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(54) **Construction method and constructional elements.**

(57) A method is provided of erecting an arch-like structure comprising means (12), base plates (14), connectors (16) and purlins (18) or cross bracings. The method involves attaching a first beam (12*a*) to the base plate (14) by means of a first bolt (20) only with the beam (12*a*) lying on the ground. The end of the first beams (12*a*) is lifted sufficiently to allow the connection thereto of the second beam (12*b*) and this process is repeated with subsequent beams (12*c*) through to the last beam (12*d*). The whole operation is carried out on the ground and the arch rises into the air. A connector is described as is a base connector. A beam including a box section on either side of a profiled web is described along with variations thereof and a light weight structure which can be converted to a trailable vehicle and which includes the principle of the invention is also described.

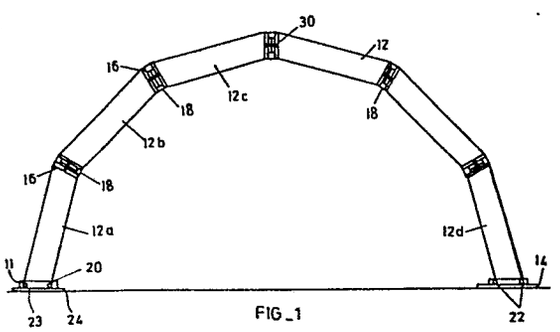

FIG_1

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This invention relates to fixed constructions.

The invention includes an extruded metal beam and connectors for a plurality of beams as well as a method of combining the beams and the connectors into a structure.

According to the invention a method of erecting a structure comprises the steps of attaching a first base plate to a base for the structure, pivotally connecting a first constructional element to the first base plate , rigidly connecting one or more additional constructional elements to the free end of the first constructional element by first hoisting the free end of each connected constructional element to a height sufficient to allow the rigid connection, of the additional constructional element, to the free end and connecting the free end of the last constructional element to a second base plate which is attached to the base.

In the preferred form of the invention the structure is arch-like, and the method comprises the preliminary step of cutting the ends of the constructional elements at a predetermined angle, which will depend on the curvature of the arch.

The method includes the additional steps of rigidly securing the structure to the base plates once erected.

The structure of the invention may be erected, along with a number of similar structures, in the arrangement

of a building and, if necessary, be connected to one another at least in pairs by means of cross bracing and additionally or in the alternative, by means of purlins. The method therefore includes the additional steps of erecting a plurality of structures in a predetermined arrangement to form a structural whole or building frame and cladding the building frame. The structures may be connected to one another in pairs so that the method includes the further steps of securing one more constructional elements between adjacent pairs of the structures at predetermined intervals.

The method preferably includes the further step of connecting adjacent structures together in pairs by means of one or more constructional elements secured to the two structures in a pair. The resulting pairs of structures may be connected to one another by means of purlins or tension members.

The constructional elements located across the building frame from structure to structure will be referred to as "purlins" while the tension members will be referred to as "cross bracing" or "ties", for the sake of clarity. The constructional elements used as purlins may be the same as the constructional elements used in the construction of the arch-like structures, but it will be appreciated that suitable structural elements of a different shape may also be used.

The two structures in a pair with their connecting constructional elements are preferably erected at the same time in which case the method of the invention will comprise the steps of pivotally connecting two adjacent first constructional elements to their respective first base plates, rigidly connecting the two first constructional elements to one another by means of a purlin, rigidly connecting one or more additional constructional elements to the free ends of the first constructional elements by first hoisting the free ends of the connected constructional elements to a height sufficient to allow the rigid connection of an additional purlin and constructional elements to the free ends and connecting the free ends of the last constructional elements to a pair of second base plates attached to the base.

Alternatively, or in addition to the purlins connecting adajcent structures, the structures may be cross braced.

In the preferred form of the invention the method includes the intermediate steps of locating a connector element or elements to the free end or ends of the constructional element or elements and connecting the additional constructional element or elements to the connector. The term "additional constructional element or elements here includes the constructional elements of the arch-like structure as well as the purlins.

The invention includes a constructional element comprising an expanded extruded beam, preferably of metal, which includes a box section on either end of a profiled web, the web being cut, between the profiles at predetermined intervals and expanded.

In the preferred form of the invention the constructional element is optionally provided, along an upper edge thereof, with channels adapted to receive the enlarged edge of a flexible sheet memeber.

The invention also includes a connector comprising an extrusion of H-section, the bar of the H being adapted to abut the ends of the constructional elements in use and the legs of the H being adapted to receive the ends of the constructional elements in use.

The legs of the H and the ends of the constructional elements are preferably formed with holes adapted to receive bolts.

The bottom connectors may be of H-section, but the remaining conector H-section extrusions may conveniently be provided with at least one bracket on the side of the H, preferably extruded integrally with the H-section. The bracket preferably comprises a channel with opposed walls adapted to receive the end of the purlin therebetween.

The connector may conveniently include a flange on the outside of the H which flange may be provided with means, preferably an aperture formed therein, to receive the cross bracing elements.

A base connector is also provided comprising an extruded box section tube, adapted to fit within the legs of the H of the H-section connectors, which is integral with a wide base.

The base may be connected to the ground a foundation or the like.

The above structure and the method of erecting it, is ideally suited for larger industrial or agricultural buildings, or for large temporary structures. However the constructional elements and connectors can be scaled down for the construction of permanent or temporary domestic buildings.

In one such a form the connectors are adapted to allow the hinging of the beams to a position where, in a dismantled form the beams, still connected to one another at their ends, lie adjacent one another. The purlins are preferably box-shaped and dimensioned to recieve the ends of the beams therein in dismantled form, means being provided to connect an axle to the resultant flat structure to provide a trailable vehicle.

The invention is further described with reference to the accompanying drawings in which :-

Figure 1 is a diagrammatic sectional side elevation of an arch-like structure according to the invention;

Figure 2 is a plan view of a part of the structure showing the connector;

Figure 3 is a cross section through an un-expanded extruded beam;

Figure 4 is a cross section through an expanded beam;

Figure 5 is a side elevation of a part of an expanded beam;

Figure 6 is an end elevation of a base connection; and

Figure 7 is an end elevation of a light-weight temporary structure.

The structure or arch-like structure 10 shown in Figure 1 is part of the structural whole or frame of a building and comprises a plurality of constructional elements or beams 12 supported on base plates 14. The beams 12 are connected to one another by means of connectors 16. The arches 10 are erected in pairs, each arch in a pair being connected to the other by means of purlins 18 (shown in cross section in Figure 1) the purlins being the same beams as are used in constructing the arch 10 with the exception that the ends of the purlins are cut at right angles while the ends of the beams 12 are cut at a pre-determined angle. This angle will, of course, depend on the curvature of the arch.

The arch is erected as follows:

The base 11 is prepared. This is normally a level site which is provided with a concrete screed and the base plates 14 are placed in position. A pair of first beams 12a are pivotally connected to their respect base plates 14 by means of bolts and nuts 20. The beams 12a are allowed to lie virtually flat on the ground. The connectors 16 are now attached to the ends of the beams 12a in a manner to be described below and the purlin 18 between the two beams 12a is connected to the connector 16. The next pair of beams 12b is now attached, each beam 12b in the pair being connected to its respective connector. To do this the free ends of the connected beams 12a are lifted clear of the ground to allow the rigid connection thereto of the next or additional beams 12b. It will be appreciated that the beams 12a need not be hoisted to their final position, it is sufficient merely to hoist them high enough for the free ends of the beams 12b to rest on the ground.

The next pair of connectors 16 is now attached to the free ends of the second connected beams 12b which are then hoisted just high enough for the connection thereto of the next pair of beams 12c. the hoisting apparatus being moved from the ends of the first beams 12a to the ends of the second beams 12b.

In this manner the whole arch 10 is erected by merely lifting the free ends of each connected beam pair to allow the attachment thereto of the next beam until the last pair

of beams 12d are fixed in place which beams are then connected to the second base plates on the other side of the structure by means of bolts and nuts 22. The arch 10 may now be rigidly connected to the first base plate by means of bolts 23.

In this manner a plurality of arches may be erected according to a predetermined plan to provide a building frame comprising pairs of connected arches. The resulting pairs of arches may be connected to one another by means of ties or cross bracing extending from flanges 30 which are arranged to project from the connectors 16.

The side elevation of Figure 1, being diagrammatic, does not show the diamond pattern of the webs which will be described below.

The connector 16 can be seen in greater detail in the plan view in Figure 2 where the H-section extrusion can be seen to comprise two pairs of legs 24 extending on either side of a cross bar 25. The extruded H-section 24 is cut to the desired length which is related to the depth of the beams 12, the ends of which fit between the legs 24 on either side of the cross bar 25. To secure the connector 16 to the beams 12, bolts and nuts 26 are located in appropriately positioned holes drilled into the box sections of the beams 12 and the legs 24 of the H. The H-section is extruded integrally with two channel formations 27, one on either side of the H. The channel formations 27 comprise two walls 28 adapted to

receive the purlins 18, which are the same or similar to as the arch beams 12. The walls 28, in fact, provide the brackets to support the purlin beams 18 and are provided with appropriately positioned holes for bolts and nuts 29 which, once again, pass through the box sections of the beams 18.

In addition to the extruded legs 24 and brackets 28, flanges 30 are provided on either side of the connectors 16 and formed with the holes 32 for the cross bracing or tie rods which, in the completed building frame, will extend between the pair of arches and, if necessary, between the arches in a pair. It will be appreciated that, in situations where the arches in a pair are connected to one another by means of purlins extending between the two and without cross bracing, and where the cross bracing extends between adjacent pairs of arches, the brackets 28 need be provided only on one side of the H while the flange 30 need be provided only on the other side of the H.

The beams 12 are produced from an aluminium extrusion which is shown in Figure 3 to comprise a profiled web 34 with a box section 36, 38 on either side thereof. The upper box section 38 is optionally provided with a double sided channel section, the purpose of which will be described below.

To arrive at the shape shown in Figures 4 and 5, the profiled web 34 is cut between the profiles at predetermined intervals which will depend on the desired final shape of the beam. The cuts between adjacent profiles are staggered

and the extrusion is then gripped by mechanical means at the box sections which are then pulled apart to expand the web into the diamond pattern shown in Figure 5. This process is well known and described in several South African patents to Jury and Spiers (Pty) Limited.

The beams 12 of the arches and the beams 18 of the purlins are both the same or similar as has been mentioned above. The ends of the beams 12 are cut at an angle which will, of course depend on the desired curvature of the arch, while the ends of the purlin beams 18 are cut at right angles to the longitudinal axes thereof.

Figure 5 also shows the connector 16 in side elevation in position on a purlin 18 where it can be seen how the flange 30 on one side of the connector 16 fits between the ties 34a formed by the expanded web of the beam.

An alternative to the base 14 is the use of the base connector 114 shown in Figure 6. This connector has dimensions similar to the end of the beam 12 so that it fits within the legs H connector 16. The base connector 114 includes a wide base 114a with tubular box section projection 114b which fits within the legs of the H as has been mentioned above. The projection 114b is jig drilled as are the other components of the system, for the location of bolts. The base may be provided with ground spikes (not shown) which may be cemented to the concrete base 100 of the building.

Figure 7 shows a light weight structure 200 embodying the principles of the invention. The structure comprises beams 202, connectors 204 and purlins 206.

A fabric cover 208 is provided and poles 210 spread the fabric on either side of the structure. Pegs or spikes 212 are provided to hold lines 214 which secure the poles and similar pegs hold the base plates 214 and the beams 202 in position.

The structure 200 can be dismantled and converted into a trailer by removing only some of the bolts in the connectors and folding or hinging the still connected beams with their free ends towards one another in zig zag fashion. The hinged beams are laid flat and the channel shaped purlins 206 are slid over the ends of the beams and the connectors and bolted into position forming a flat structure. An axle assembly (not shown) and a towbar assembly (not shown) are provided and once these are bolted in position the structure is converted to a trailable vehicle on which the fabric cover and other goods can be loaded. This structure 200 is useful as temporary garage, tent or the like.

Once the structure is erected and all the arches in the building frame are rigidly connected, the frame may be clad with conventional sheet material cladding such as roofing sheets. Alternatively sheets of flexible material or tarpaulins of canvas, plastics impregnated canvas or a synthetic textile may be used. Prior to their location on the structure, the sheets will be provided with rope

reinforced edges or similarly enlarged edges along two sides thereof which are then drawn into the channels 42 and 44 provided along the upper box sections 38 of the beams 12 of two adjacent arches 10. The sheets will, of course, be drawn into the facing channels of two adjacent arches to span the space between the adjacent arches 10. With properly designed leaders, the sheets may be pulled, by means of ropes located in the channels 42 and 44, from one side of the frame completely over the frame to the other side. If an appropriately sized rope reinforcing edge is used, the joints between the beams 12 and the sheet material should be water proof.

It will be appreciated that the constructional elements and connectors of the invention can be mass produced and bolted together without scaffolding or the like. In addition, due to the simplicity of the elements involved, the structures can be erected largely with unskilled labour. The structural method and means provided is particularly suitable for temporary buildings as the building and building frames can be dismantled and re-erected rapidly some other place.

CLAIMS

1.

A method of erecting a structure comprising the steps of attaching a first base plate to a base for the structure, pivotally connecting a first constructional element to the first base plate, rigidly connecting one or more additional constructional elements to the free end of the first constructional element by first hoisting the free end of each connected constructional element to a height sufficient to allow the rigid connection, of the additional constructional element, to the free end and connecting the free end of the last constructional element to a second base plate which is attached to the base.

2.

A method according to claim 1 which includes the additional step of cutting the ends of the constructional element at a predetermined angle and erecting a plurality of structures in a predetermined arrangement to form a structural whole or building frame and cladding the frame.

3.

A method according to claim 1 or claim 2 characterised

in that two adjacent first constructional elements are pivotally connected to their respective first base plates, the two first constructional elements are rigidly connected to one another by means of a purlin, one or more additional constructional elements are rigidly connected to the free ends of the first constructional elements by first hoisting the free ends of the connected constructional elements to a height sufficient to allow the rigid connection of an additional purlin and constructional elements to the free ends and connecting the free ends of the last constructional elements to a pair of second base plates attached to the base.

4.

A method according to any one of claims 1 to 3 which includes the intermediate steps of locating a connector element or elements to the free end or ends of the constructional element or elements and connecting the additional constructional element or elements to the connector.

5.

A constructional element comprising an expanded extruded beam which includes a box section on either end of a

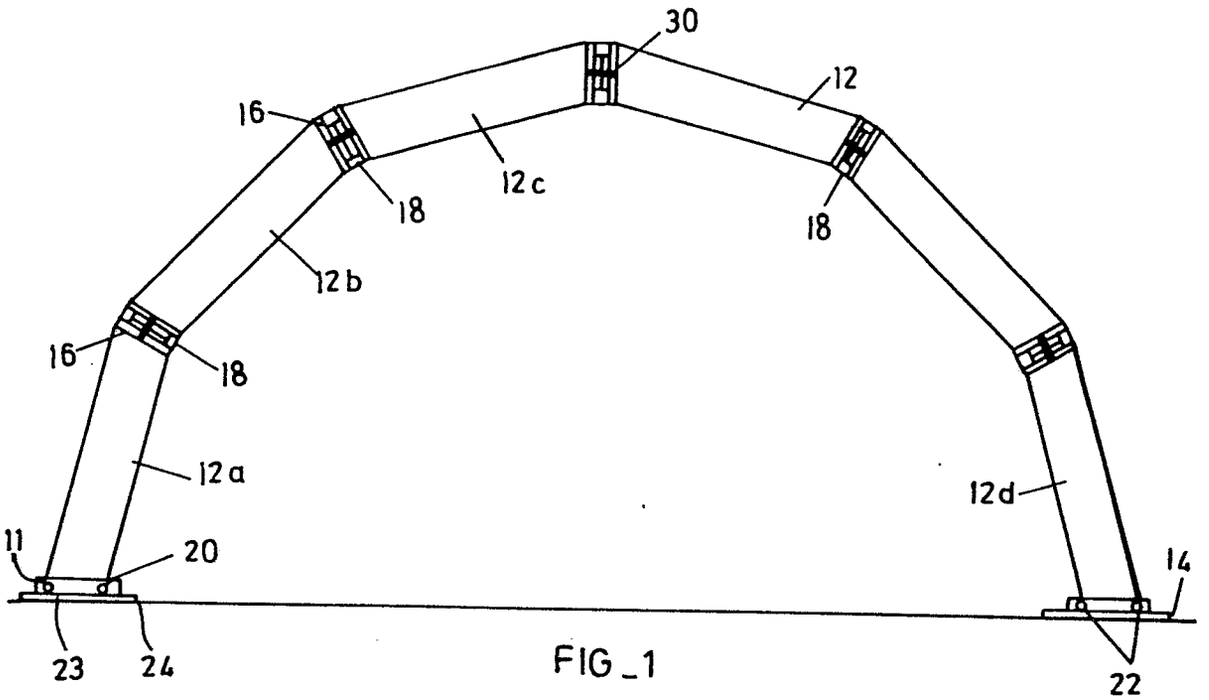
profiled web, the web being cut between the profiles at predetermined intervals and expanded, and the element including channels which are adapted to receive an end of a flexible member.

6.

A connector comprising an extrusion of H-section, the bar of the H being adapted to abut the ends of the constructional elements in use and the legs of the H being adapted to receive the ends of the constructional elements in use, characterised in the provision of a bracket comprising a channel with opposed walls which is adapted to receive the ends of similar constructional elements therebetween.

7.

A building system including a connector for pivotal connection of a constructional element to a base, a plurality of purlins attached to the constructional element and connecting means associated with the base for an axle and towbar for trailable connection of the building system to a vehicle.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12c
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12b
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12d
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FIG_1

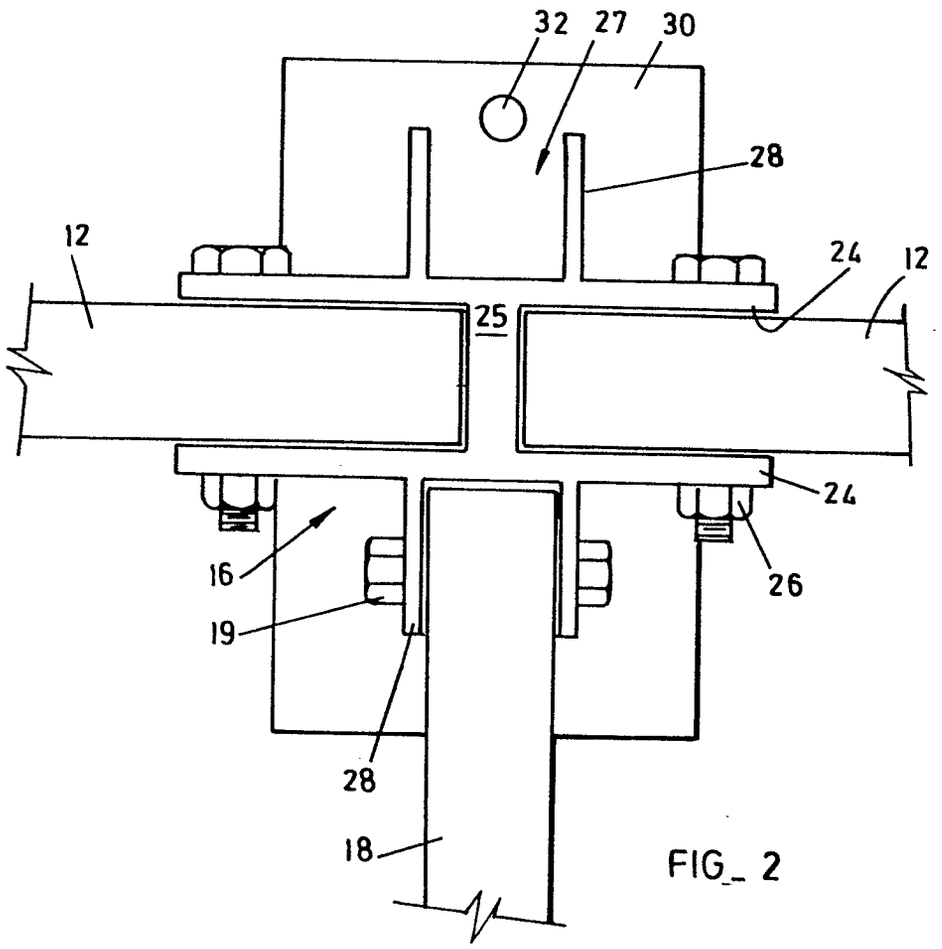
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FIG_ 2

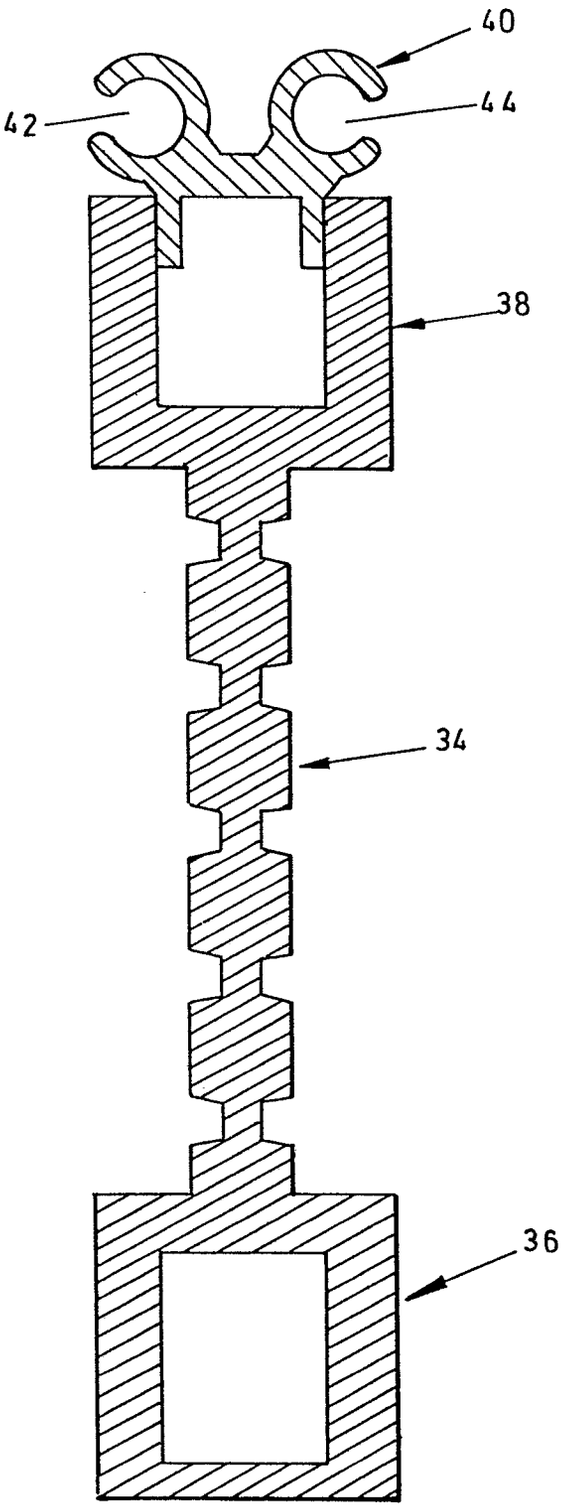

FIG_3

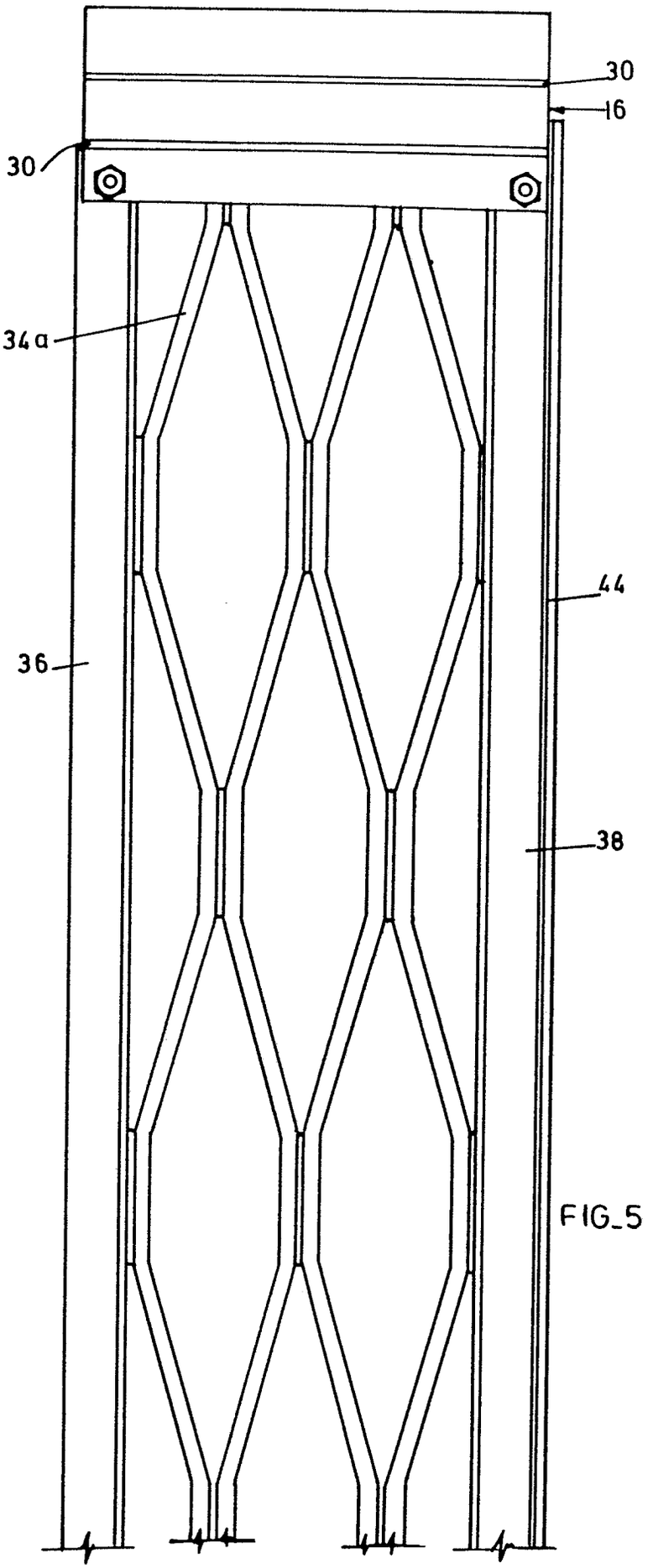

FIG_5

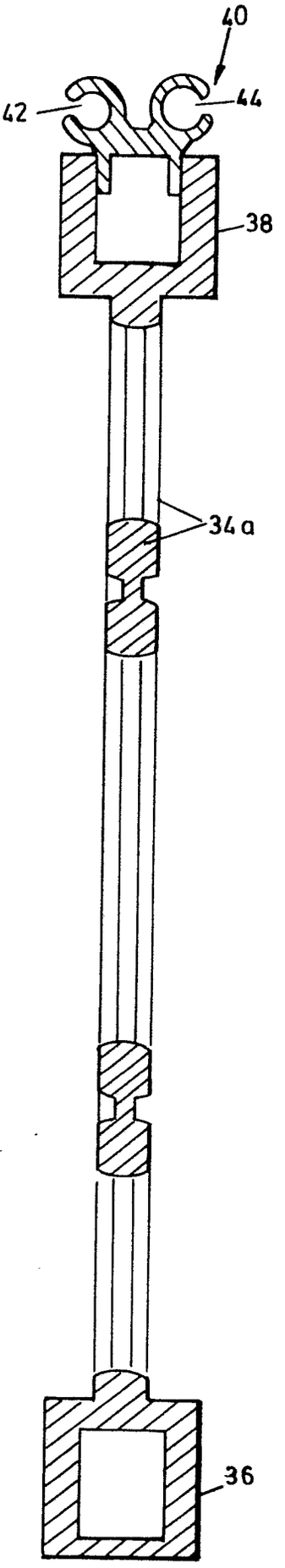

FIG_4

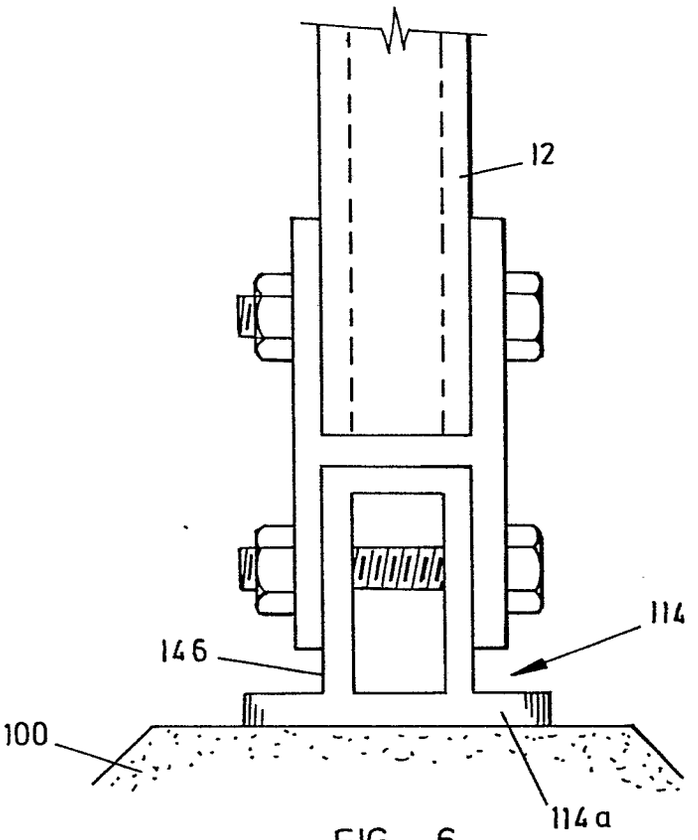
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FIG_6

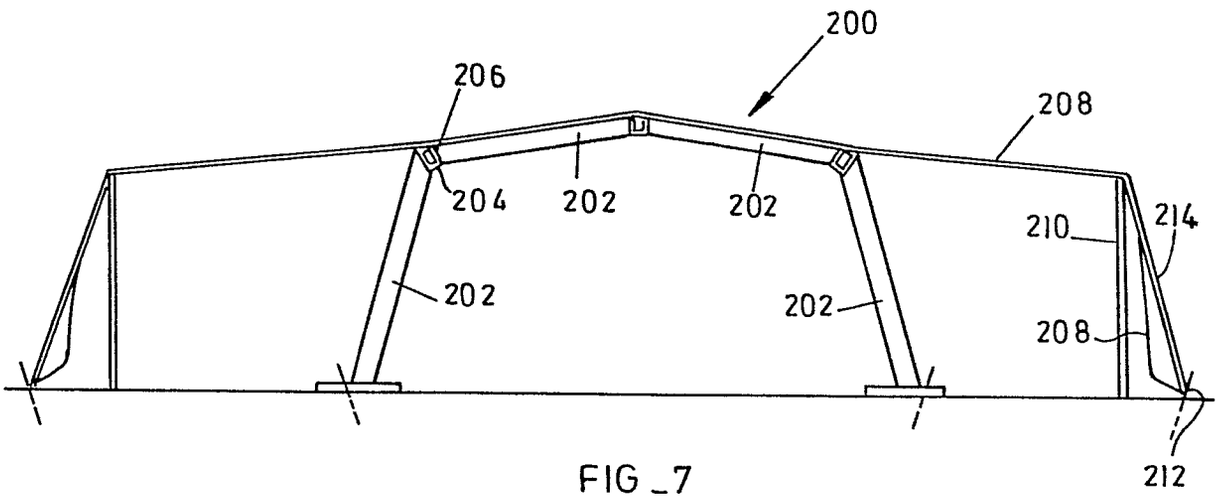
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FIG_7