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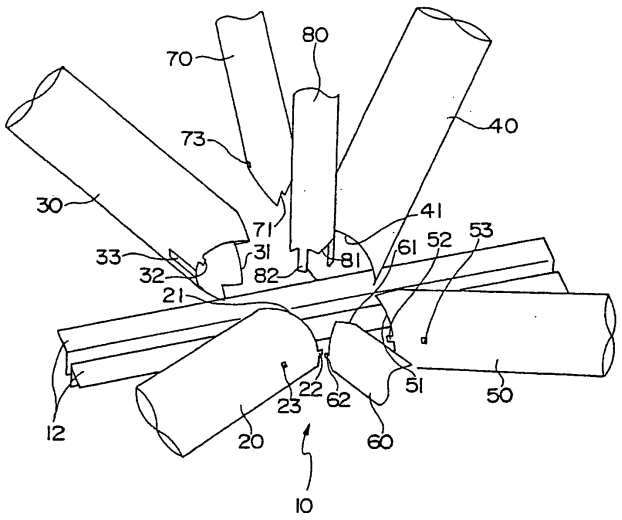
(54) Assembling method and assembly jig of building structure composed of pipe structure

(57) The invention provides a method and an assembly jig for fixing a pipe structure unit manufactured by assembling tenons and mortises formed on end portions of pipes to a building structure. The pipe structure unit 10 comprises large-diameter pipes 20, 30, 40 and 50 and small-diameter pipes 60, 70 and 80 which are assembled on an assembly jig 100 by assembling tenons and mortises formed in advance on the ends of the pipes via laser machining. The pipes are provided with mounting portions disposed on the other ends thereof, which are used to temporarily tighten the pipes to flanges of pillars 200 and 210. A jack 130 of the assembly jig 100 is lifted to compress the gaps formed at the tenons and temporarily tightened portions, and the pipes are fully tightened in this state. If necessary, the joint portions of the pipes are welded via spot welding and the like to complete the building structure.

Fig.2



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Description

BACKGROUND OF THE INVENTION

Field of the invention

[0001] The present invention relates to an assembling method and an assembly jig of a building structure composed of a pipe structure unit formed by joining a plurality of pipes.

Description of the related art

[0002] For example, it is desirable that building structures such as large-scale halls, factories, exhibition halls and the like have a structure in which the ceiling is supported by a large span, so that a space having no pillars is formed in the interior thereof.

[0003] One method is adopted to create such large-scale building structure in which metal pipes are assembled in a trussed structure.

[0004] In order to gather the ends of plural pipes in one location to join the same, a method is adopted to manufacture in advance a joint member corresponding to the shape of pipes to be joined, and to fix the ends of the pipes via welding to the joint member.

[0005] The present applicant has disclosed in Japanese patent application No. 2005-301233 a joint structure for joining a plurality of pipes by subjecting the pipes to high-precision processing via a laser beam machine to create tenons, mortises and tenon grooves to the pipes, and joining the plurality of pipes by assembling the tenons, mortises and tenon grooves on the pipes directly.

SUMMARY OF THE INVENTION

[0006] The object of the present invention is to provide an assembling method and an assembly jig of a building structure utilizing the above-mentioned joint structure of pipes.

[0007] In order to achieve the above objects, the present invention provides an assembling method comprising the steps of preparing a plurality of pipes having an end face and a necessary tenon, mortise or tenon groove for joining formed on one end thereof, and a mounting unit disposed on the other end thereof for mounting to a corresponding member; temporarily tightening the mounting unit of each pipe to the corresponding member; joining the joining end faces of the pipes on an assembly jig to form a joint portion; compressing a gap formed between the joint portion and the mounting units by lifting the assembly jig; fully tightening the mounting unit of each pipe; and fixing the joint portion via welding.

[0008] The present invention also provides an assembly jig comprising a base, a table provided on the base and capable of being lifted and lowered via a jack, and a jig unit mounted on the table, wherein the jig unit is composed of orthogonally arranged panel members, a profile of the upper surface of the panel members formed to have a shape enabling to support from underneath a joint portion of the pipe structure unit being assembled.

[0009] According to the present invention, the pipes can be connected directly to form a trussed structure, so that large-scale building structures can be built inexpensively and in a short time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

FIG. 1 is an explanatory view showing a portion of a building structure to which the present invention is applied;
FIG. 2 is an explanatory view showing a joint portion of a pipe structure unit used in the present invention;
FIG. 3 is an explanatory view showing the state in which the pipe structure unit is joined according to the present invention;
FIG. 4 is an explanatory view of an assembly jig;
FIG. 5 is an explanatory view showing the step of assembling the pipe structure unit on the assembly jig; and
FIG. 6 is an explanatory view showing the state in which the completed pipe structure unit is viewed from below.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0011] FIG. 1 is an explanatory view showing a portion of the building structure to which the present invention is applied.

[0012] The structure denoted as a whole by reference symbol B constitutes a large-scale exhibition hall or other types of halls, for example, which enables to create therein a large space without pillars.

[0013] FIG. 1 shows a view in which a roof portion of the structure B is viewed from the floor in the direction of arrow L, having a main pillar 1, sub pillars 2 branched from the upper portion of the main pillar 1, girders 3 disposed above the sub pillars 2, and beams 4 connecting the girders 3 disposed at both sides of the structure B, wherein the respective structures are composed for example of metal pipes. An assembly 5 mainly composed of pipes having a trussed structure is fixed between the girders and the beams, constituting a ceiling and reinforcing the roof of the building structure.

[0014] FIG. 2 is an explanatory view showing a joint portion of a pipe structure unit 10 used in the present invention.

[0015] According to the illustrated pipe structure unit 10, the joint portion is formed by having the ends of seven pipes connected to a channel member 12.

[0016] The seven pipes are composed of four large-diameter pipes 20, 30, 40 and 50, and three small-diameter pipes 60, 70 and 80.

[0017] The joining end face of each pipe is processed via a laser beam machine to have an end face shape capable of realizing a surface contact with the joining plane of the joint. Then, simultaneously when performing the end face processing, a tenon, a mortise and a tenon groove for joining pipes are processed.

[0018] The processing data for these processes are computed based on the three-dimensional CAD and CAM data of the joint portion.

[0019] An end face 21 and a tenon 22 are processed on the first large-diameter pipe 20. Further, a mortise 23 for receiving a tenon 62 of the first small-diameter pipe 60 described later is processed. Similarly, an end face 31, a tenon 32, a tenon groove 33 to which the channel member 12 is inserted and the like are processed on the second large-diameter pipe 30.

[0020] An end face 41, a tenon and a mortise not shown are processed on the third large-diameter pipe 40. An end face 51, a tenon 52, a mortise 53 and the like are processed on the fourth large-diameter pipe 50.

[0021] An end face 61 and a tenon 62 are processed on the first small-diameter pipe 60. An end face 71 and a mortise 73 are processed on the second small-diameter pipe 70. An end face 81 and a tenon 82 are processed on the third small-diameter pipe 80.

[0022] FIG. 3 illustrates a state in which a pipe structure unit 10 is joined according to the present invention.

[0023] FIGS. 4 and 5 are explanatory views showing an assembly jig 100 used for assembling the above-mentioned pipe structure unit 10, and the step of assembling the assembled pipe structure unit 10 to pillars 200 and 210 of the building structure.

[0024] The assembly jig 100 comprises a base 110 and a table 120 capable of being lifted and lowered via a jack 130 having a pantograph mechanism. A jig unit 150 placed in an exchangeable manner on the table 120 is composed of multiple plate members 151 and 152 arranged orthogonally.

[0025] These plate members are subjected to high-precision processing via the laser beam machine, and a profile P_1 defined on the upper surface constitutes a shape for supporting the pipe structure unit 10 from underneath. The processing data of this profile are computed based on the three-dimensional CAD and CAM data of the joint portion.

[0026] FIG. 5 illustrates the step of assembling the pipe structure unit 10 on the assembly jig 100.

[0027] The eight pipes constituting each pipe structure unit 10 have their respective upper end faces fixed to pillars, girders and beams.

[0028] FIG. 5 illustrates a state in which the upper ends of the third large-diameter pipe 40 and the fourth large-diameter pipe 50 are fixed to the two pillars 200 and 210, respectively.

[0029] For this fixture, a plate-like mounting unit 45 is disposed on the upper end of the pipe 40, and a similar mounting unit 55 is disposed on the pipe 50.

[0030] Mounting plate members 205 and 215 are also welded in advance to the pillars 200 and 210. The plate member 205 has bolt holes 206 for mounting, and similar bolt holes are provided on the plate member 215.

[0031] Now, the steps for assembling the fourth large-diameter pipe 50 will be described. At first, the bolt holes 56 on the mounting unit 55 disposed on the upper end of the large-diameter pipe 50 are positioned to correspond to the bolt holes 206 on the plate member 205 of the pillar 200, and they are temporarily tightened via bolts and nuts.

[0032] Then, the upper ends of the remaining pipes are temporarily attached to the mounting units of the corresponding members.

[0033] In this state, the lower ends of the pipes and the channel member are assembled on the assembly jig 100 using the tenons, mortises and tenon grooves formed in advance via laser machining, by which the joint portion is formed.

[0034] At this time, the height of the table 120 of the assembly jig 100 is adjusted to facilitate assembly of the joint portion.

[0035] Naturally, gaps required for joining or gaps corresponding to tolerances exist between the tenons, mortises and tenon grooves constituting the joint portion of the assembled pipe structure unit 10.

[0036] Furthermore, since the upper portions of the pipe structure unit 10 are temporarily tightened to the corresponding members, gaps also exist at the temporarily tightened portions.

[0037] Thus, in the above-mentioned state, the jack 130 is operated to lift the table 120 in the direction of arrow Z. By this operation, the gaps formed at the joints of the pipe structure unit 10 and the gaps formed at the temporarily tightened portions on the upper ends of the pipes are compressed.

[0038] In this state, the bolts and nuts of the temporarily tightened portions of the pipes are fully tightened. Next, the joint portions of the pipe structure unit 10 are fixed via spot welding and the like.

[0039] After this process is completed, even if the jack 130 is operated to lower the table 120 and the jig unit 150, the pipe structure unit 10 will be fixed securely to the pillars 200, 210 and other structures, so that the rigidity of the roof of the building structure is ensured.

[0040] By repeating the above-mentioned processes, a building structure defining a large space without pillars in the interior thereof can be built easily.

[0041] FIG. 6 shows a state in which the completed pipe structure unit 10 is viewed from below.

[0042] The ends of the pipes are fixed securely via bolts and nuts to the structure such as pillars, girders and beams. Further, the joint portion of the pipe structure unit 10 is also securely formed via spot welding W_1 and the like.

[0043] The channel member 12 can be used for example as a member for supporting the ceiling member, or for attaching lighting equipments.

Claims

1. An assembling method of a building structure composed of a pipe structure unit having a trussed structure, comprising the steps of:

   preparing a plurality of pipes having an end face and a necessary tenon, mortise or tenon groove for joining formed on one end thereof, and a mounting unit disposed on the other end thereof for mounting to a corresponding member;
   temporarily tightening the mounting unit of each pipe to the corresponding member;
   joining the joining end faces of the pipes on an assembly jig to form a joint portion;
   compressing a gap formed between the joint portion and the mounting units by lifting the assembly jig;
   fully tightening the mounting unit of each pipe; and
   fixing the joint portion via welding.

2. An assembling method of a building structure according to claim 1, wherein

   the end faces and necessary tenons, mortises or tenon grooves formed to the joint portion of the pipes constituting the pipe structure unit are formed via high-precision laser processing based on processing data computed based on a three-dimensional CAD and CAM information of the joint portion.

3. An assembly jig of a pipe structure unit comprising a base, a table provided on the base and capable of being lifted and lowered via a jack, and a jig unit mounted on the table, wherein

   the jig unit is composed of orthogonally arranged panel members, a profile of the upper surface of the panel members formed to have a shape enabling to support from underneath a joint portion of the pipe structure unit being assembled.

4. The assembly jig of a pipe structure unit according to claim 3, wherein the profile of the jig unit is formed via high-precision laser processing based on processing data computed based on a three-dimensional CAD and CAM information of the joint portion of the pipe structure unit.

Fig.1

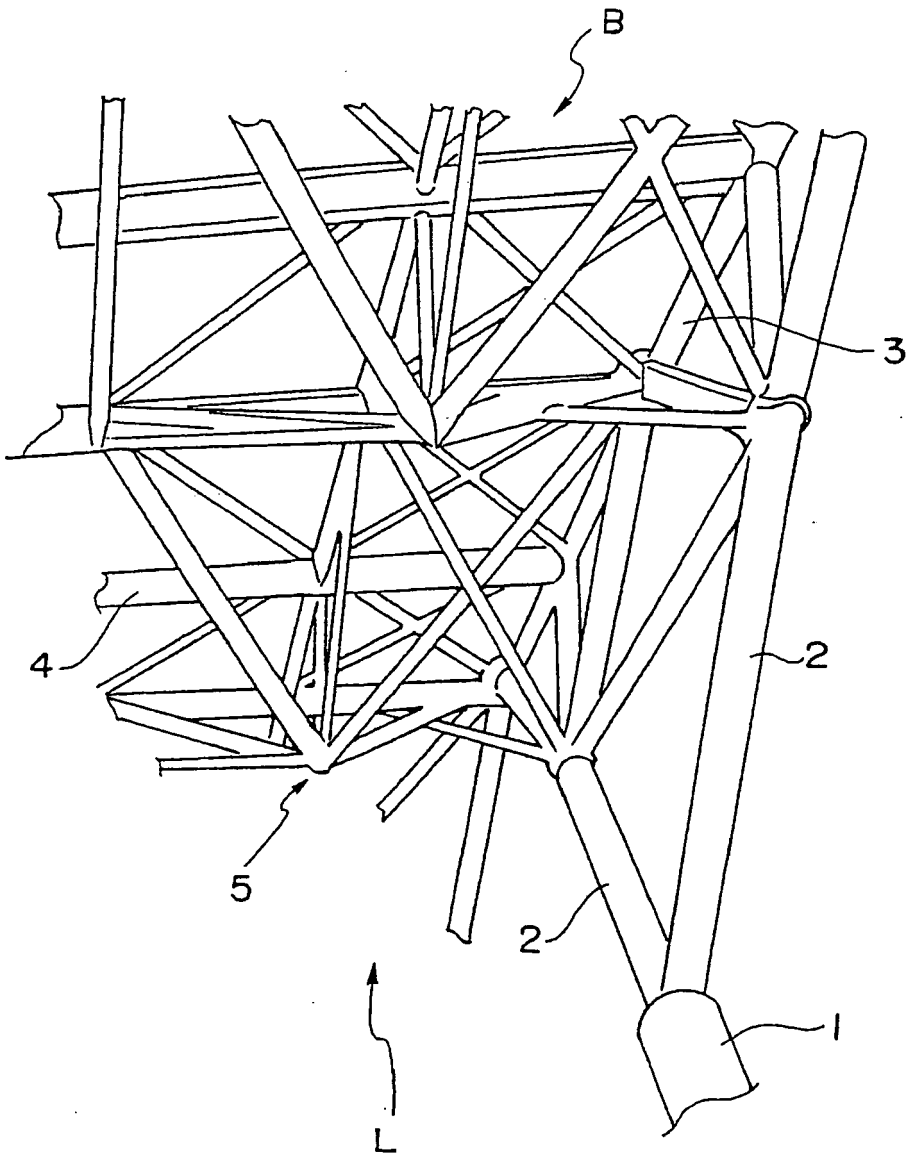

Fig.2

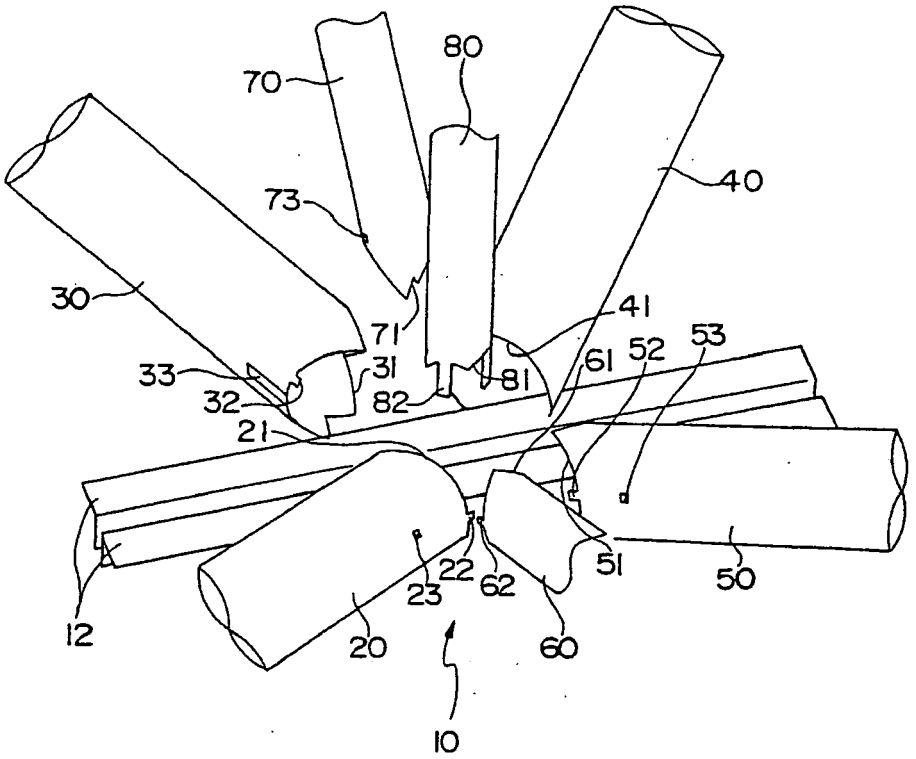
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Fig.3

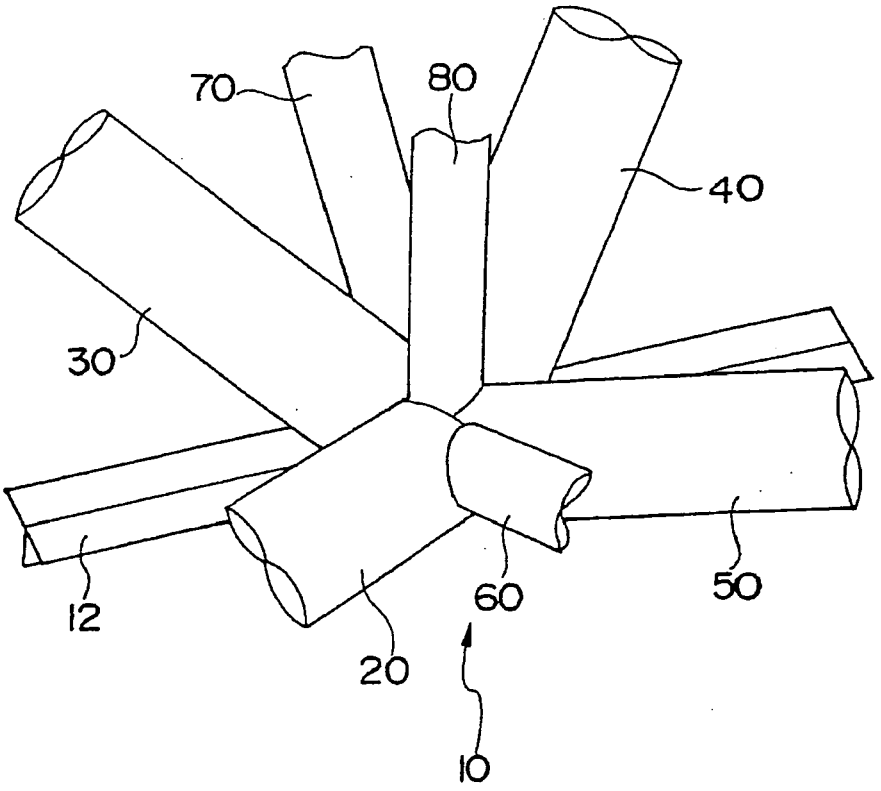

Fig.4

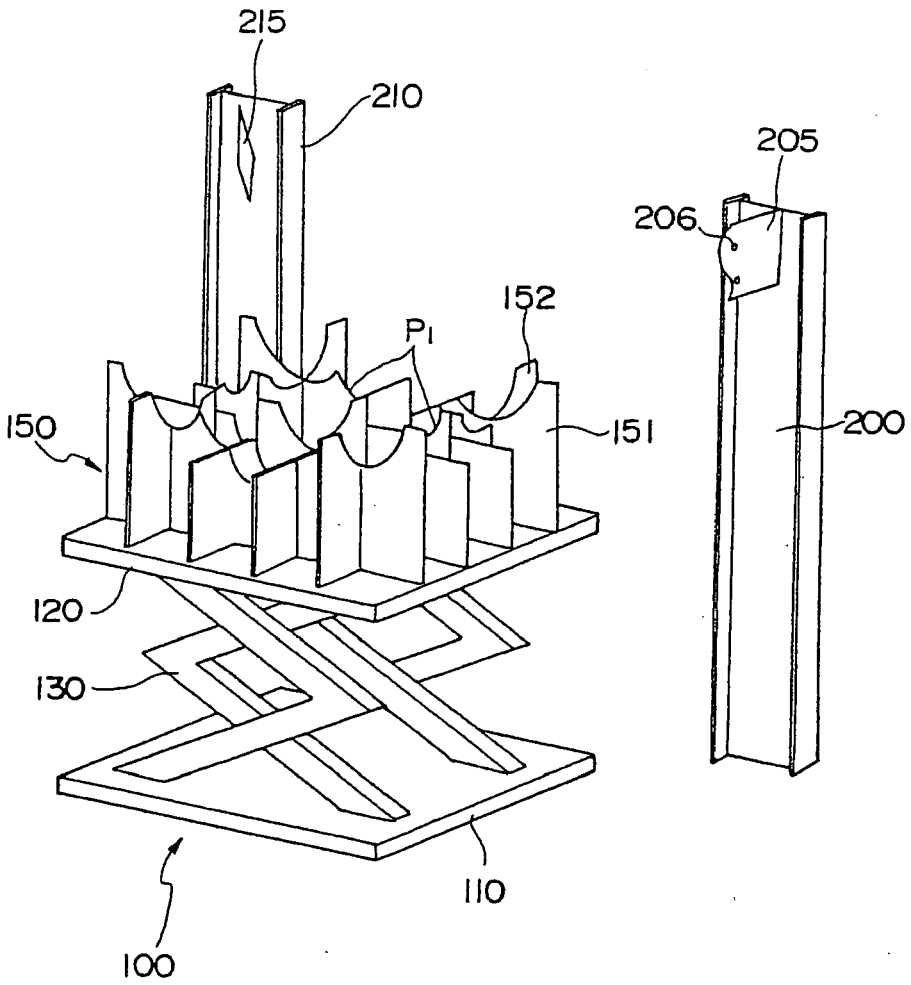

Fig.5

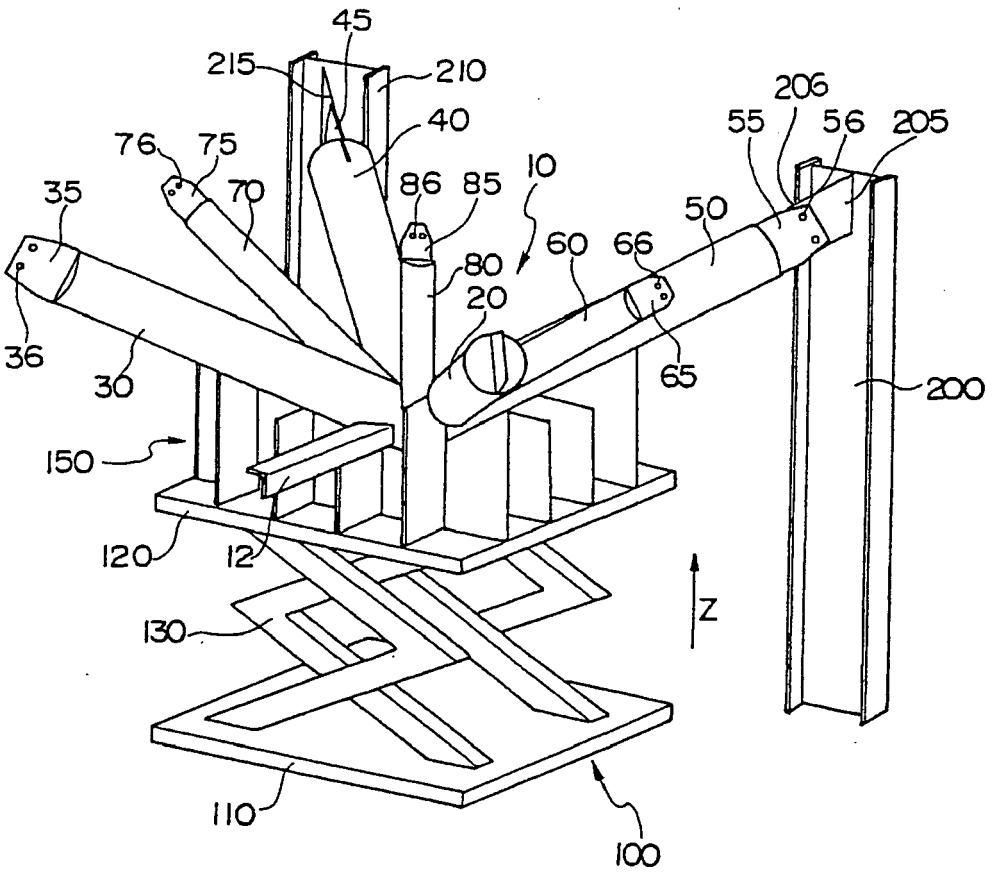
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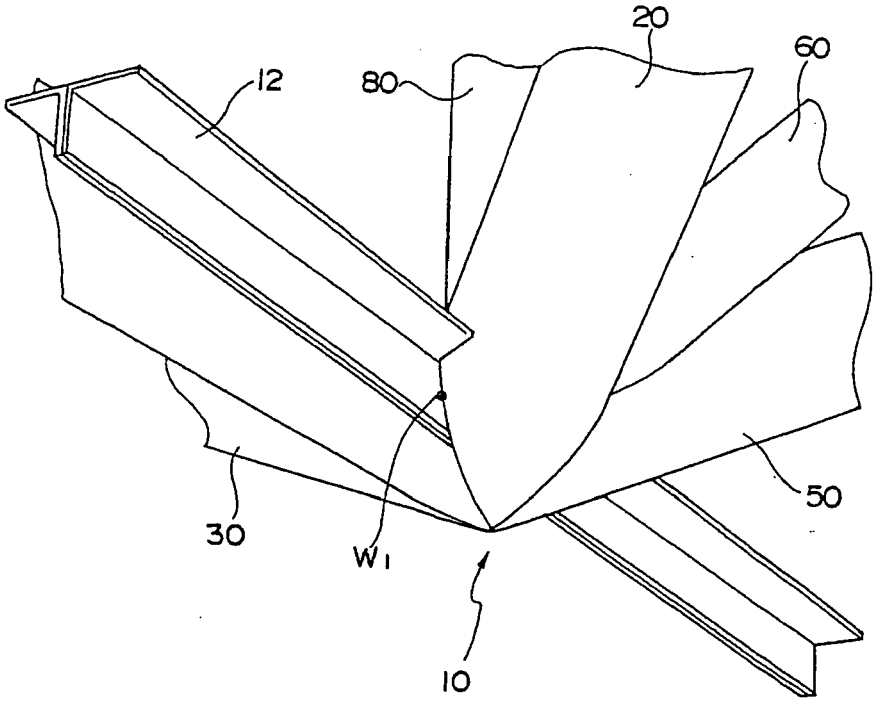
Fig.6



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005301233 A **[0005]**