that support universal beams 150, 152, 154. The tower 148 provides an example of the scaffolding system according to the present invention supporting a load.

[0107] The tower 148 has four sole plates 66 (two of which are shown in figure 35). It will be appreciated that the tower 148 has a limited compressive strength and a limited buckling load.

[0108] The compressive strength and/or buckling load limit can be increased by changing the configuration of horizontal and vertical structural tubes 16 within the tower. Figures 36 to 38 each show in plan view alternative tower configurations that have increased compressive strength.

[0109] Figure 36 shows a tower configuration 156 in which there are four sole plates 66. The tower configuration 156 differs from that shown in figure 35 in that the horizontal structural tubes 16 are very short. This enables the sole plates 66 to be very close to one another. Similarly, node members 18 are also very close to one another.

[0110] Figure 37 shows a tower configuration 158 in which there are 8 sole plates 66. The sole plates 66 are arranged in two sets of four 160a, 160b. The sole plates 66 and node members 18 in each set 160a, 160b are very close to one another and are connected by short structural tubes 16. However, the two sets 160a, 160b are spaced apart and are connected by longer structural tubes 16.

[0111] Figure 38 shows a tower configuration 162 in which there are 9 sole plates 66, which are arranged in a 3x3 array. The sole plates 66 are connected by short structural tubes (which are shown in broken lines) so that the sole plates 66 (and also node members 18) are very close to one another.

[0112] Figure 39 shows a portion of a walkway 164 constructed using a scaffolding system according to an embodiment of the present invention. The walkway 164 includes node members 18, structural tubes 16, pins 44 and tie members, which are in the form of tie rods 20.

[0113] The deck of the walkway 164 is formed of scaffold boards 166 that are supported on transom units 104.

[0114] The walkway 164 further includes cleats 92 attached to horizontal structural tubes 16 adjacent the decking. The cleats 92 support kickboards 168. The walkway 164 further includes mounting brackets 170 that are attached to vertical structural tubes 16 above the kickboards 166. The mounting brackets 170 have a sleeve within which an end of a handrail 172 is supported, and a flange that has holes for securing the mounting bracket 170 to structural tubes 16.

[0115] The walkway 164 can be supported on towers (not shown) that are also constructed using the scaffolding system of the present invention.

[0116] Figures 40a and 40b show a tie member, which in this embodiment is in the form of a brace 174, and brace plate 176 in accordance with an embodiment of the present invention. The brace 174 has a rectangular cross-sectional shape, with a width that is the same as the width of the structural tubes 16. The brace 174 is attached to a node member 18 by two brace plates 176.

[0117] Each brace plate 176 has four node member attachment holes 178 to facilitate attachment of the brace plate 176 to two adjacent sleeves 22 of the node member 18 by pins 44. The brace plate 176 also has a cutout 180 to avoid interference with a sleeve 22 of the node member 18 that is perpendicular to the sleeves 22 to which it is attached.

[0118] Each brace plate 176 further has two brace attachment holes 182 to facilitate attachment of the brace 174 to the brace plate 176. Two fasteners 184 pass through both brace plates 176 and the brace 174.

[0119] The brace 174 is able to support both tensile and compressive loads. As will be appreciated, the inclination of the brace 174 relative to the sleeves 22 of the node member 18 is fixed. However, using the brace 174 in structures constructed using the scaffolding system enables the structure to withstand higher loads.

[0120] Figures 41a and 41b show a bridge 186 constructed using a scaffolding system according to the present invention. The bridge 186 has a bridge deck section 188 and two girder sections 190.

[0121] The bridge 186 includes node members 18, structural tubes 16 and tie members. In this embodiment, the tie members are in the form of braces 174 that are attached to node members by brace plates 176, as previously described in connection with figures 40a and 40b, and also tie rods 20. In figure 41a, the tie members are shown schematically as broken lines.

[0122] Figure 42 shows a second brace plate 176b in accordance with an embodiment of the present invention. Features of the second brace plate 176b that are similar to that of the brace plate 176 shown in figures 40a and 40b have been given the same reference numeral with the suffix 'b'.

[0123] The second brace plate 176b can attach two separate braces 174 to a single node member 18, as shown in figure 42.

[0124] Figure 43 shows a third brace plate 176c in accordance with an embodiment of the present invention. Features of the third brace plate 176c that are similar to that of the brace plate 176 shown in figures 40a and 40b have been given the same reference numeral with the

suffix 'c'.

[0125] The third brace plate 176c can attach four separate braces 174 to a single node member 18, as shown in figure 43. The cutout 180c is in the form of a square aperture in the centre of the third brace plate 176c. A sleeve of a node member 18 is able to pass through the cutout 180c.

[0126] Figures 44 and 45 show a clevis unit 192 and tie member, in the form of tie rod 194, in accordance with an embodiment of the present invention. Clevis unit 192 facilitates connection of tie rods 194 to node members 18.

[0127] The clevis unit 192 has a bearing plate 196 through which an end of the tie rod 194 passes. A threaded nut 198 co-operates with a thread (not shown) on the end of the tie rod 194 to enable the tension in the tie rod 194 to be adjusted.

[0128] The clevis unit 192 also has two side plates 200 that are extend from opposing sides of the bearing plate 196. The side plates 200 have holes 202 through which a fastener, such as pins 44, 46, can pass to secure the clevis unit 192 to a node member 18.

[0129] Tie rod 194 is thicker than tie rod 20, and thus is able to support greater tensile loads. As will be appreciated, the maximum tensile load supported by tie rod 20 is limited by the diameter of the pins 44, 46 and the diameter of the transverse hole 50. The clevis unit 192 and tie rod 194 arrangement is suited to heavier duty applications (when compared with the tie rod 20 and pin 44, 46 arrangement).

[0130] It will be appreciated that structures constructed using the scaffolding system of the present invention can use a combination of the tie members previously described. That is, a combination of tie rods 20, braces 174 and tie rods 194.

[0131] It will be understood to persons skilled in the art of the invention that many modifications may be made without departing from the spirit and scope of the invention.

[0132] The scaffolding system of the present invention has the benefit that it provides components that can be easily lifted by one or two people, as appropriate. Accordingly, a structure can be constructed using the scaffolding system where access is difficult and/or inhibited. For example, the scaffolding system can be used to provide a deck within a large vessel, such as a pressure vessel that has small access openings.

[0133] The deck can be provided on the top surface of a gantry that is supported by towers.

[0134] Alternatively, the scaffolding system can be used to construct a deck that is supported on an arch-like structure. The arch-like structure may also be supported on towers.

[0135] Structures that are constructed using the scaffolding system of the present invention can be quickly assembled and disassembled by a crew of operators with minimal use of equipment, such as cranes.

[0136] Because the scaffolding system of the present invention provides a set of component parts, the scaffolding system can readily be adapted to form structures that suit specific applications and/or specific load requirements. Subsequently, the same component parts can be used for different applications, as desired.

[0137] In one alternative embodiment, the structural tubes can be arranged to receive mating portions of the node members. In such an embodiment, the structural tubes may be hollow to define an internal cavity. The mating portions may also be sleeves that have an outer width that is less than the width of the internal cavity.

[0138] In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

Claims

1. A scaffolding system comprising:

   a plurality of elongate structural tubes;
   a plurality of node members, each node member having three or more mating portions that each extend along one of three mutually perpendicular axes that pass through the respective node member, end portions of the structural tubes can be releasably secured to the mating portions to provide a framework of vertical columns that extend between pairs of node members and horizontal beams that extend between pairs of node members; and
   a plurality of tie members that can each be releasably secured at opposing ends to a node member such that the respective tie member is inclined relative to the vertical columns or the horizontal beams, such that the scaffolding system, when assembled, is capable of supporting structural loads.

2. A scaffolding system according to claim 1, wherein the mating portions are sleeves that each define a cavity for receiving an end portion of the structural tubes.

3. A scaffolding system according to either claim 1 or 2, further comprising a plurality of fasteners for releasably securing the structural tubes within the sleeves.

4. A scaffolding system according to claim 3, wherein the sleeves are provided with holes such that one of the fasteners can extend transversely through the sleeve to secure a structural tube within the respective sleeve.

5. A scaffolding system according to claim 4, wherein the structural tube also comprises one or more holes adjacent each end such that a respective one of the fasteners can extend transversely through both the sleeve and a structural tube.

6. A scaffolding system according to claim 5, wherein the tie members are in the form of tie rods that are each tensioned to provide a tensile force between the node members to which the respective tie rod is secured.

7. A scaffolding system according to claim 6, wherein the plurality of fasteners can each releasably secure one or more of the tie rods to a respective node member.

8. A scaffolding system according to claim 7, wherein the plurality of fasteners include pins having transverse holes through which ends of the tie rods can pass.

9. A scaffolding system according to claim 6, further comprising a plurality of clevis units that can be releasably secured to the node members, wherein one of the plurality of tie rods can be releasably secured to each clevis unit.

10. A scaffolding system according to any one of claims 1 to 5, wherein the tie members are in the form of a rigid braces.

11. A scaffolding system according to claim 10, further comprising a plurality of brace plates that can be releasably secured to the node members, wherein one or more of the plurality of braces can be releasably secured to each brace plate.

12. A scaffolding system according to either claim 11, wherein each brace plate comprises brace attachment holes that facilitate attachment of one or more of the plurality of braces to the respective brace plate.

13. A scaffolding system according to claim 12, wherein the plurality of brace plates include:

a first set of brace plates that have brace attachment holes to facilitate attachment of one brace to the respective brace plate;
a second set of brace plates that have brace attachment holes to facilitate attachment of two braces to the respective brace plate; and
a third set of brace plates that have brace attachment holes to facilitate attachment of four braces to the respective brace plate.

14. A scaffolding system according to claim 2, wherein the plurality of node members comprise:

a plurality of first node members that each have three sleeves;
a plurality of second node members that each have four sleeves;
a plurality of third node members that each have five sleeves; and
a plurality of fourth node members that each have six sleeves

15. A scaffolding system according to any one of claims 1 to 14, wherein each structural tube is provided with mounting holes intermediate of the ends of the structural tube for mounting attachments to the structural tubes.

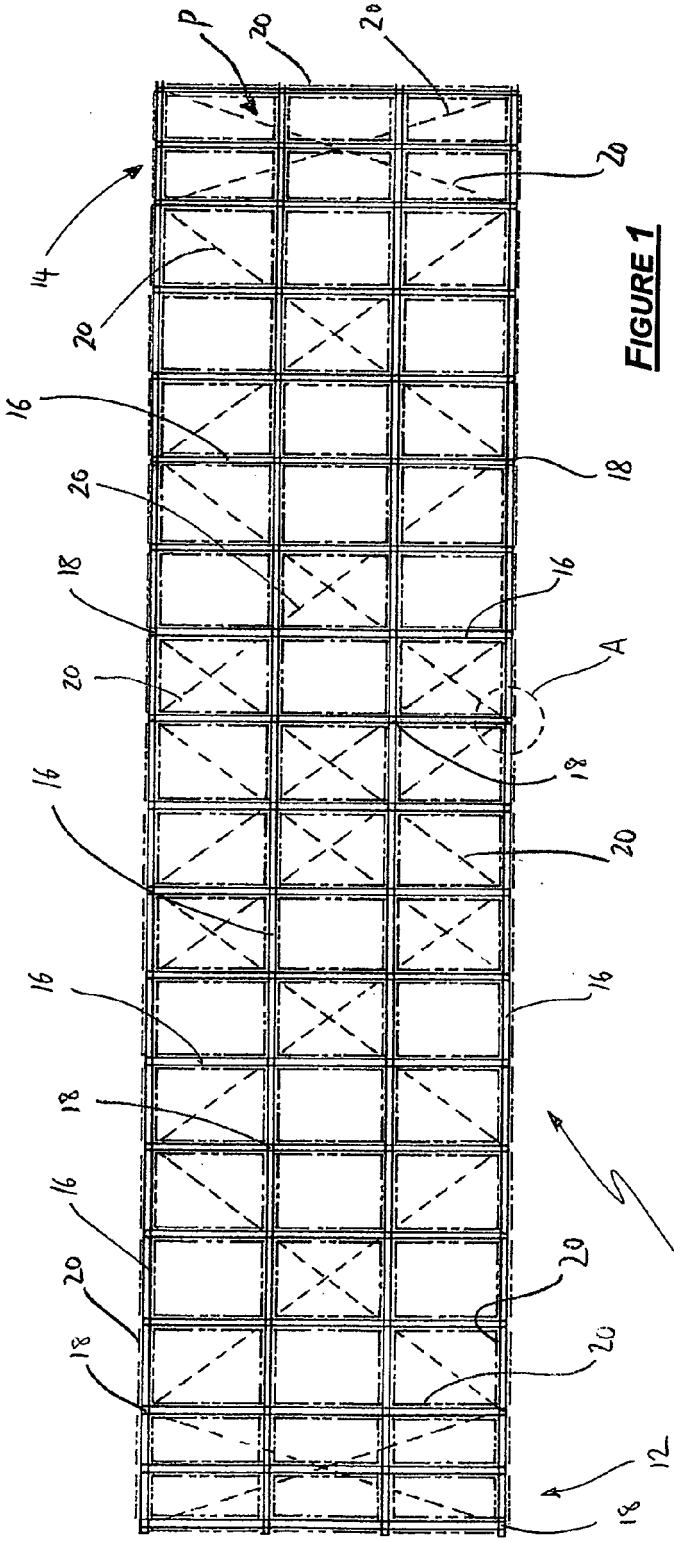

FIGURE 1

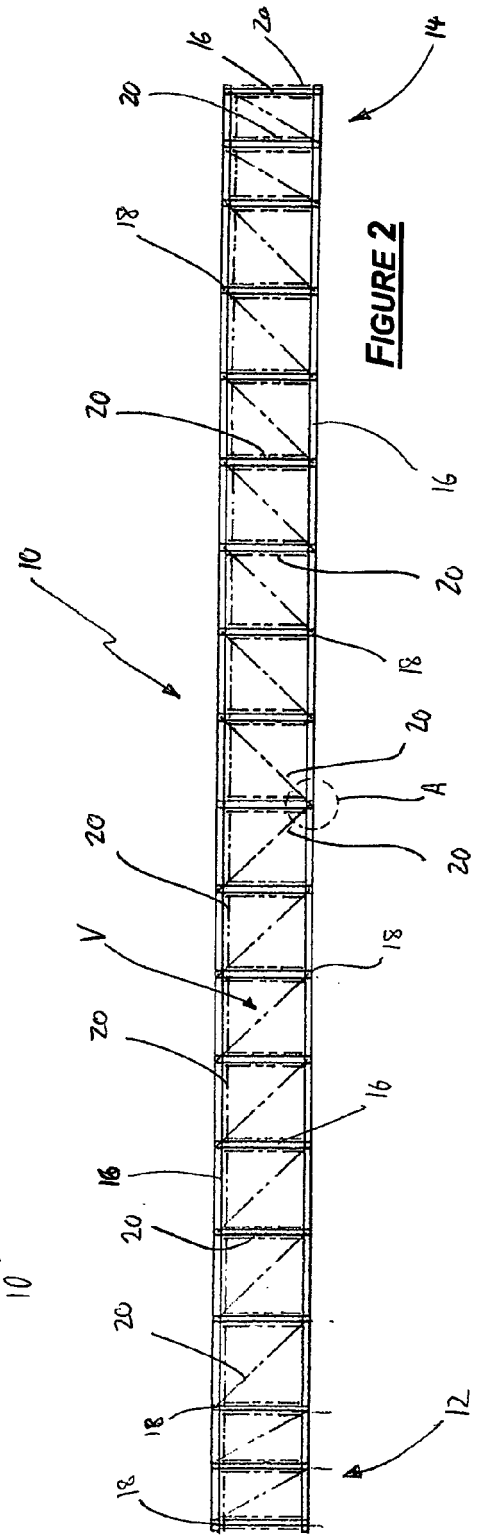

FIGURE 2

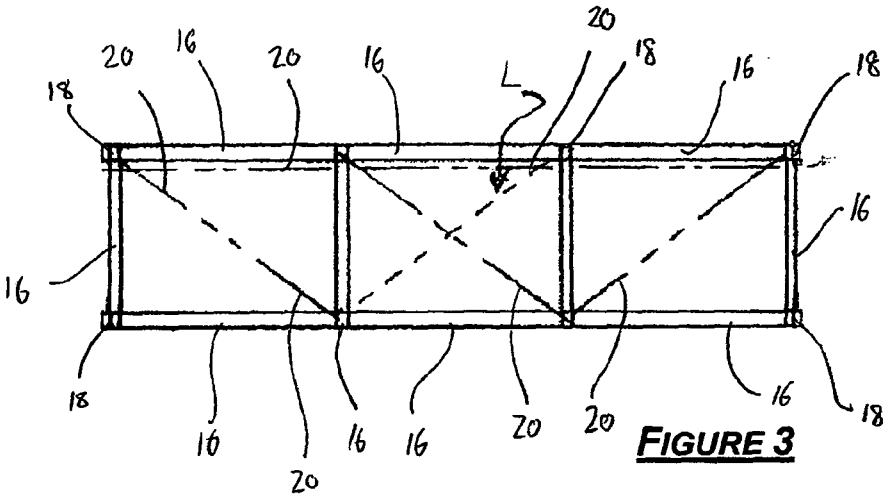

FIGURE 3

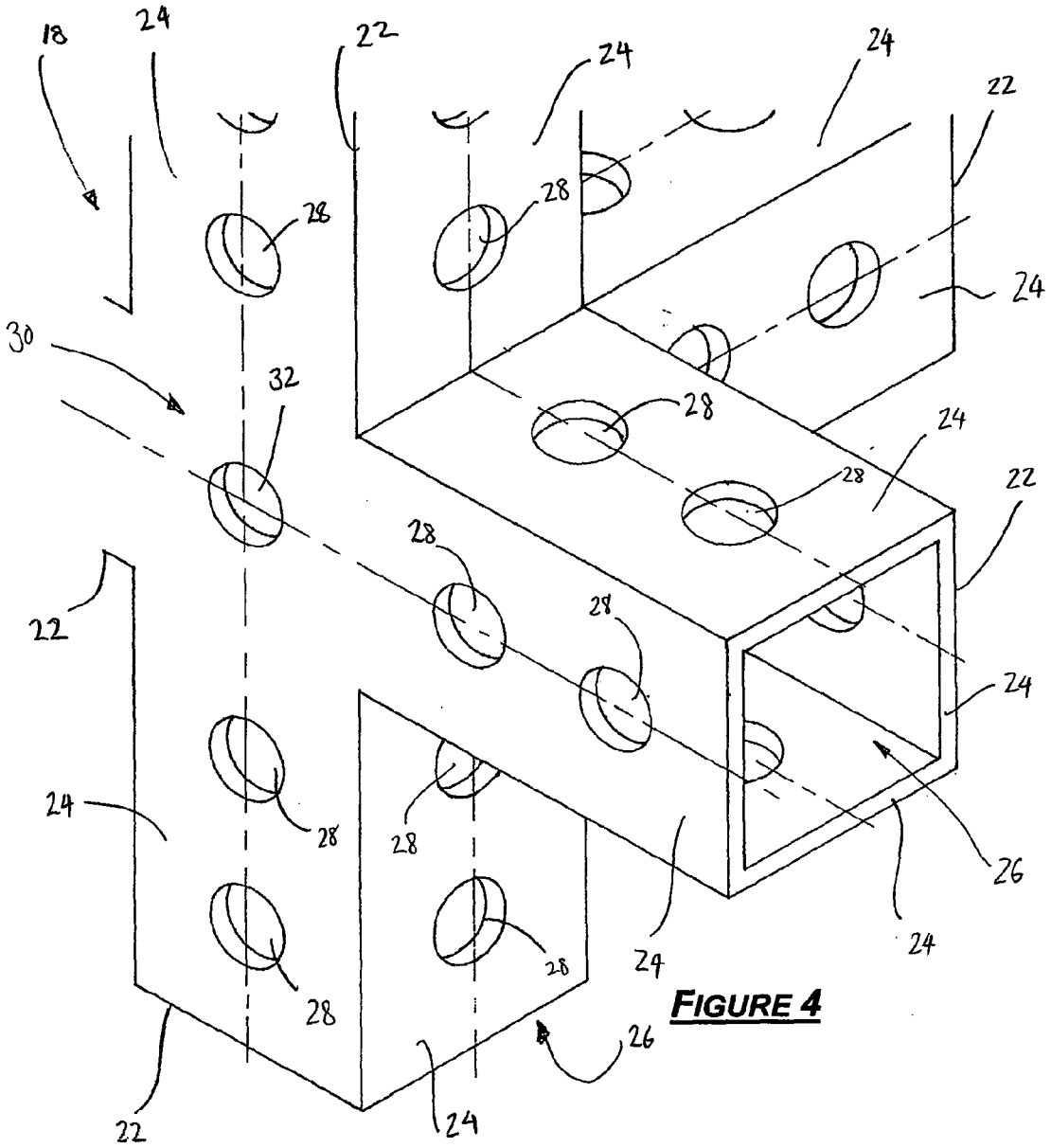

FIGURE 4

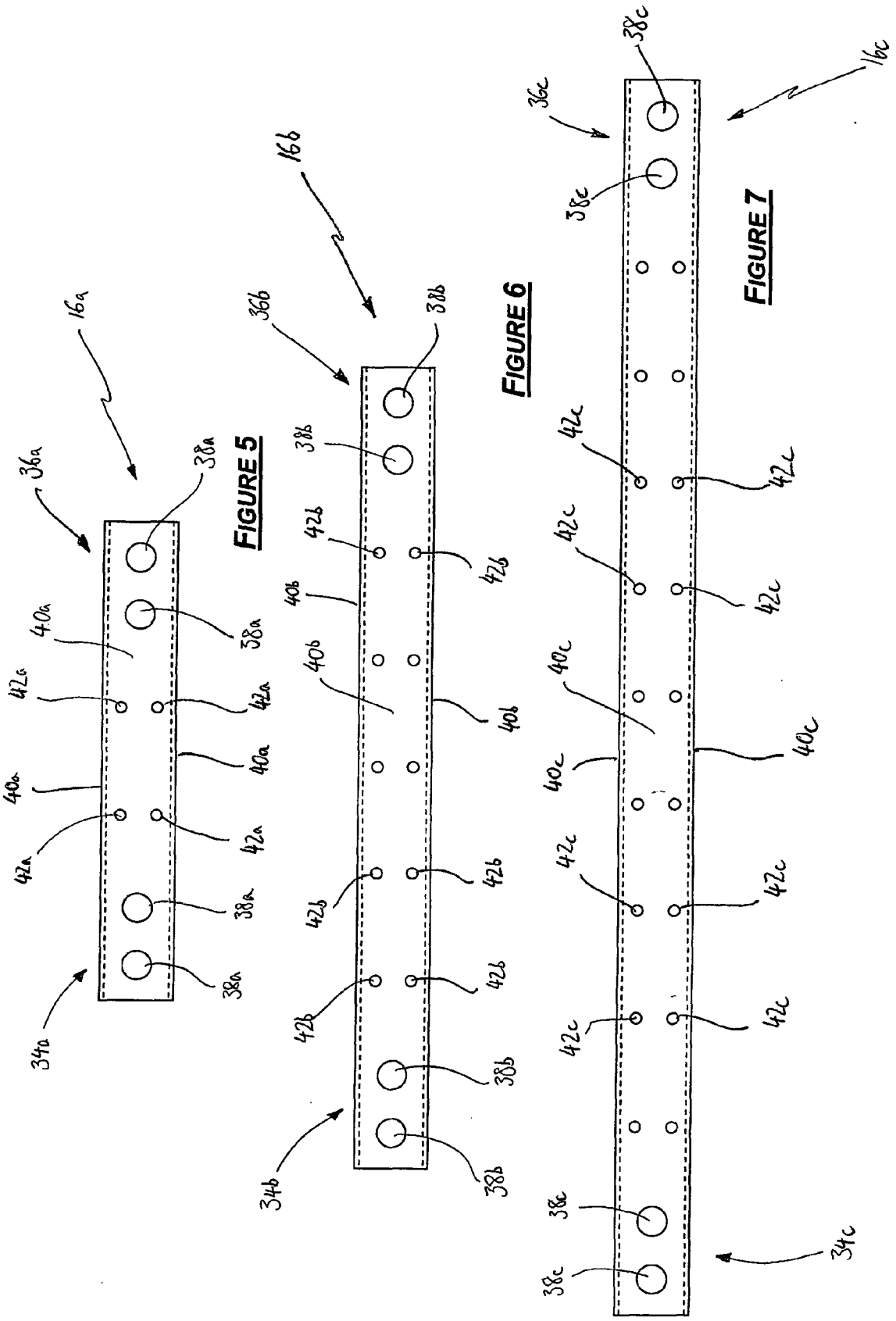

FIGURE 5

FIGURE 6

FIGURE 7

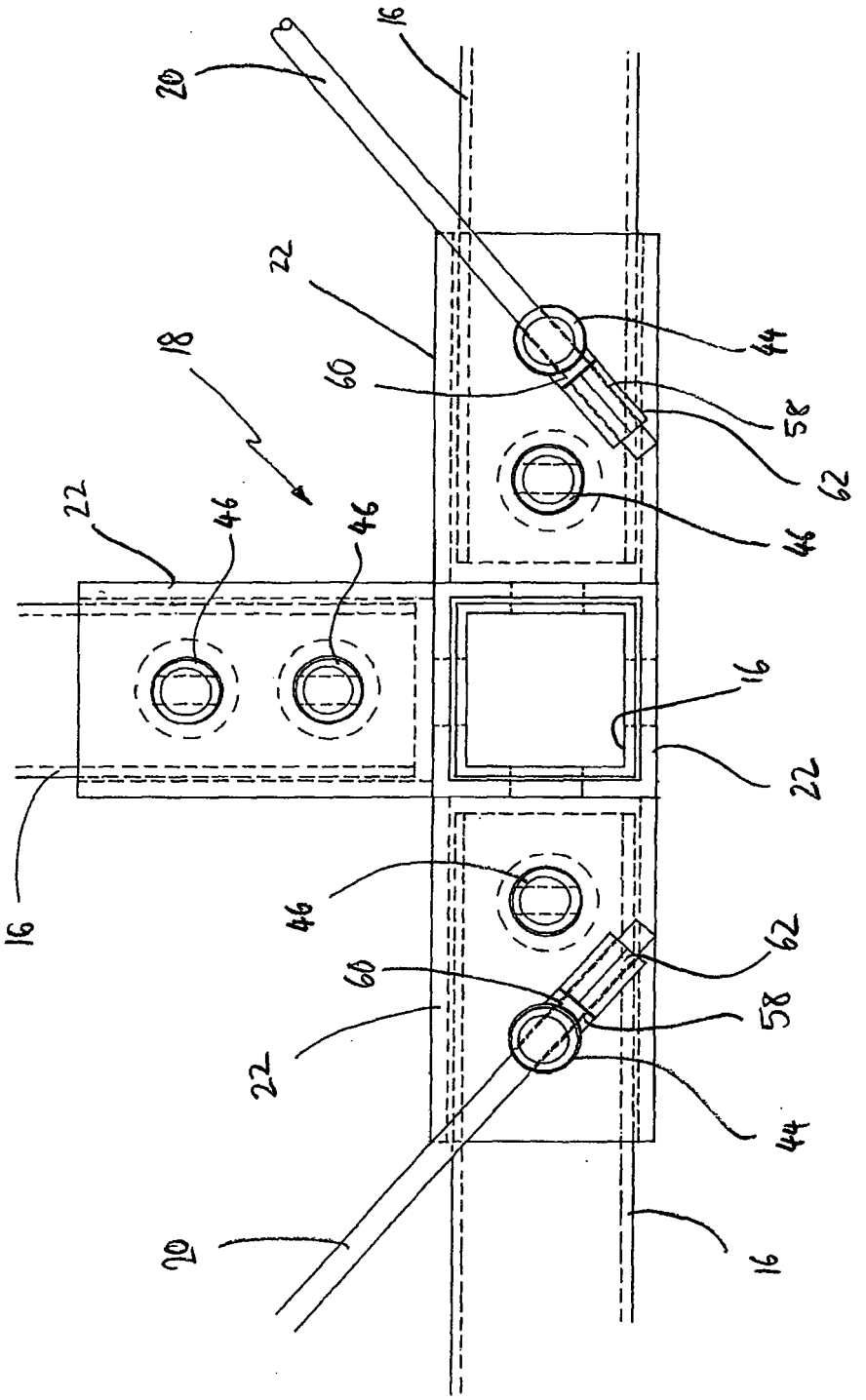

FIGURE 8

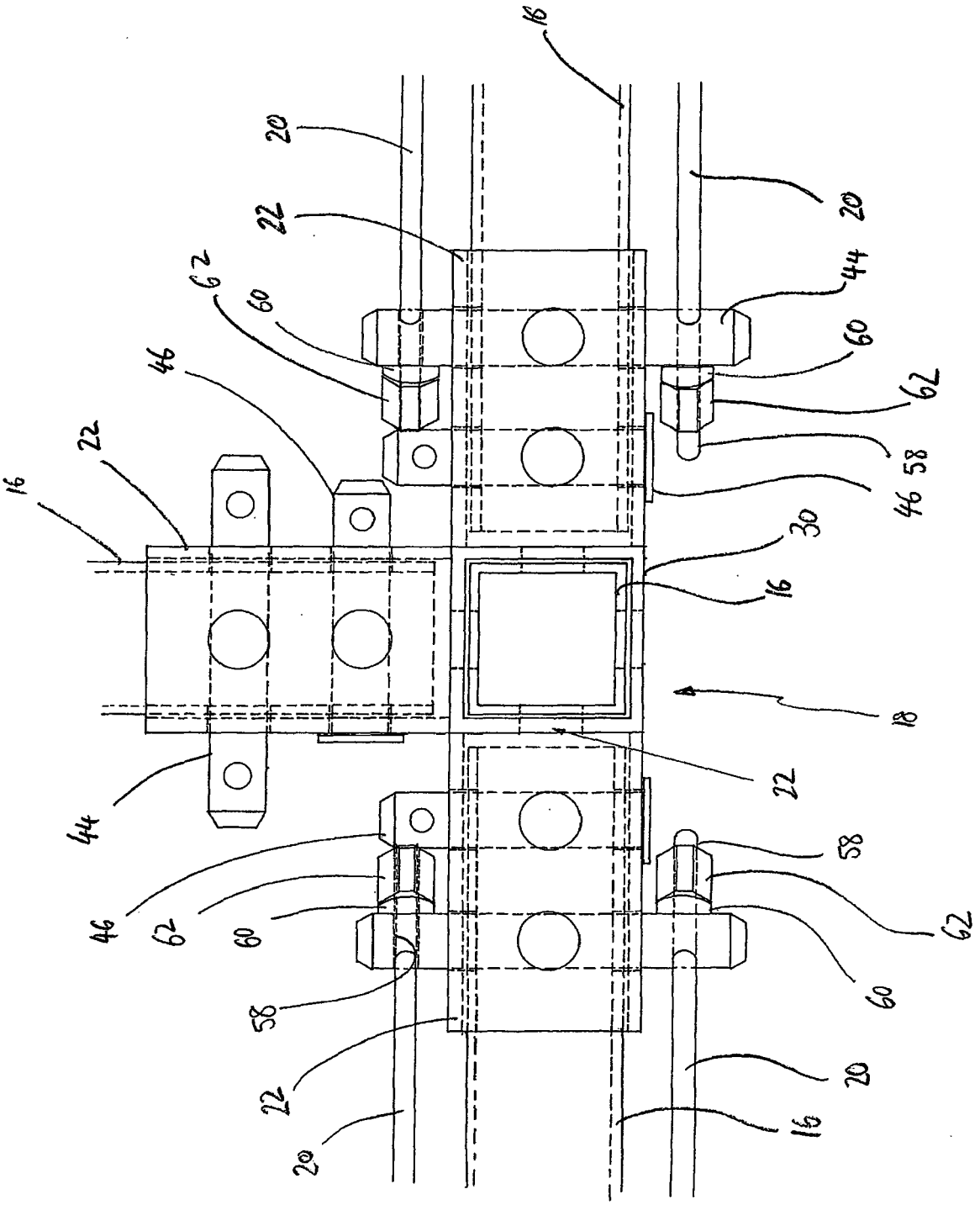

FIGURE 9

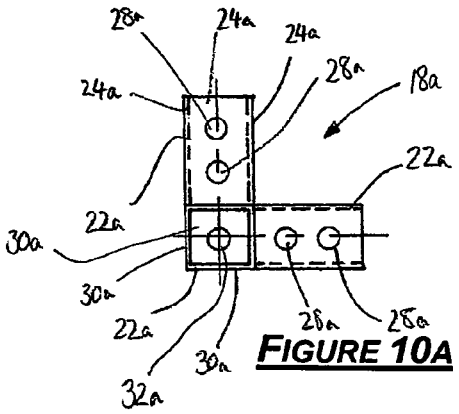

FIGURE 10A

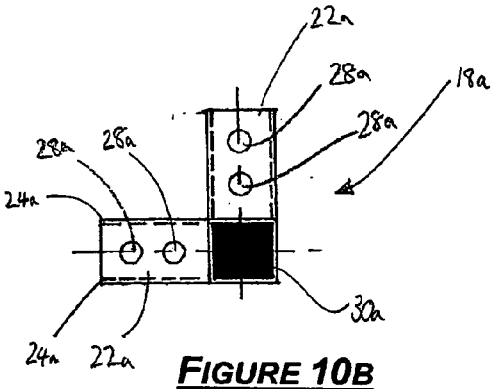

FIGURE 10B

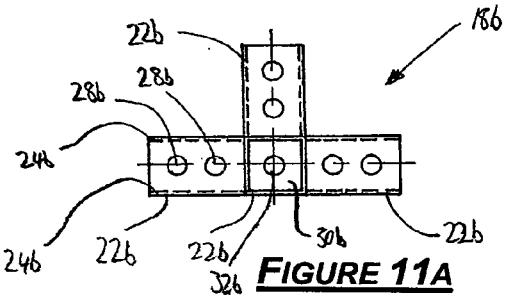

FIGURE 11A

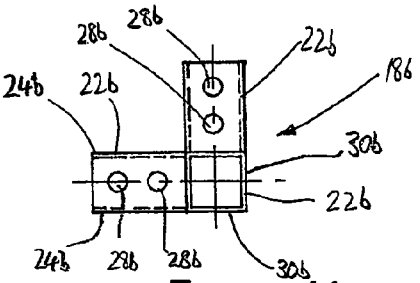

FIGURE 11B

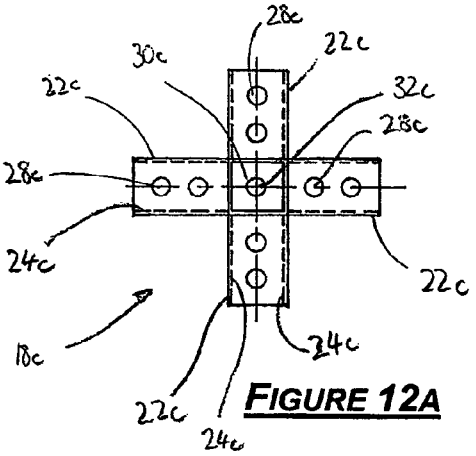

FIGURE 12A

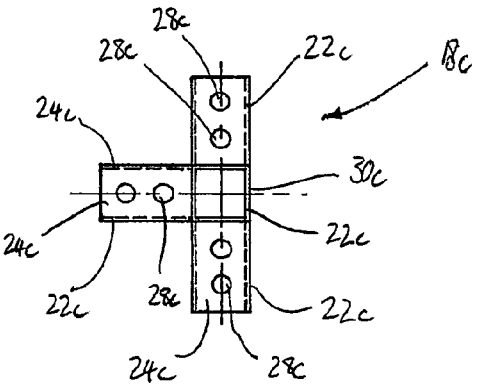

FIGURE 12B

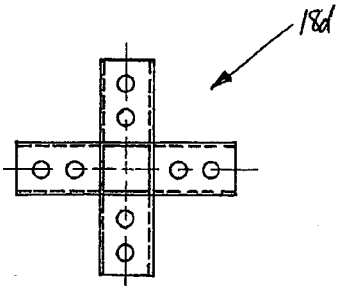

FIGURE 13A

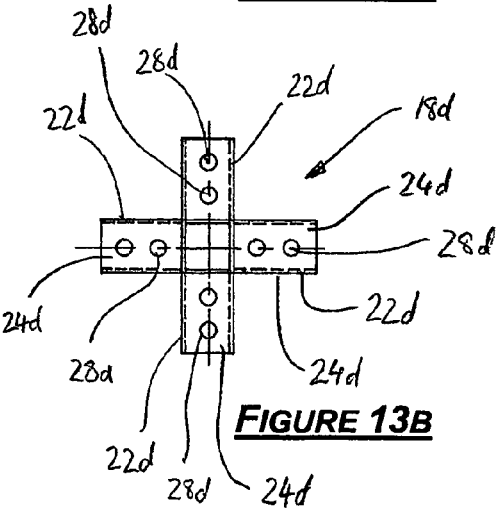

FIGURE 13B

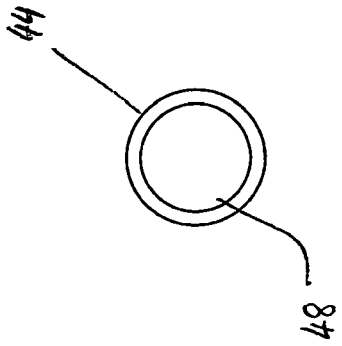

FIGURE 15

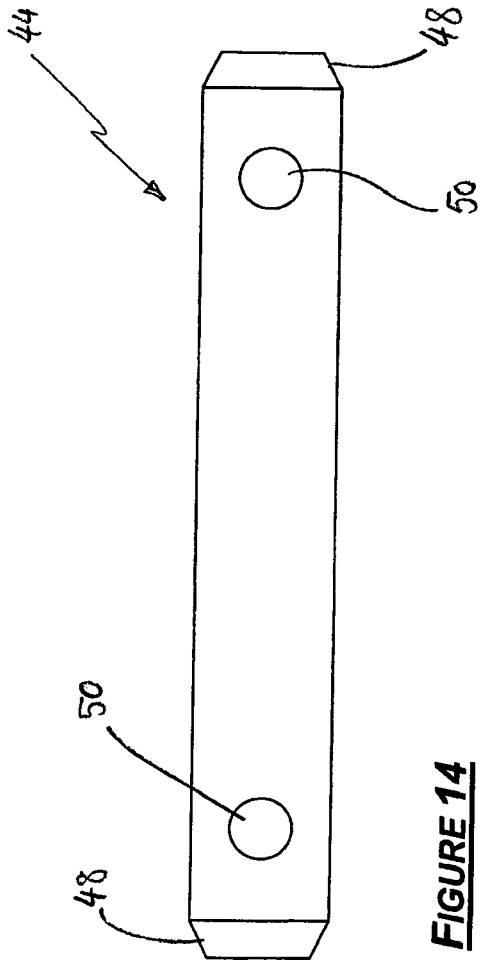

FIGURE 14

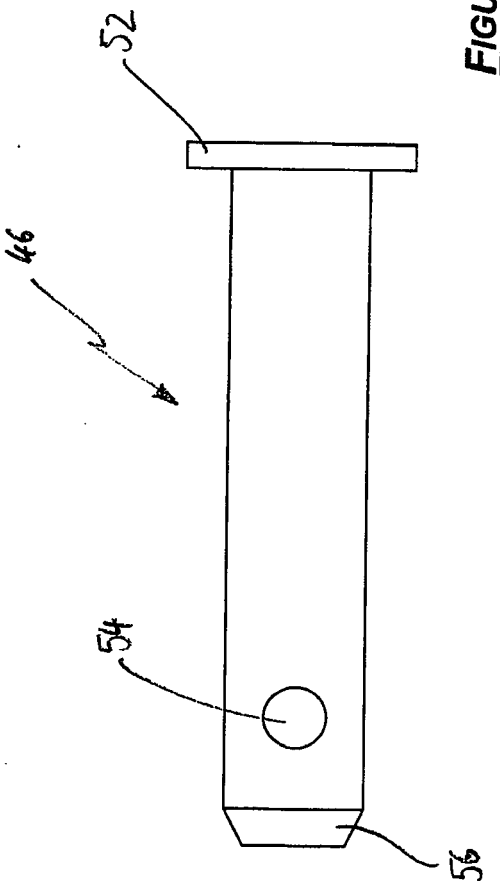

FIGURE 16

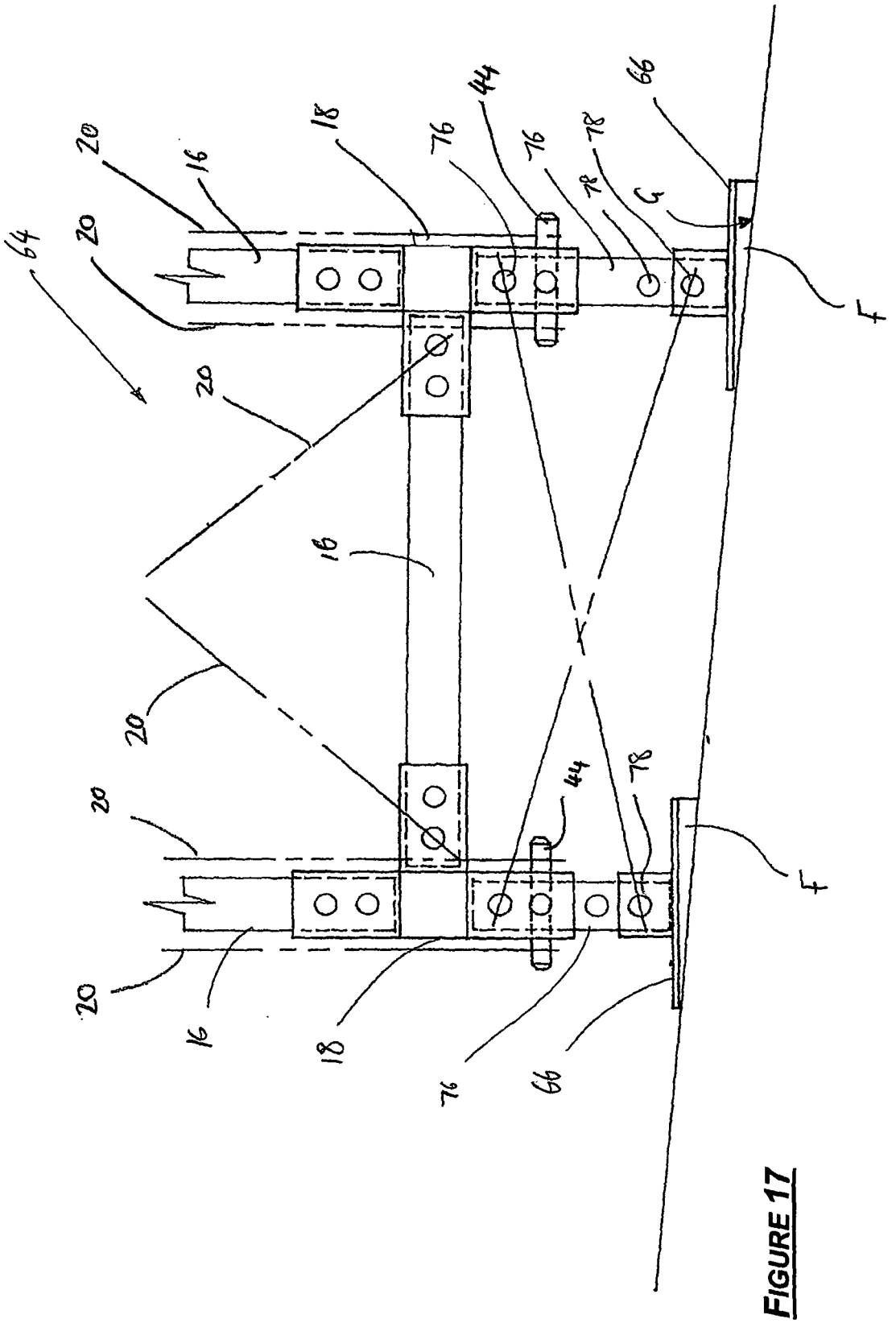

FIGURE 17

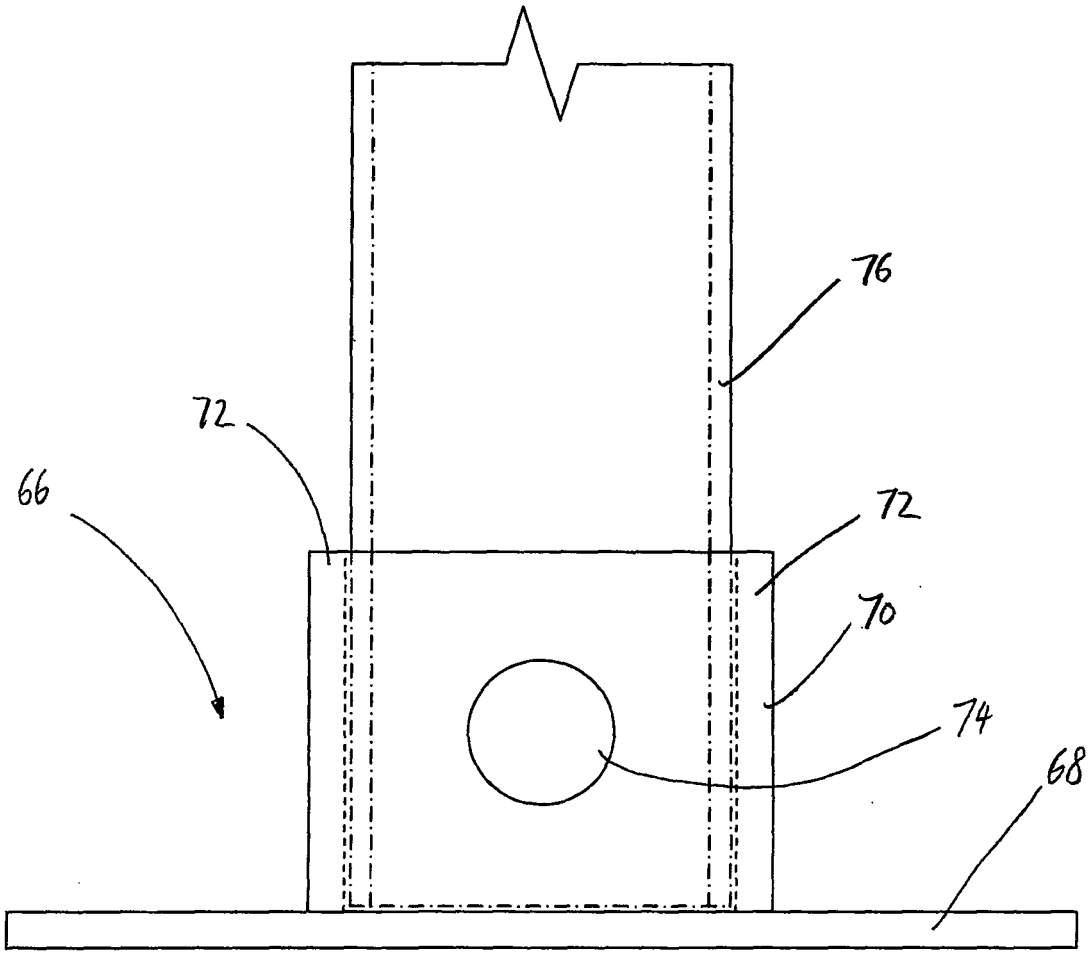

FIGURE 18

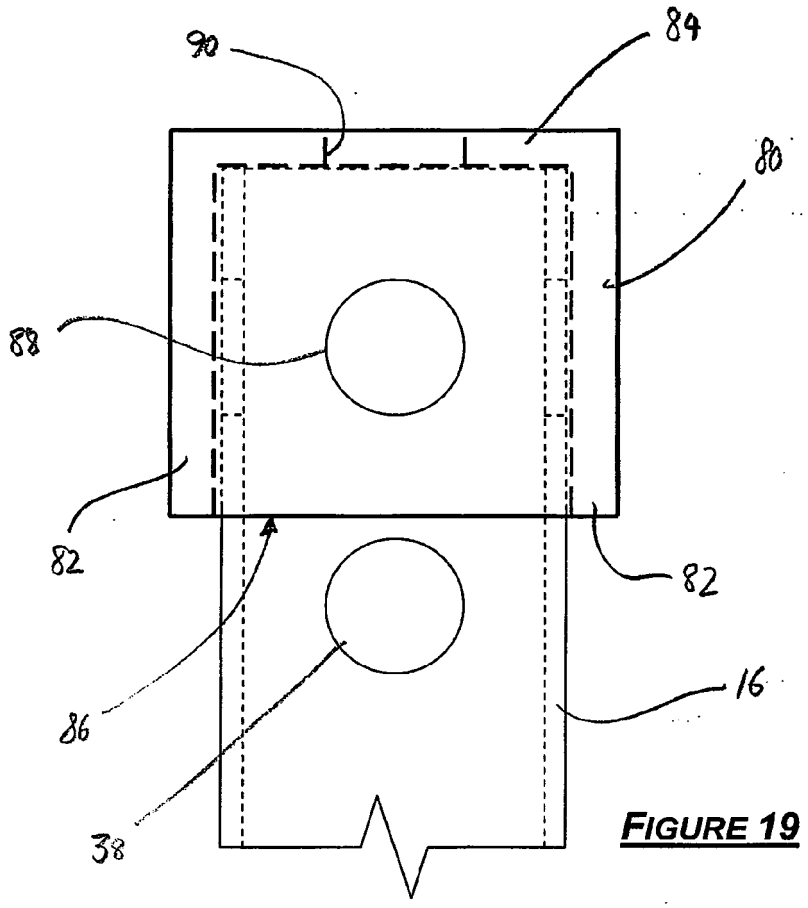

FIGURE 19

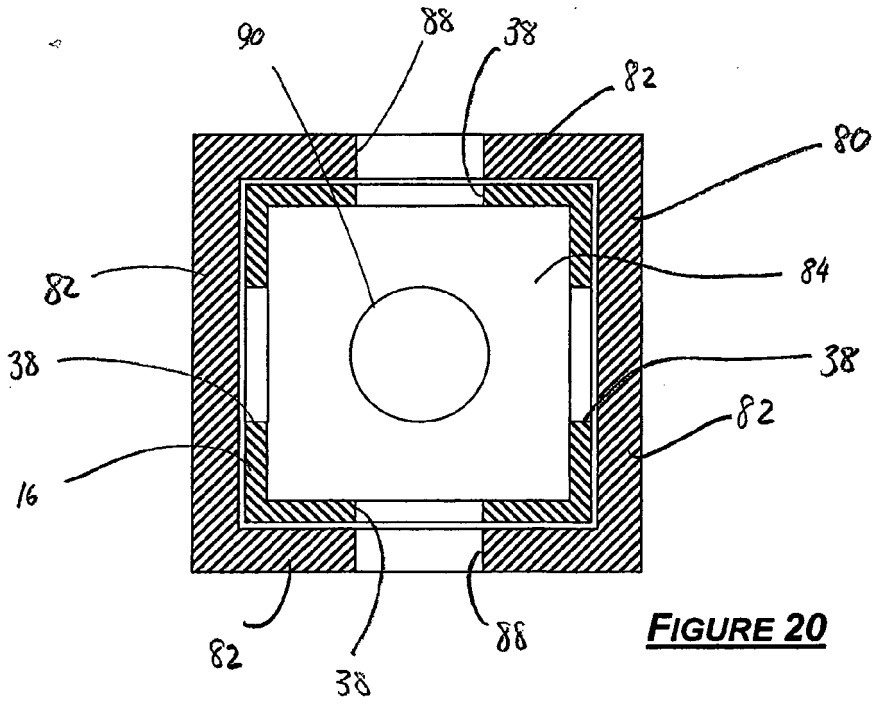

FIGURE 20

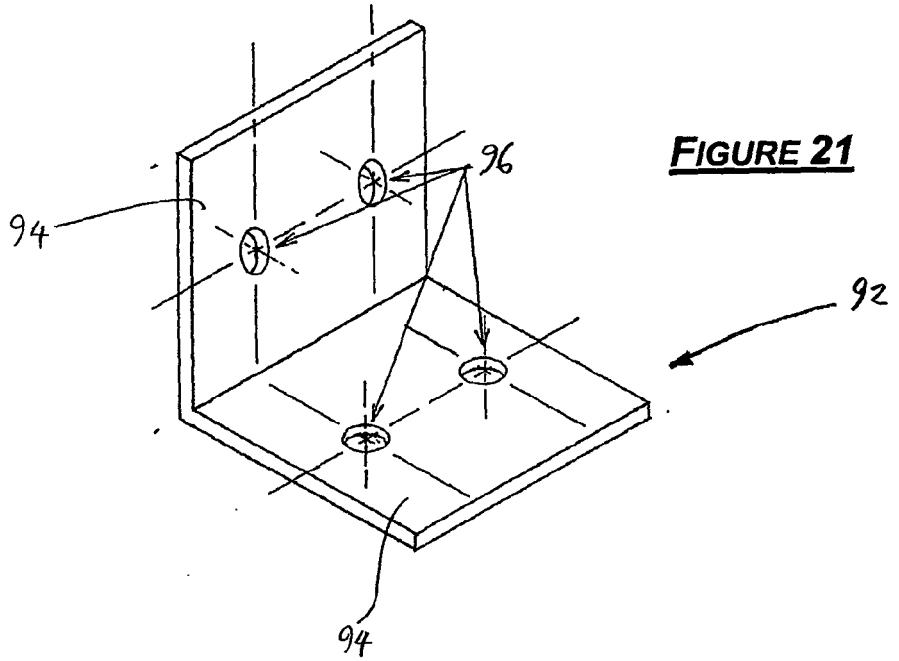

FIGURE 21

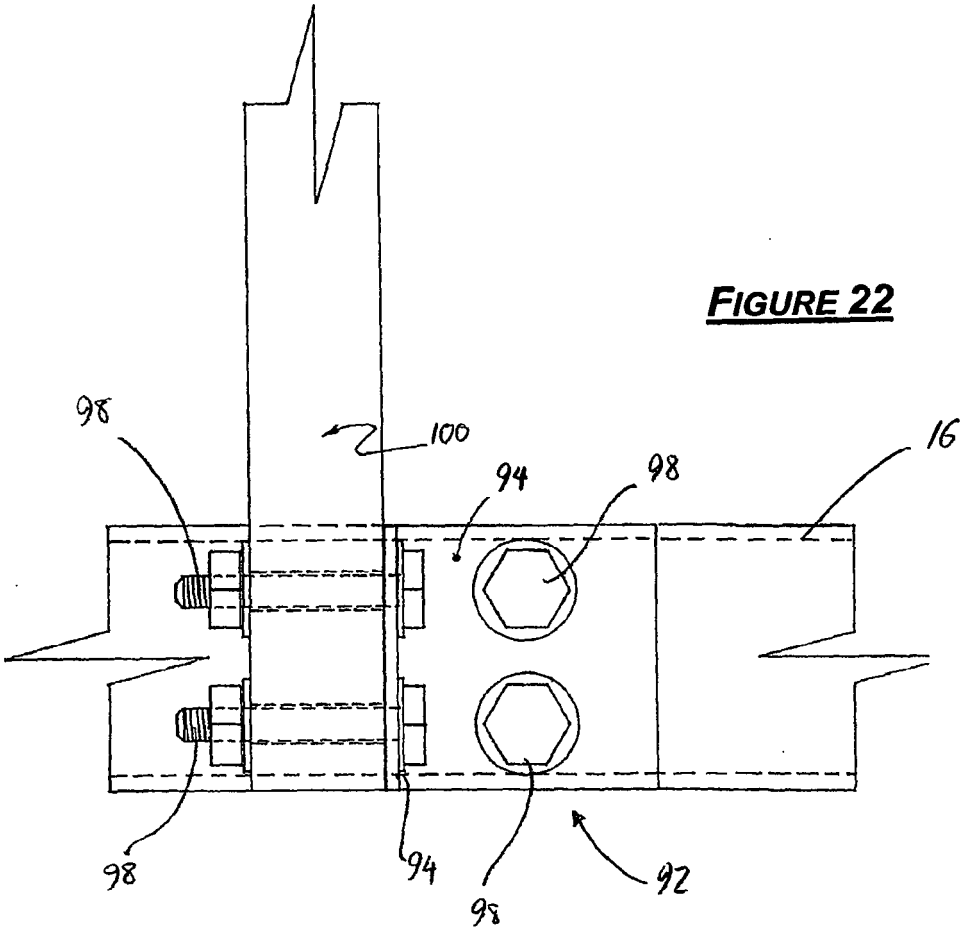

FIGURE 22

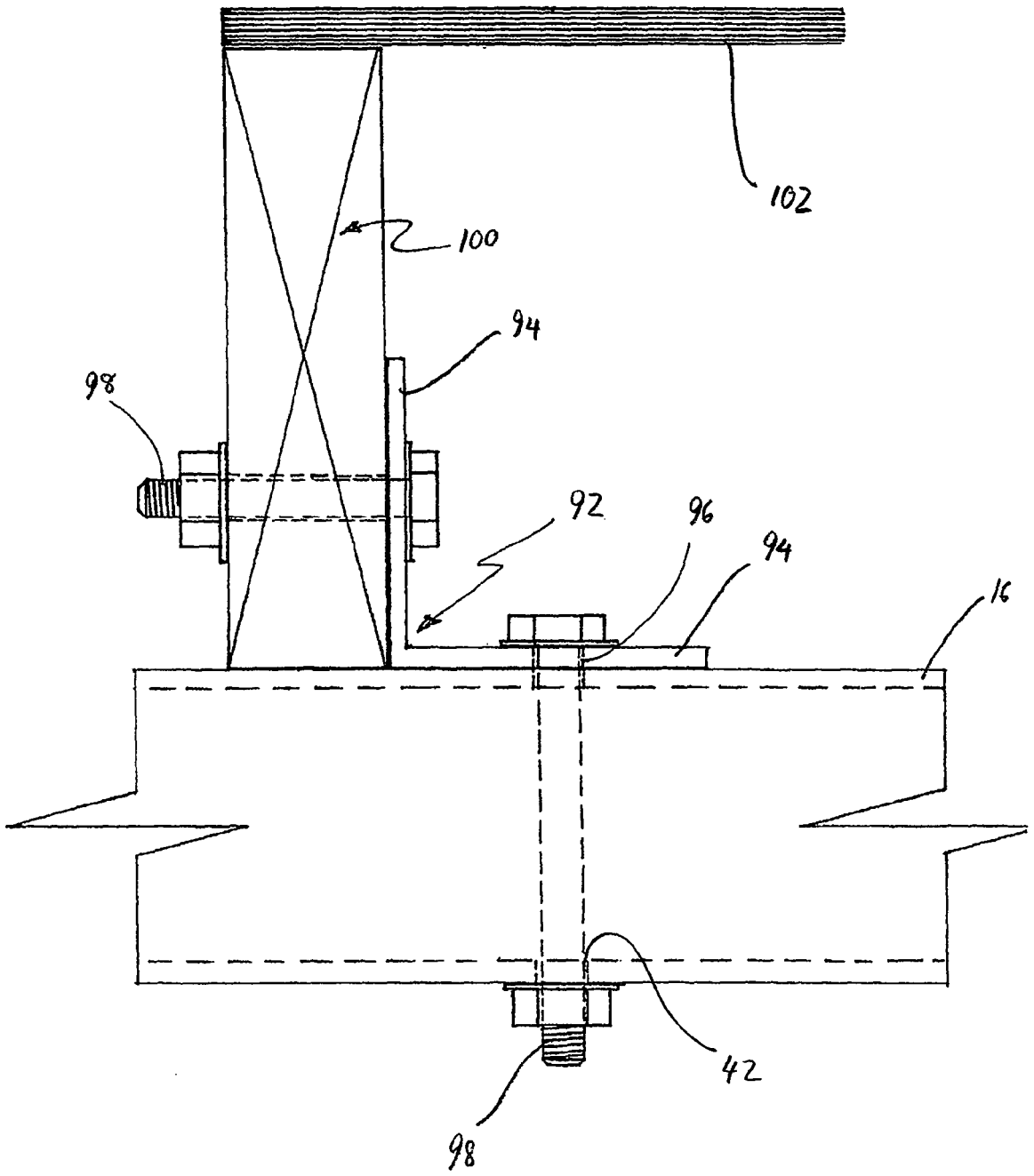

FIGURE 23

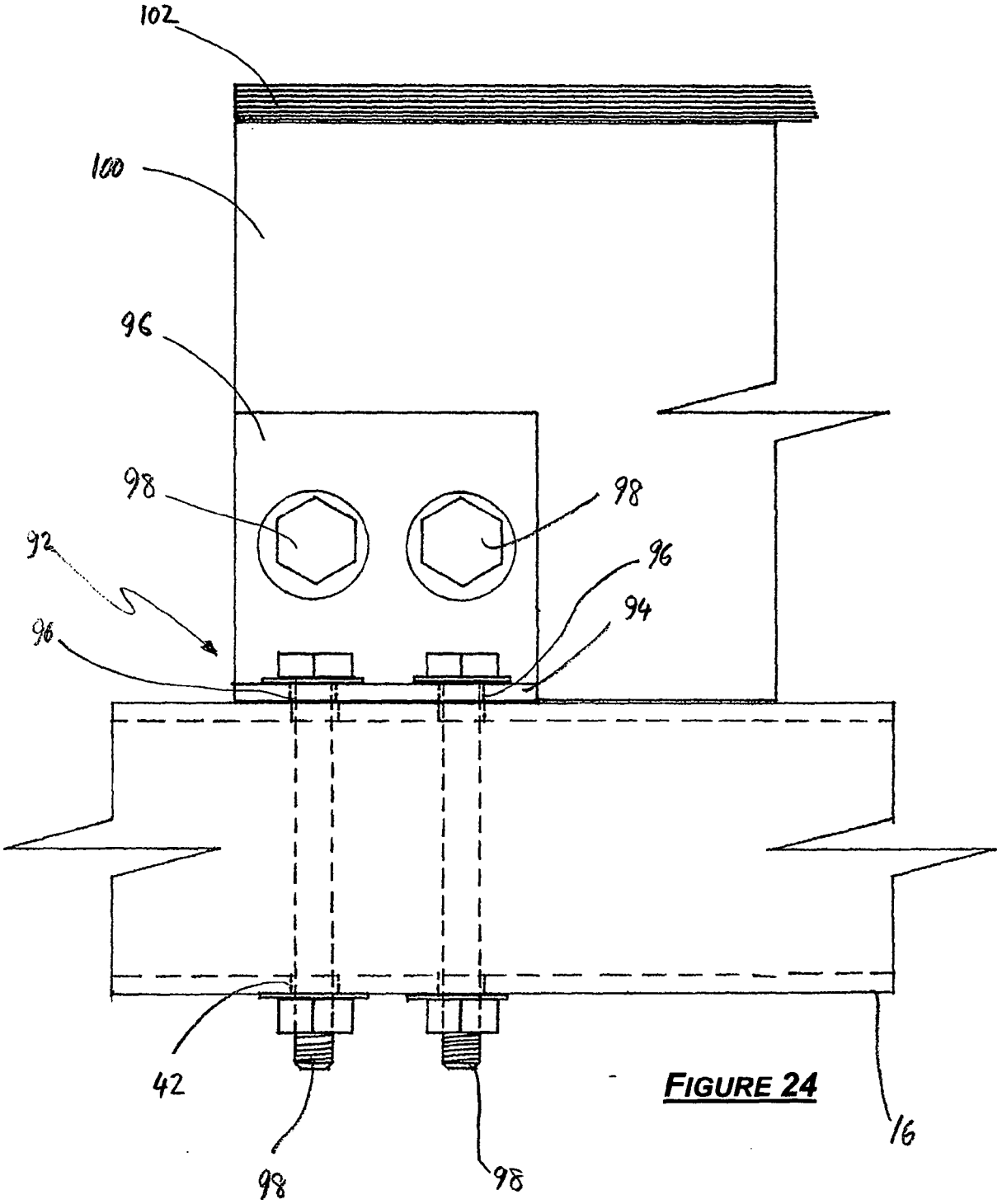

FIGURE 24

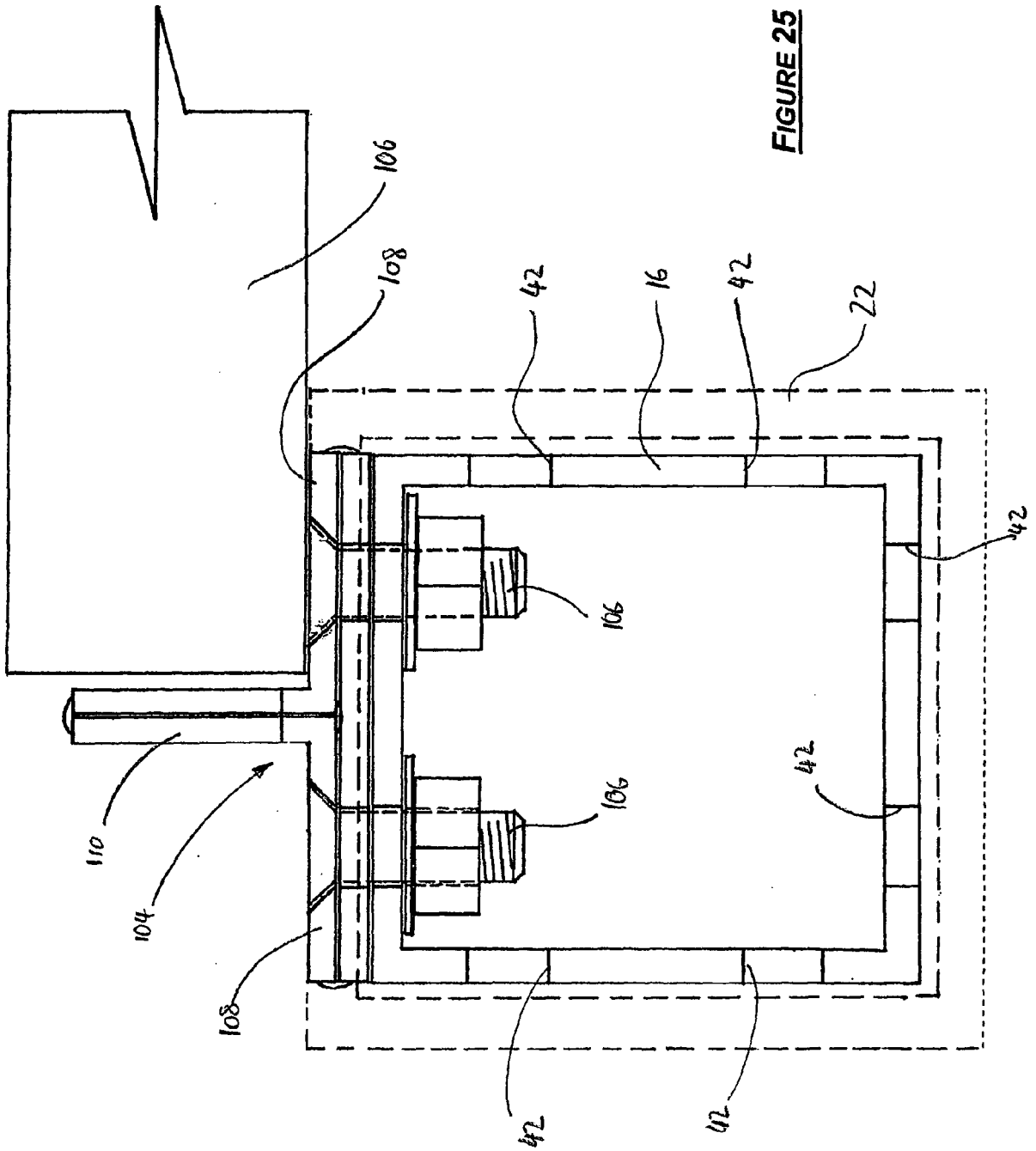

FIGURE 25

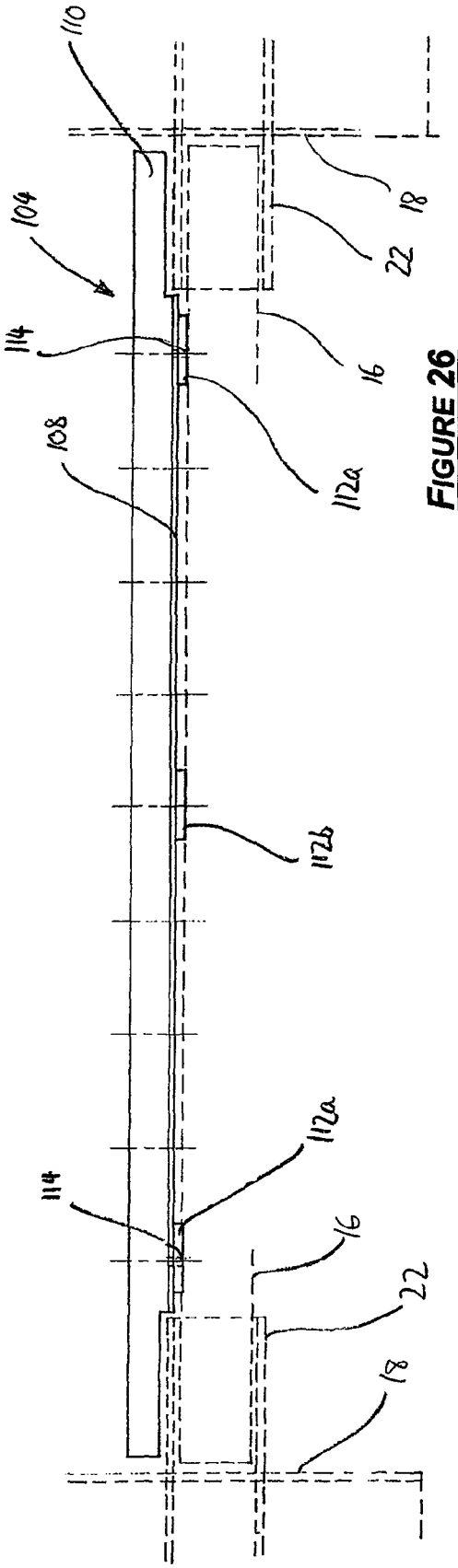

FIGURE 26

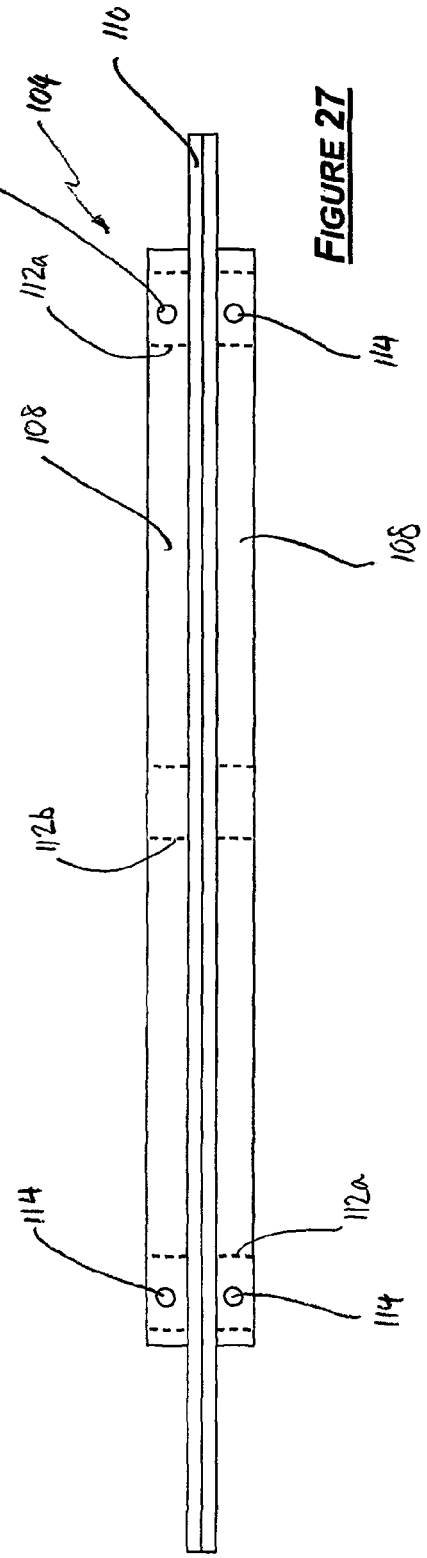

FIGURE 27

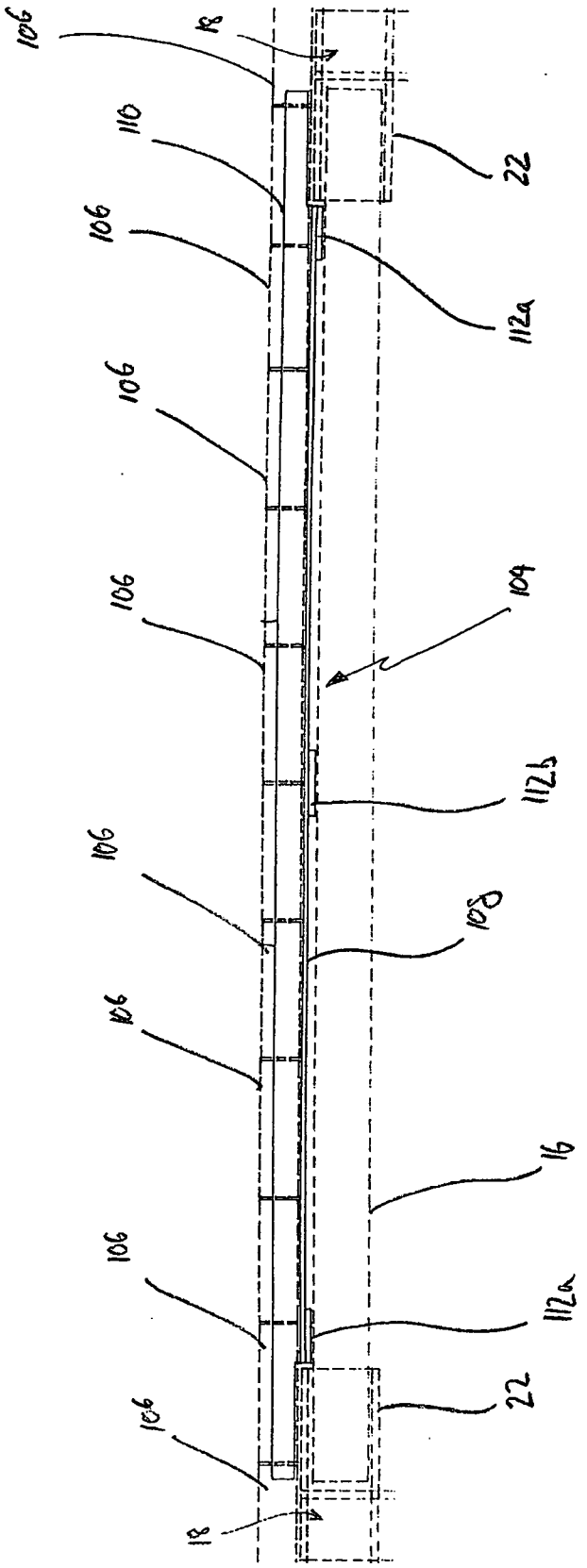
106
18
110
22
106
112a
106
106
104
106
112b
106
108
106
16
106
112a
22
106
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FIGURE 28

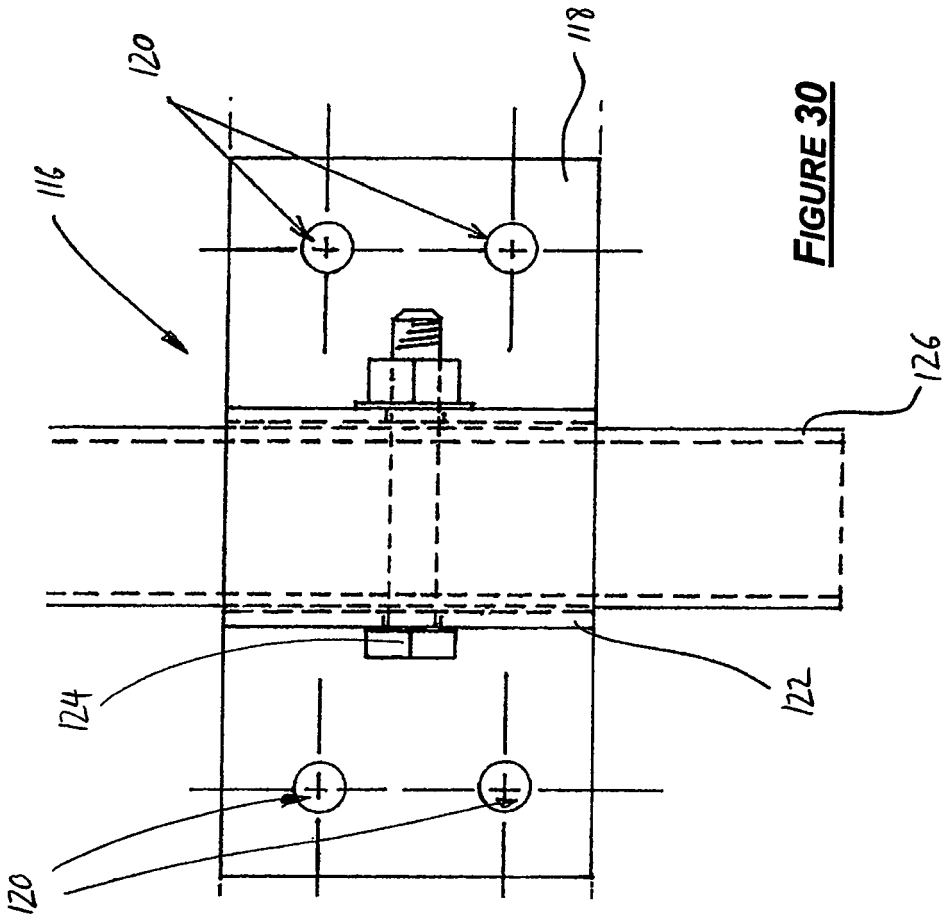

FIGURE 30

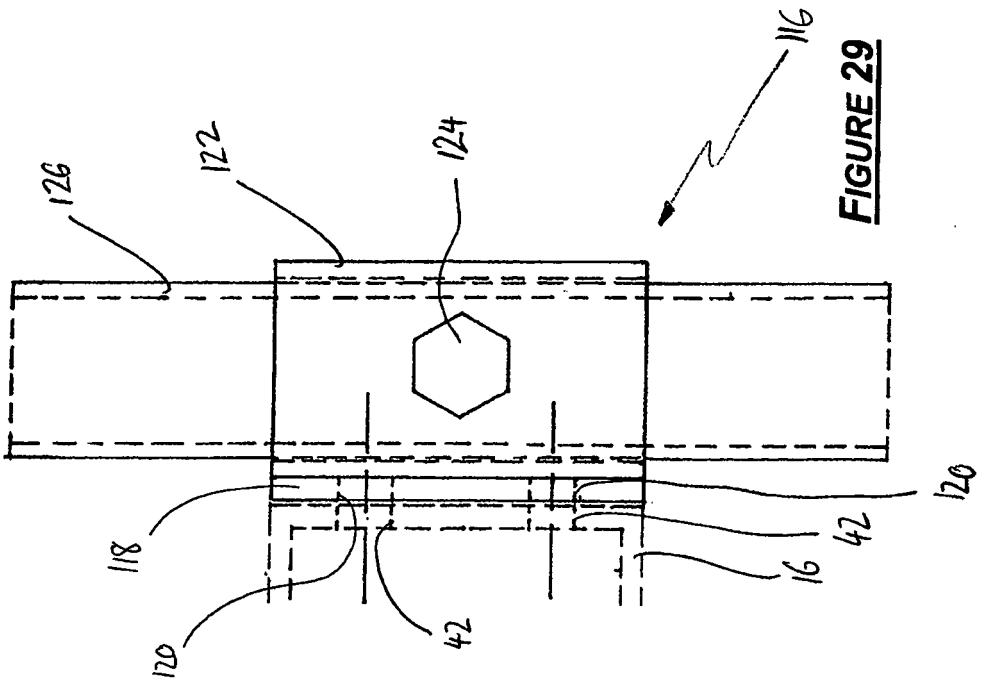

FIGURE 29

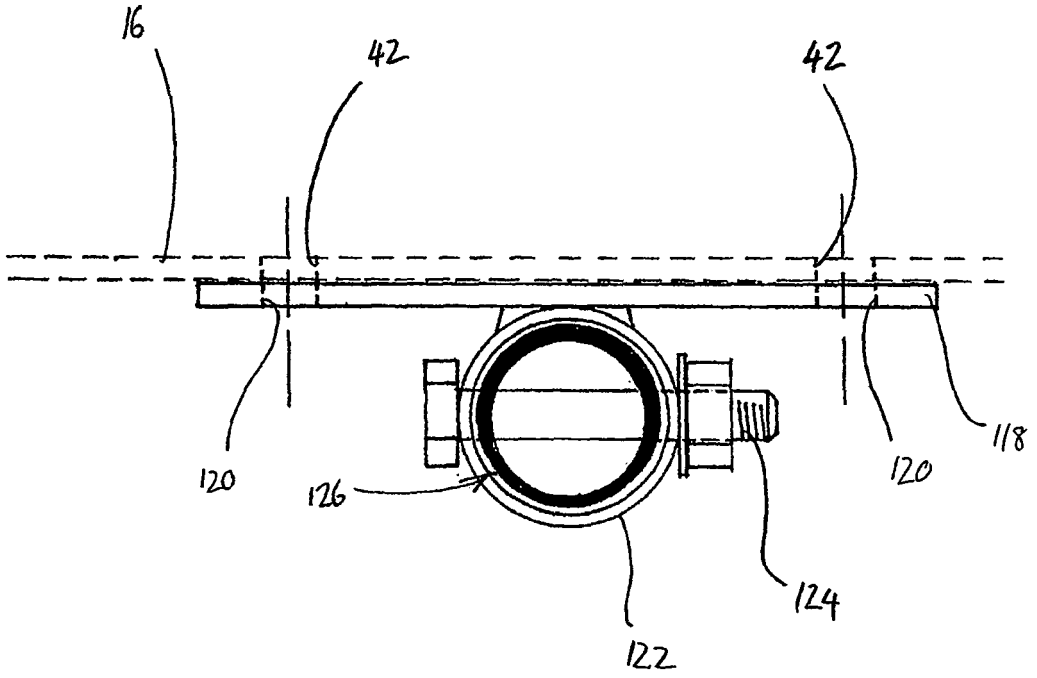

FIGURE 31

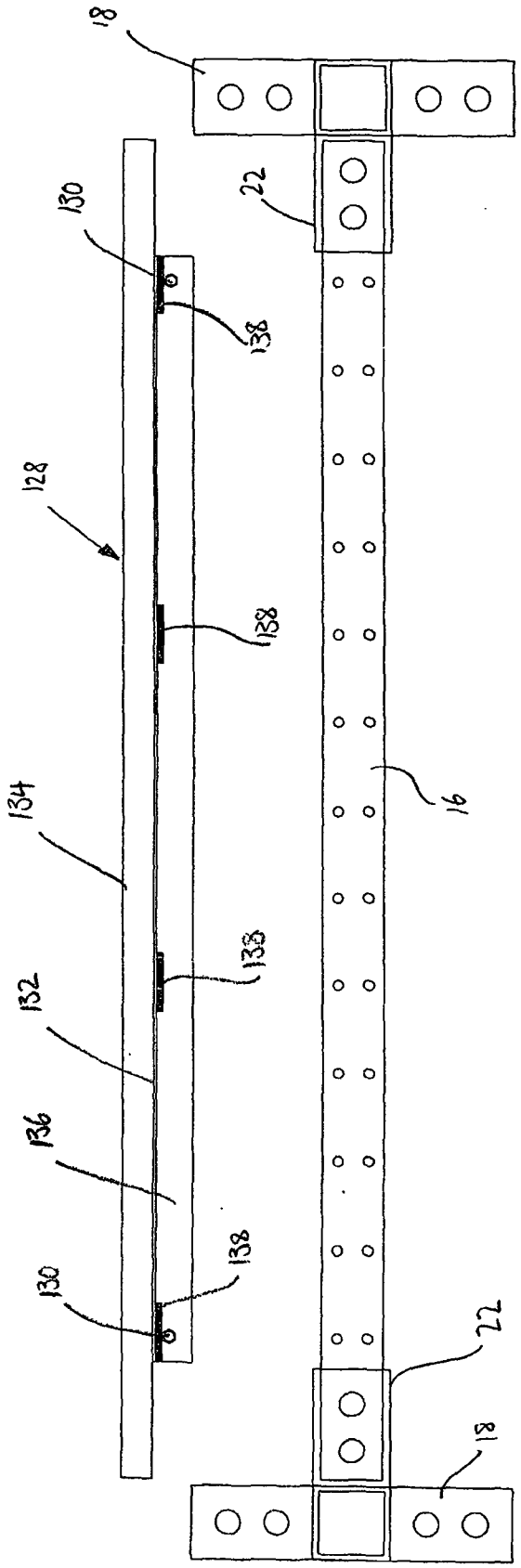

FIGURE 32A

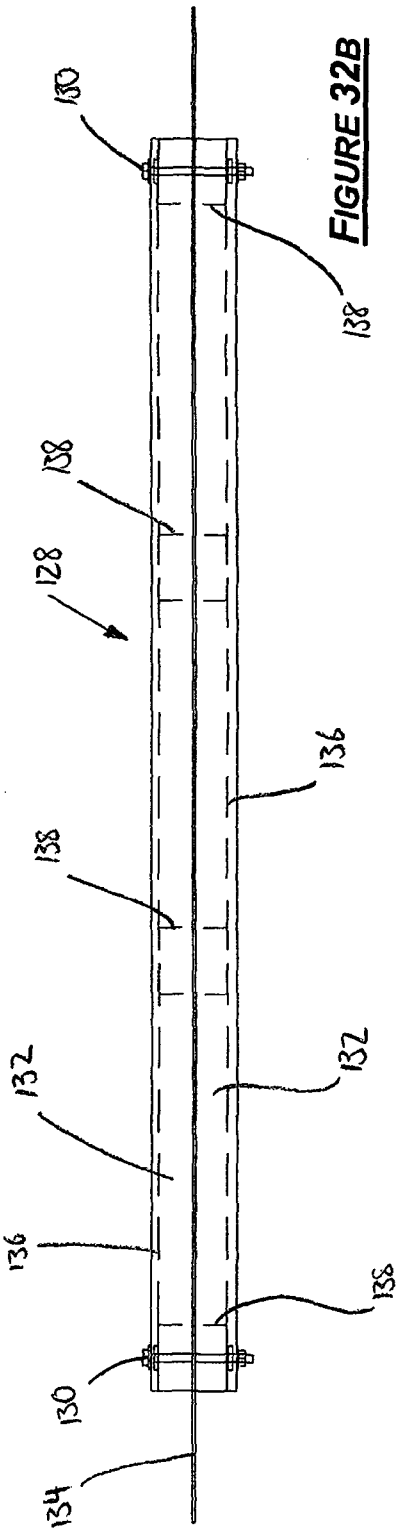

FIGURE 32B

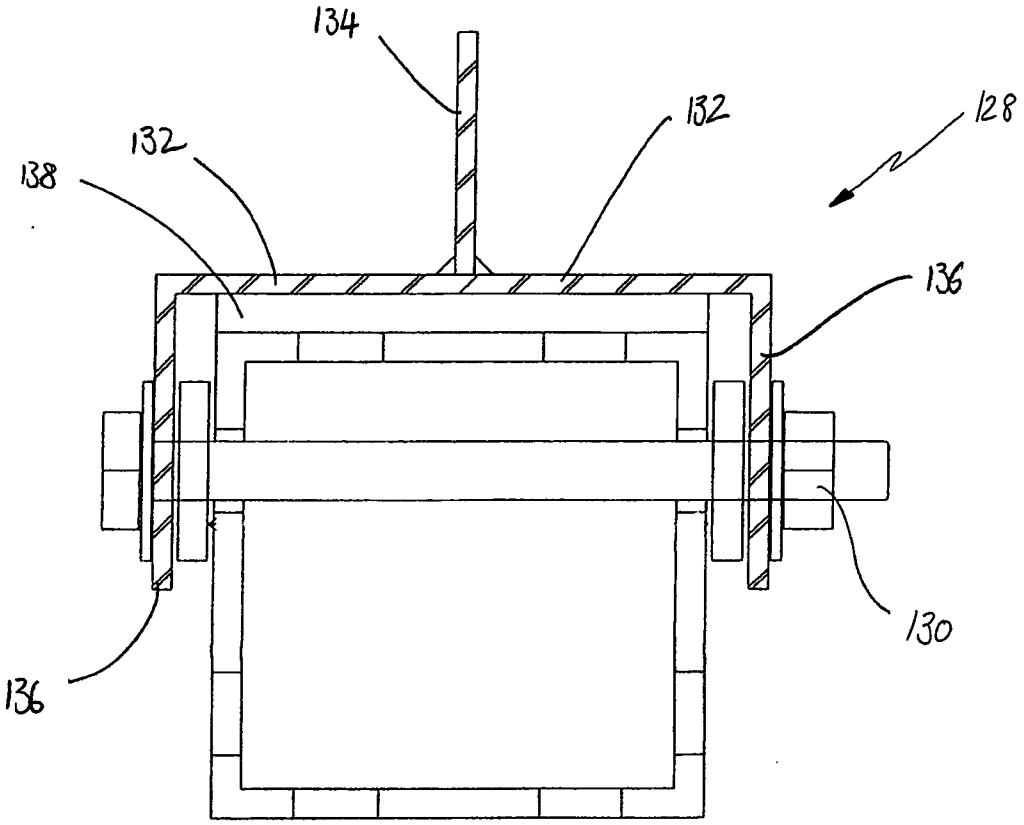

FIGURE 32C

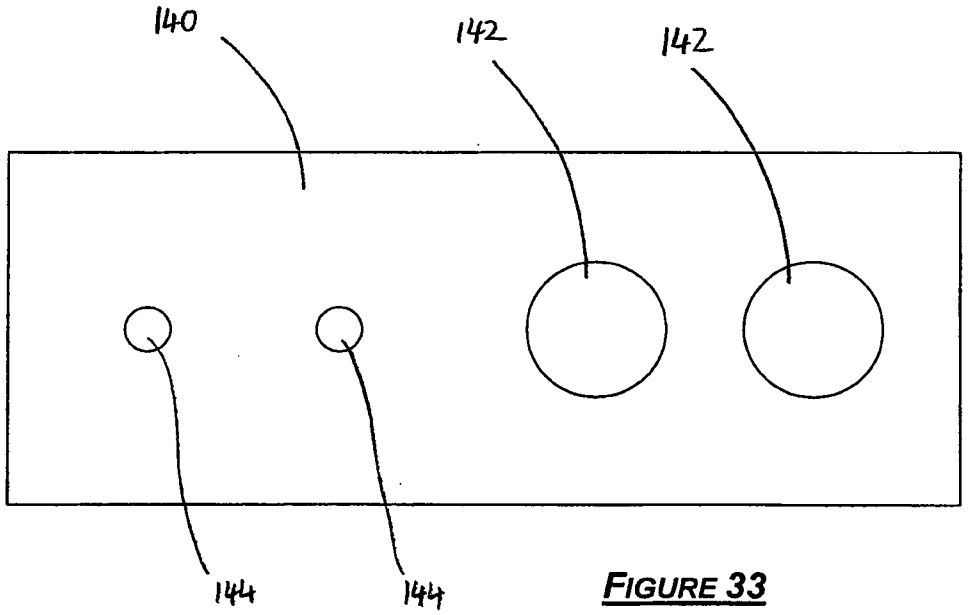

FIGURE 33

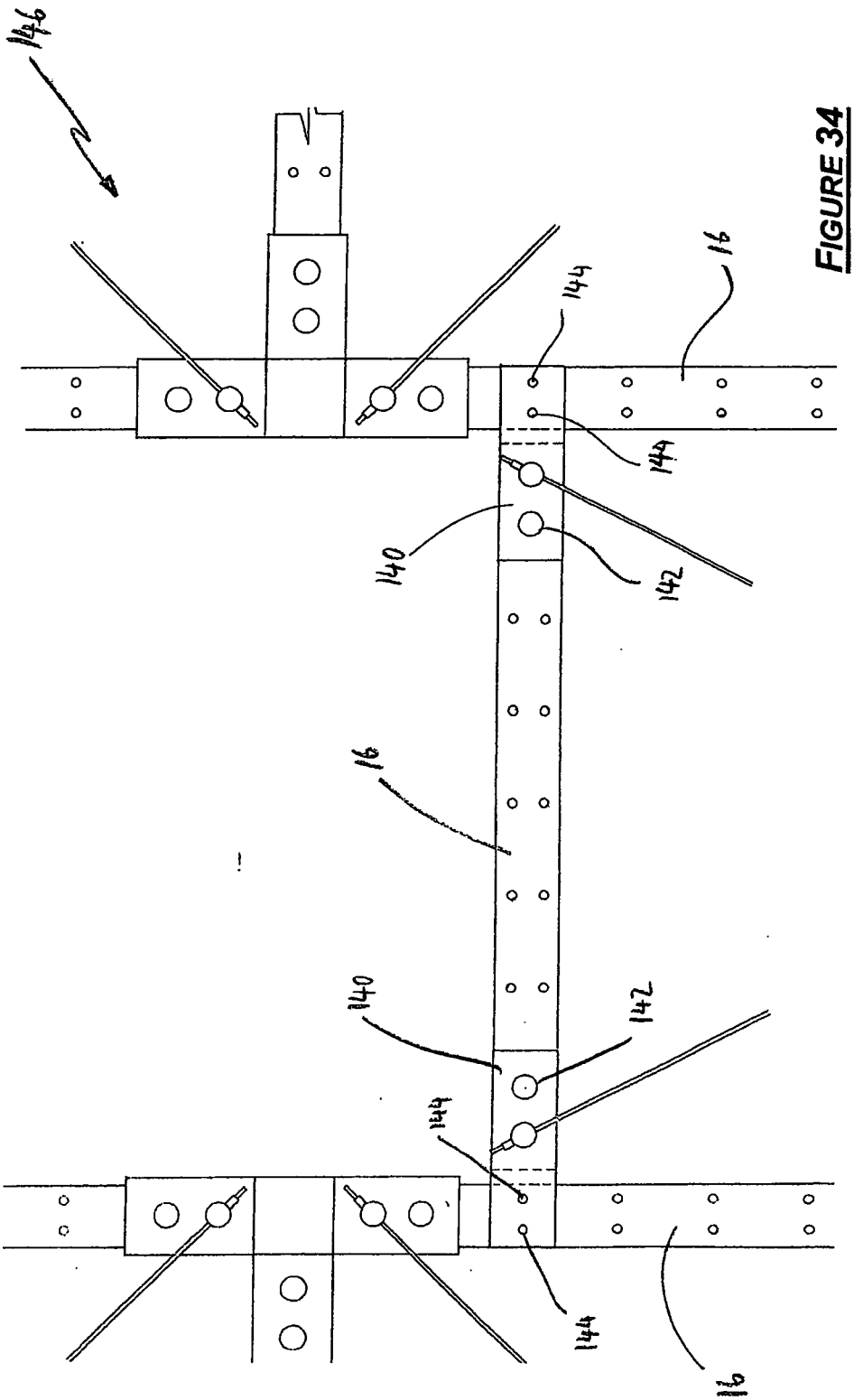

FIGURE 34

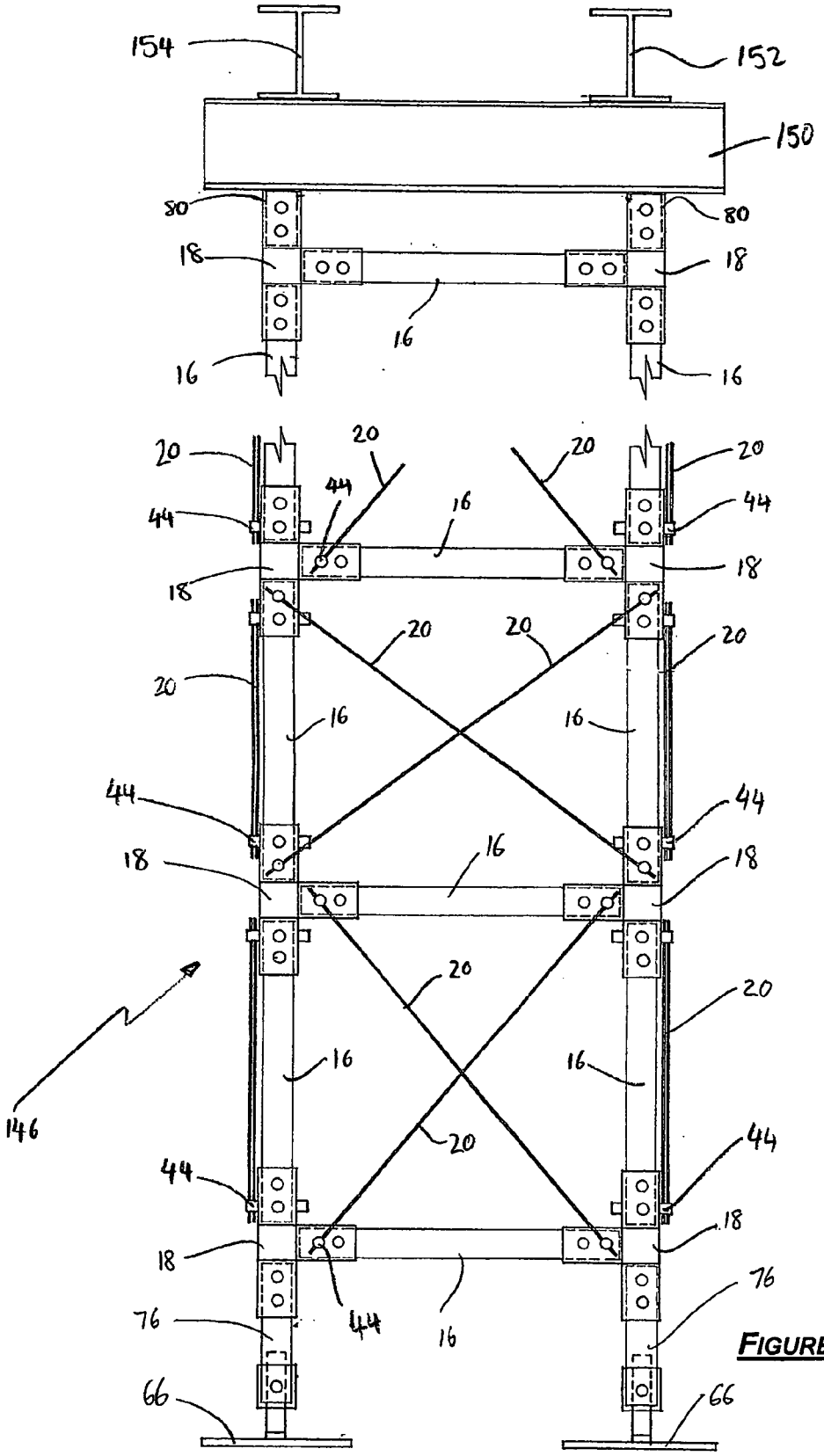
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FIGURE 35

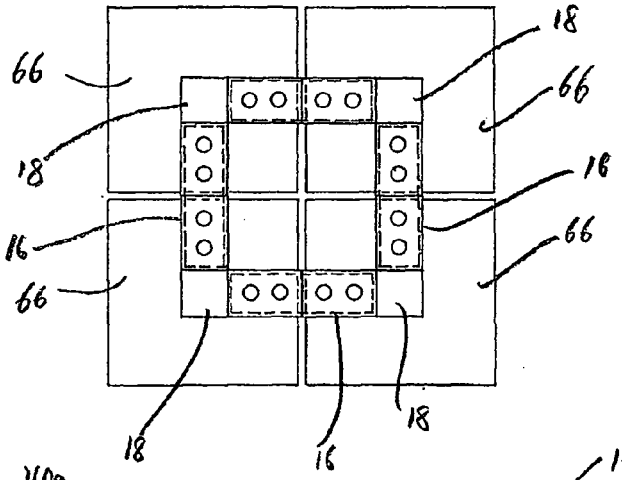

FIGURE 36

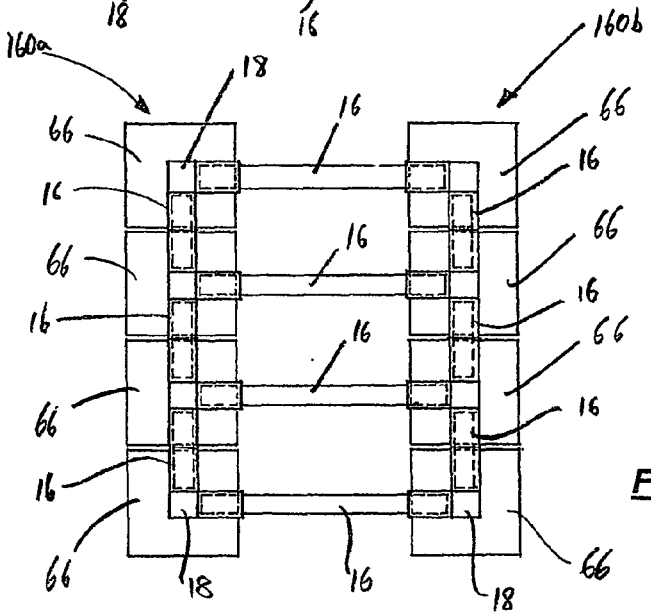

FIGURE 37

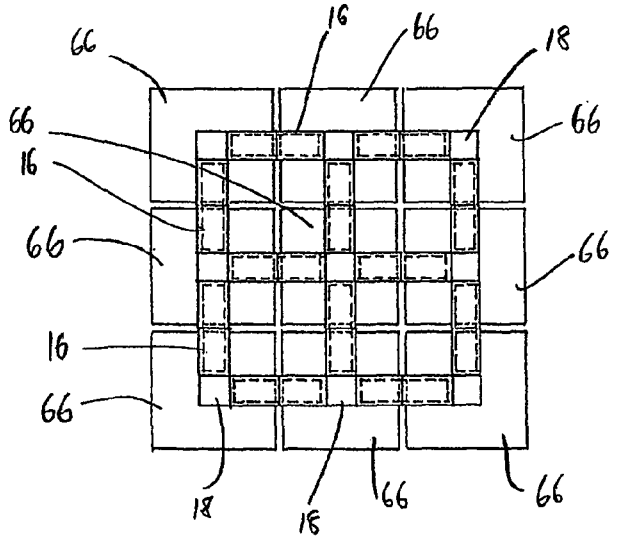

FIGURE 38

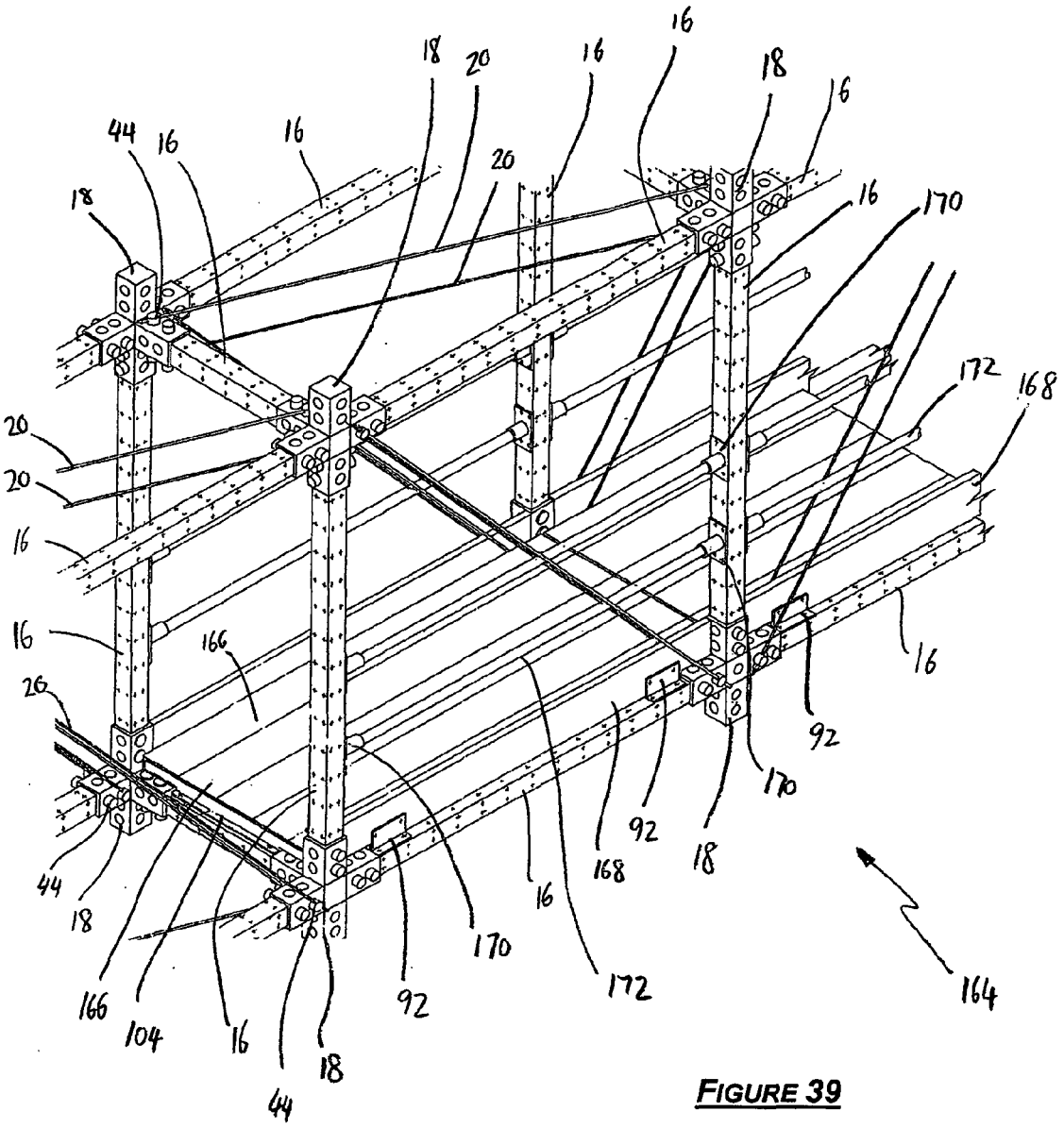
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FIGURE 39

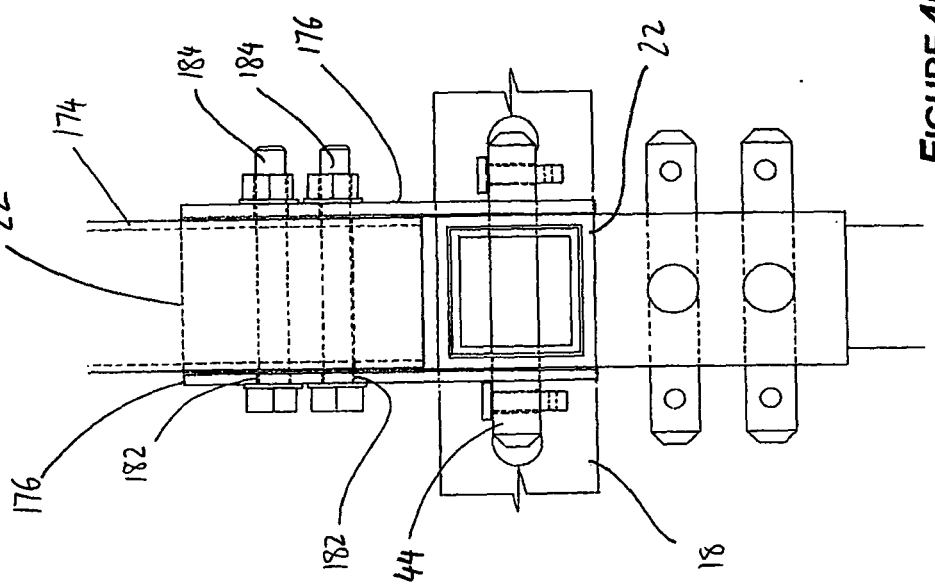

FIGURE 40B

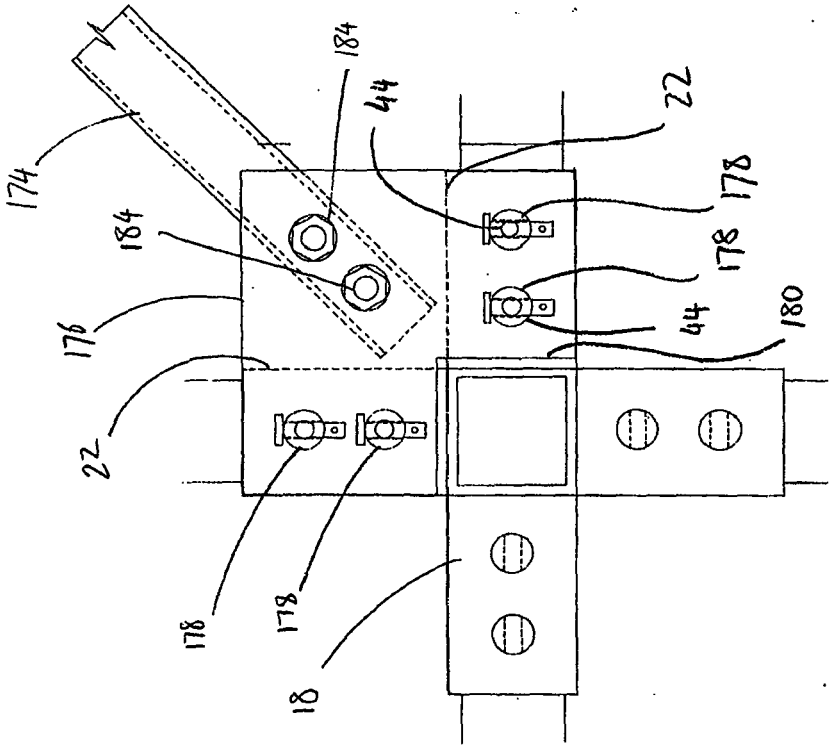

FIGURE 40A

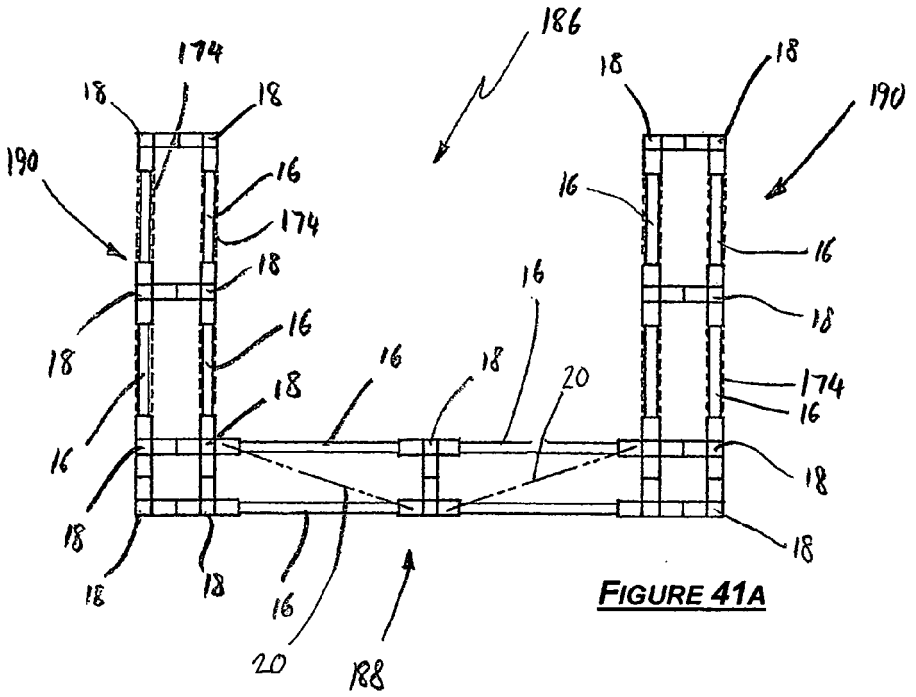

FIGURE 41A

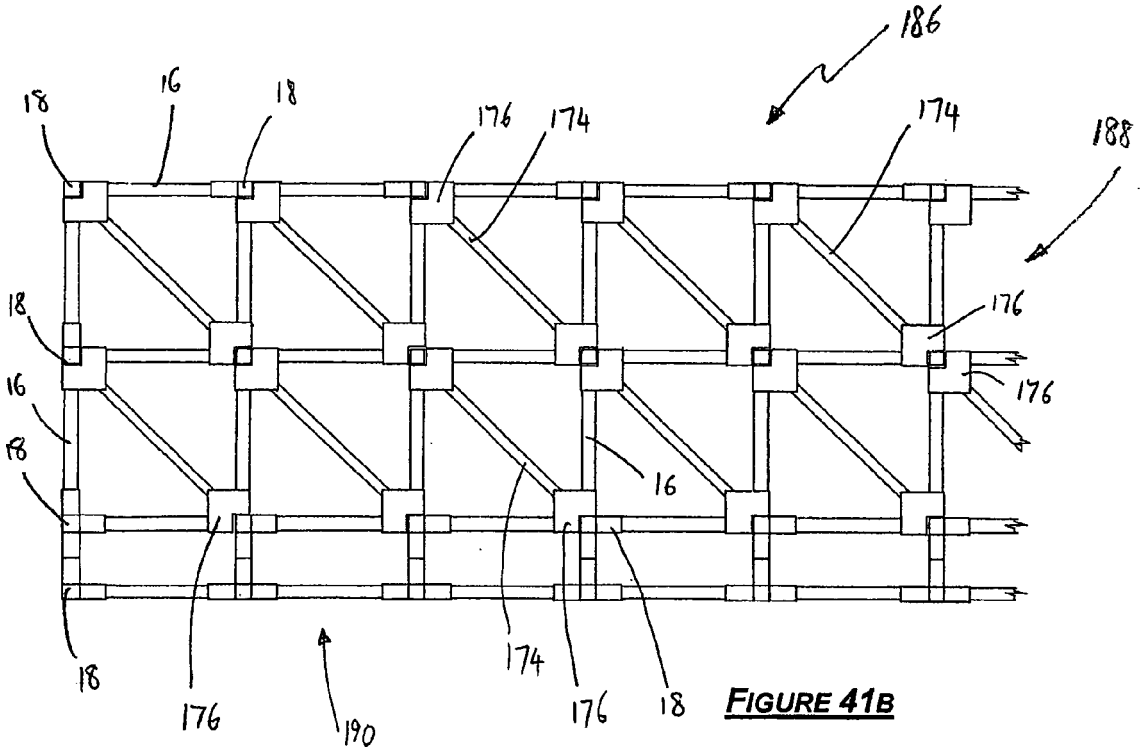

FIGURE 41B

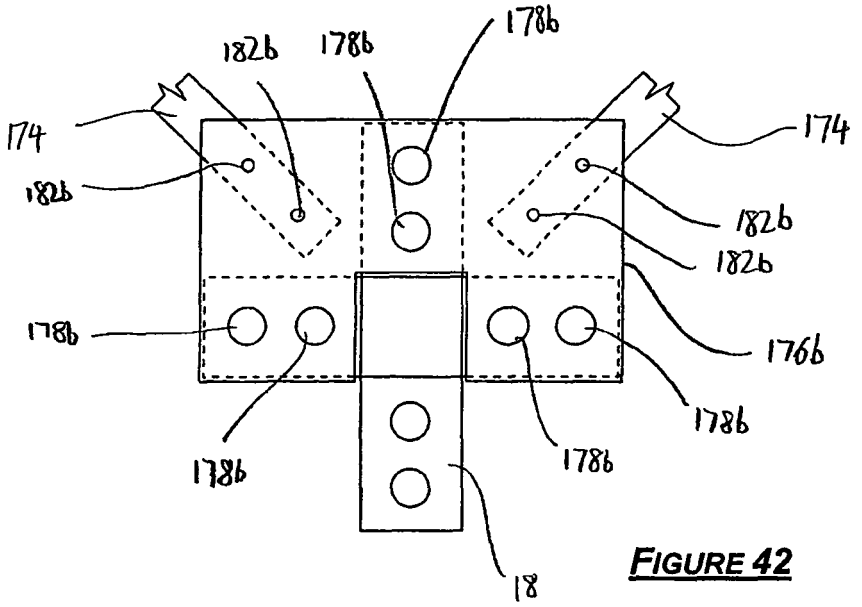

FIGURE 42

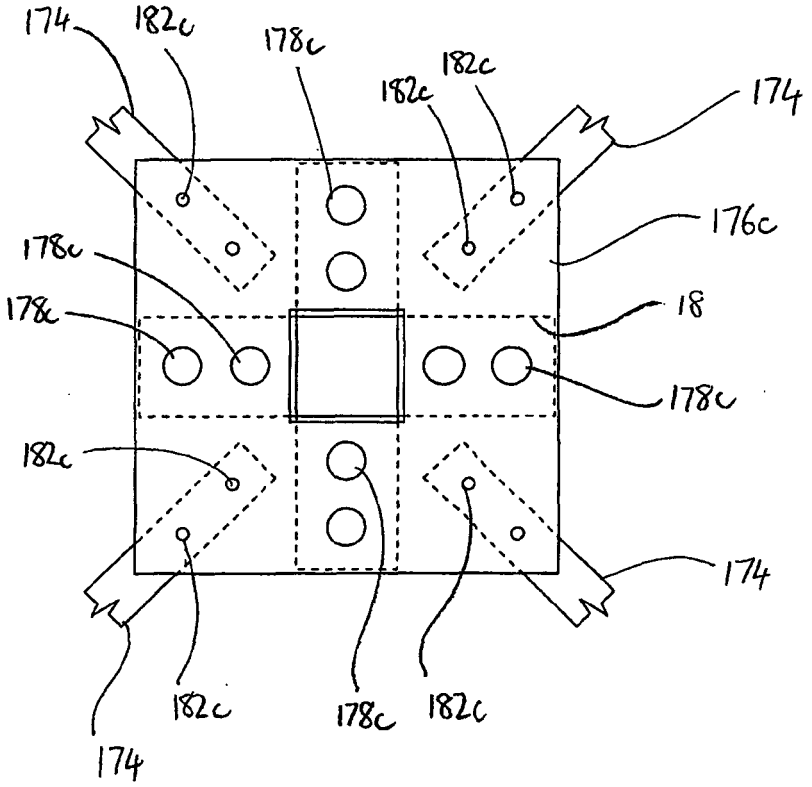

FIGURE 43

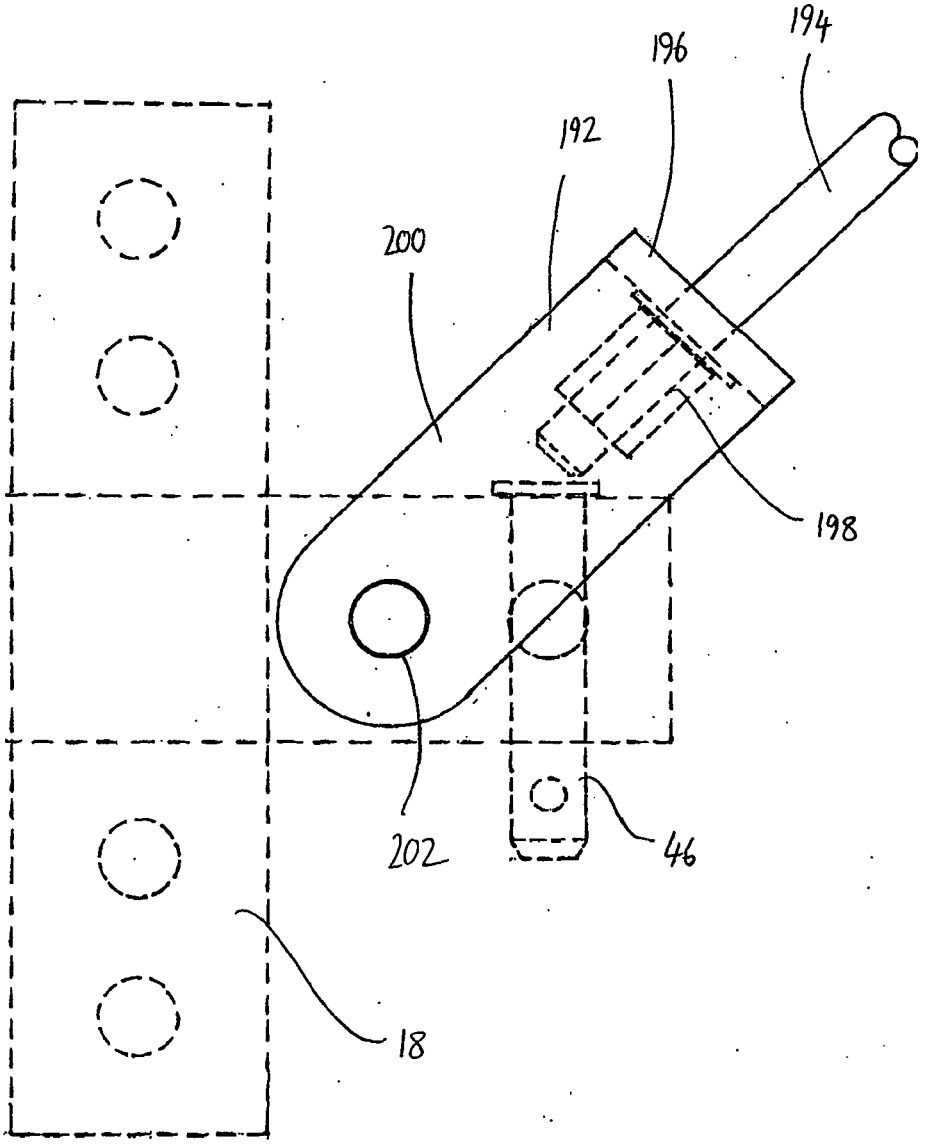

FIGURE 44

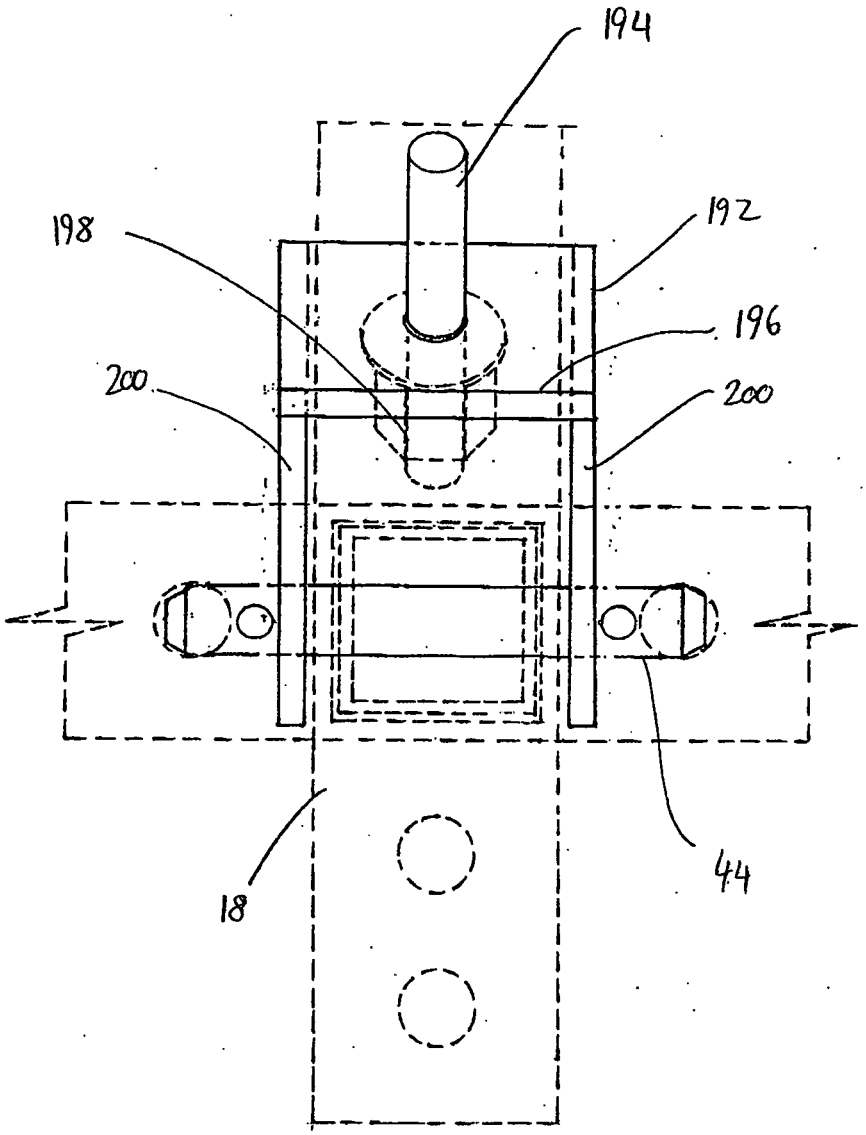

FIGURE 45

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EUROPEAN SEARCH REPORT

Application Number
EP 08 25 2275

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X Y	US 5 127 759 A (ORBOM ERIC W [US]) 7 July 1992 (1992-07-07) * abstract * * column 3, line 14 - column 7, line 67 * * figures 1,5-8 * -----	1-4,6,10 11-13	
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TECHNICAL FIELDS SEARCHED (IPC)
E04G
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 November 2008	Beucher, Stefan

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EUROPEAN SEARCH REPORT

Application Number
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Munich	21 November 2008	Beucher, Stefan

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