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(54) STRUCTURAL TIMBER FLOOR ASSEMBLY

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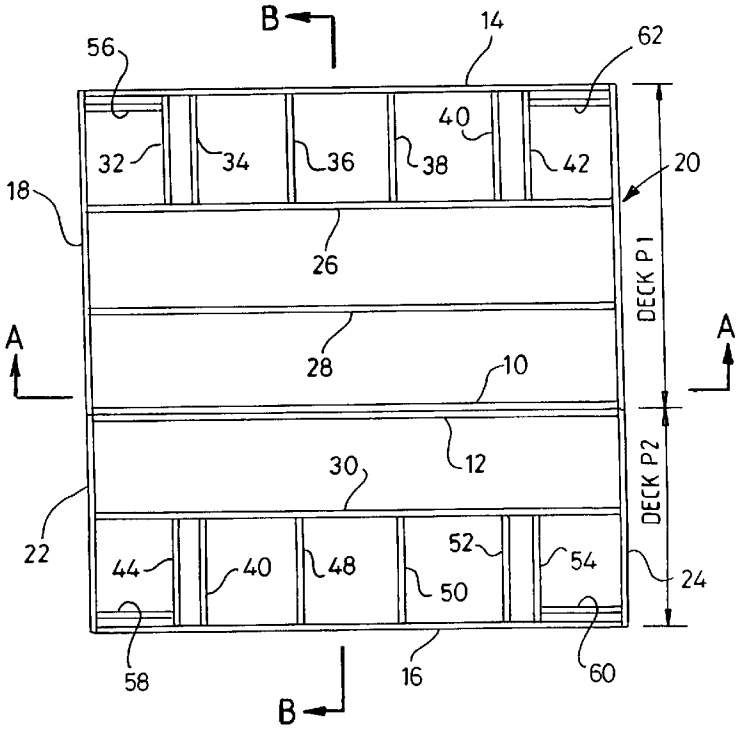
(57) **ABSTRACT**

A method is described of forming a joint between the end of a timber I-beam joist and a transverse closure such as a rim-joist, in which two holes are formed a short distance from the end of the I-beam to be butt-jointed to the rim-joist, one in each of the upper and lower rails of the I-beam section, the two holes being coaxial and generally aligned with and parallel to the web of the I-beam section. The closure is positioned relative to the I-beam and two further holes are formed through the closure and into the ends of the upper and lower I-beam rails, generally perpendicular to and intersecting the first two holes. Two cross-dowels are inserted into the two first holes, each having a transverse threaded opening, and the dowels are inserted so as to align the openings with the holes which intersect the holes containing the cross-dowels, and threaded bolts are introduced into the intersecting holes and screwed into the threaded openings in the cross-dowels so as to draw the joist towards the closure, and thereby clamp the joist thereto. The cross-dowels may be formed from metal, or from a rigid plastics material or from a composite material and may have a smooth exterior or may be externally threaded or formed with one or more annular barbs for securing them in place. The technique may be applied on site, but more preferably in the course of constructing a roofing or flooring panel off-site, the joints serving to resist distortion or bending during handling of prefabricated panels, during storage, transportation, and/or final positioning on site.



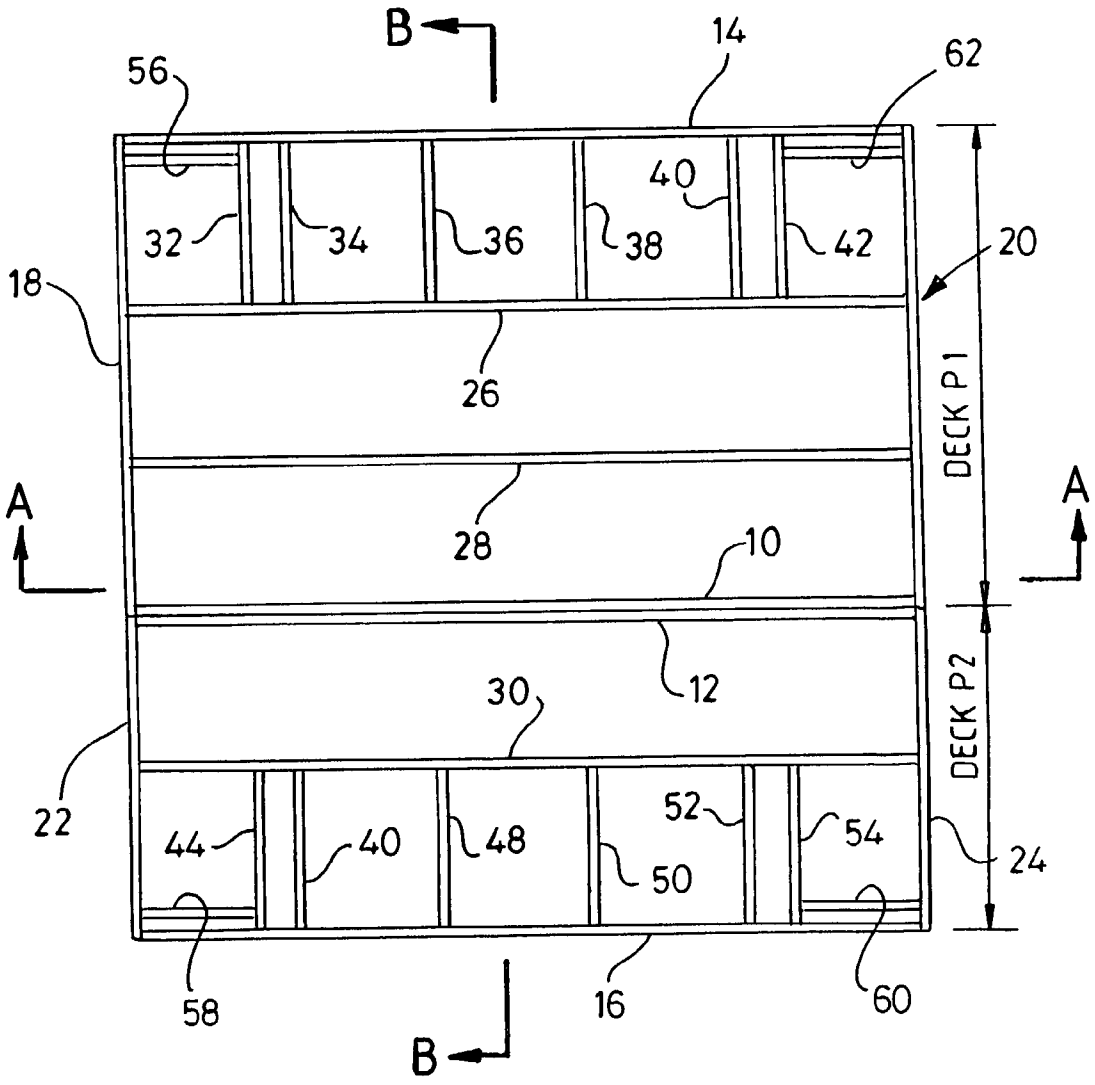

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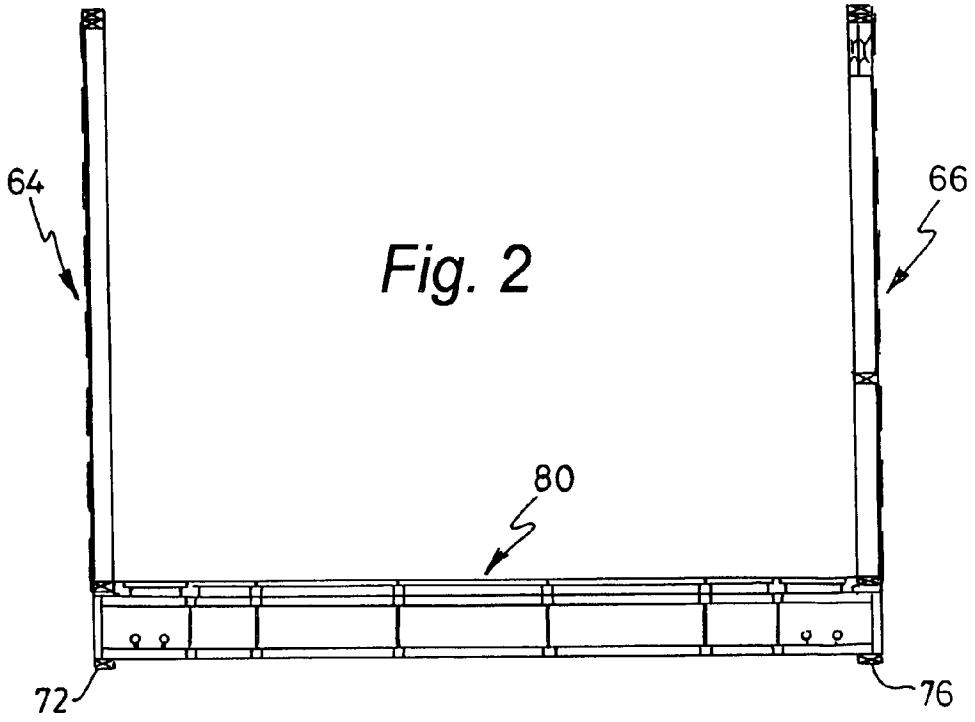
Fig. 1



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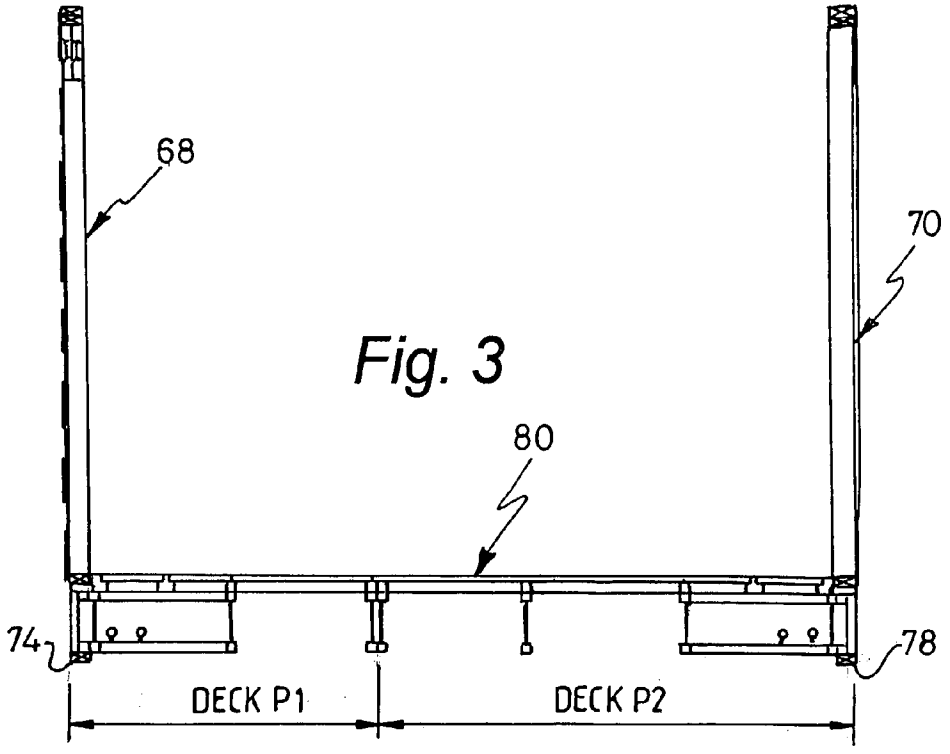

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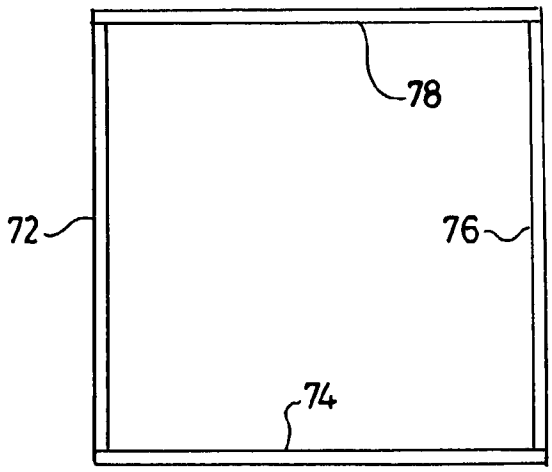

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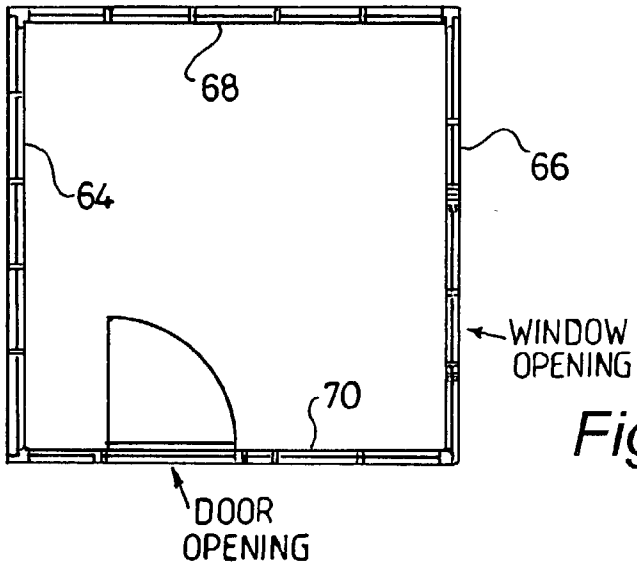

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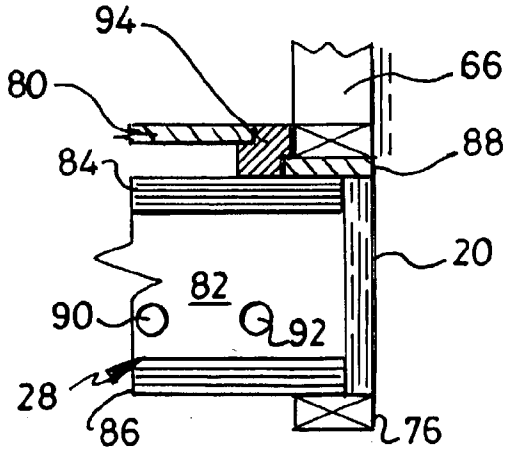

Fig. 6

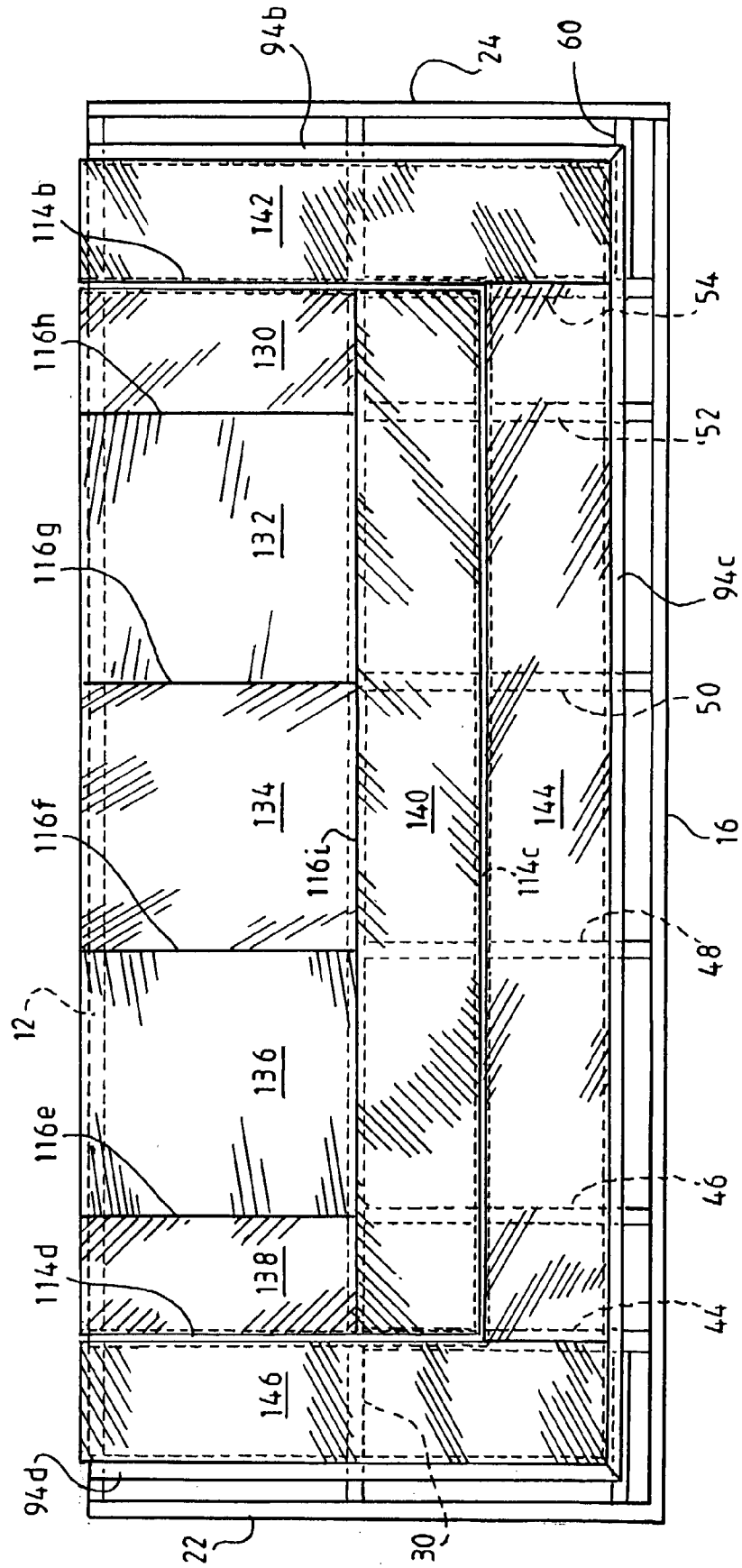
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Fig. 7

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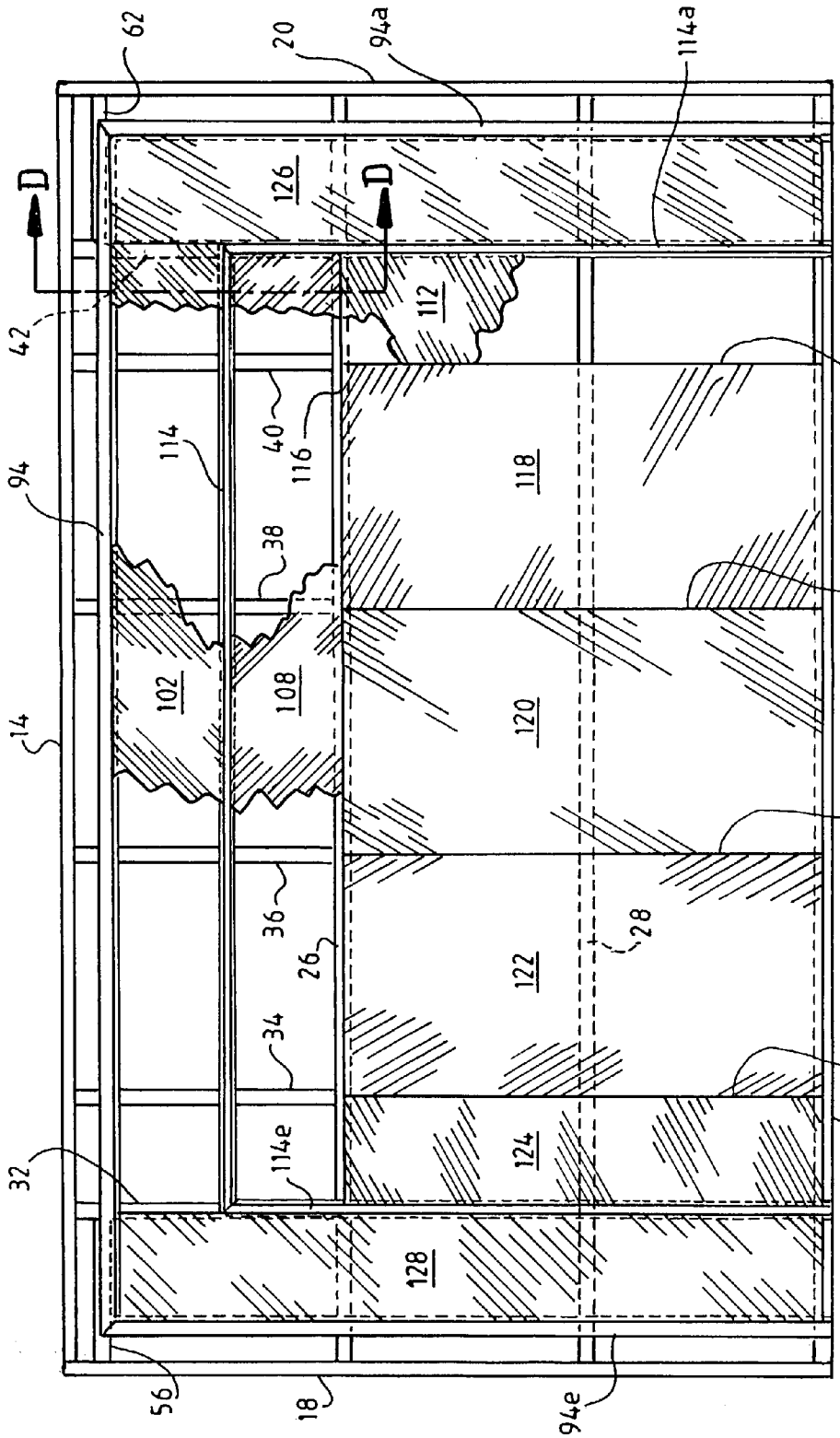
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Fig. 8

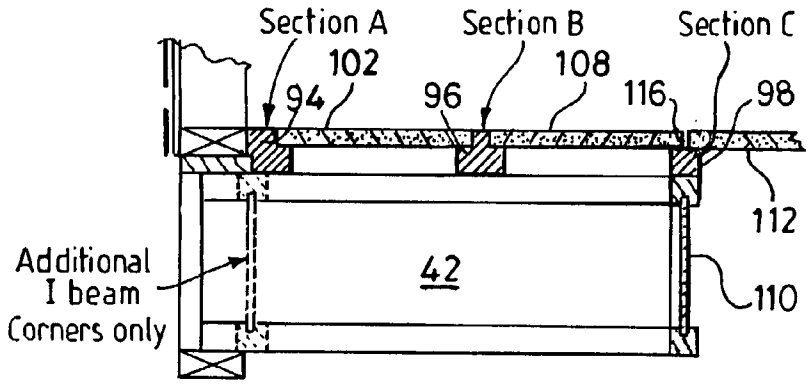

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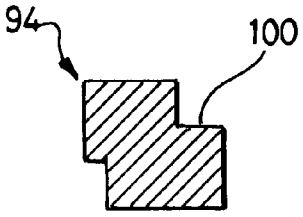
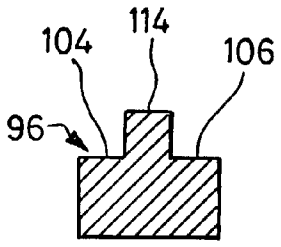
Fig. 9



Section A

Fig. 10

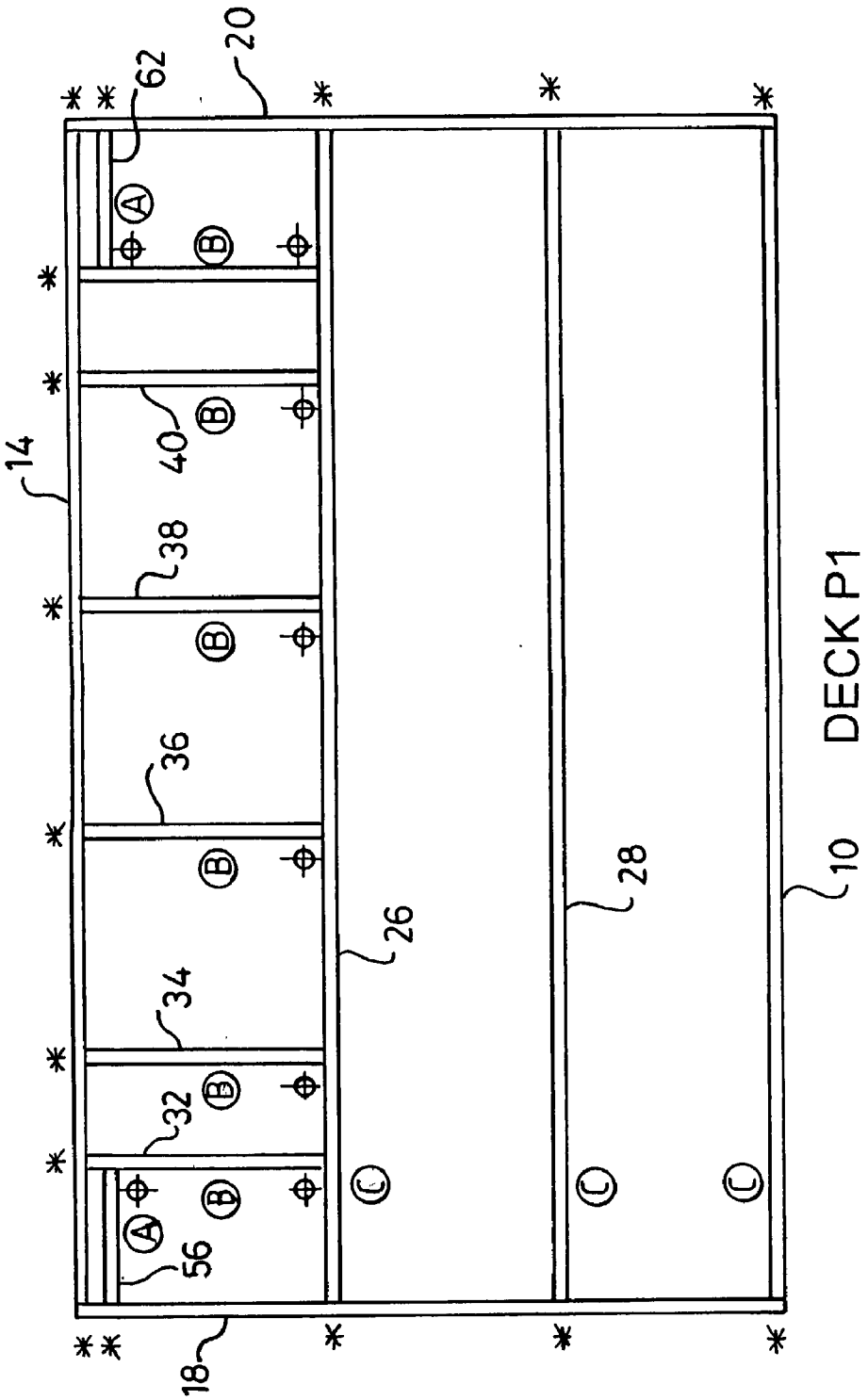


Section B

Fig. 11

Section C

Fig. 12



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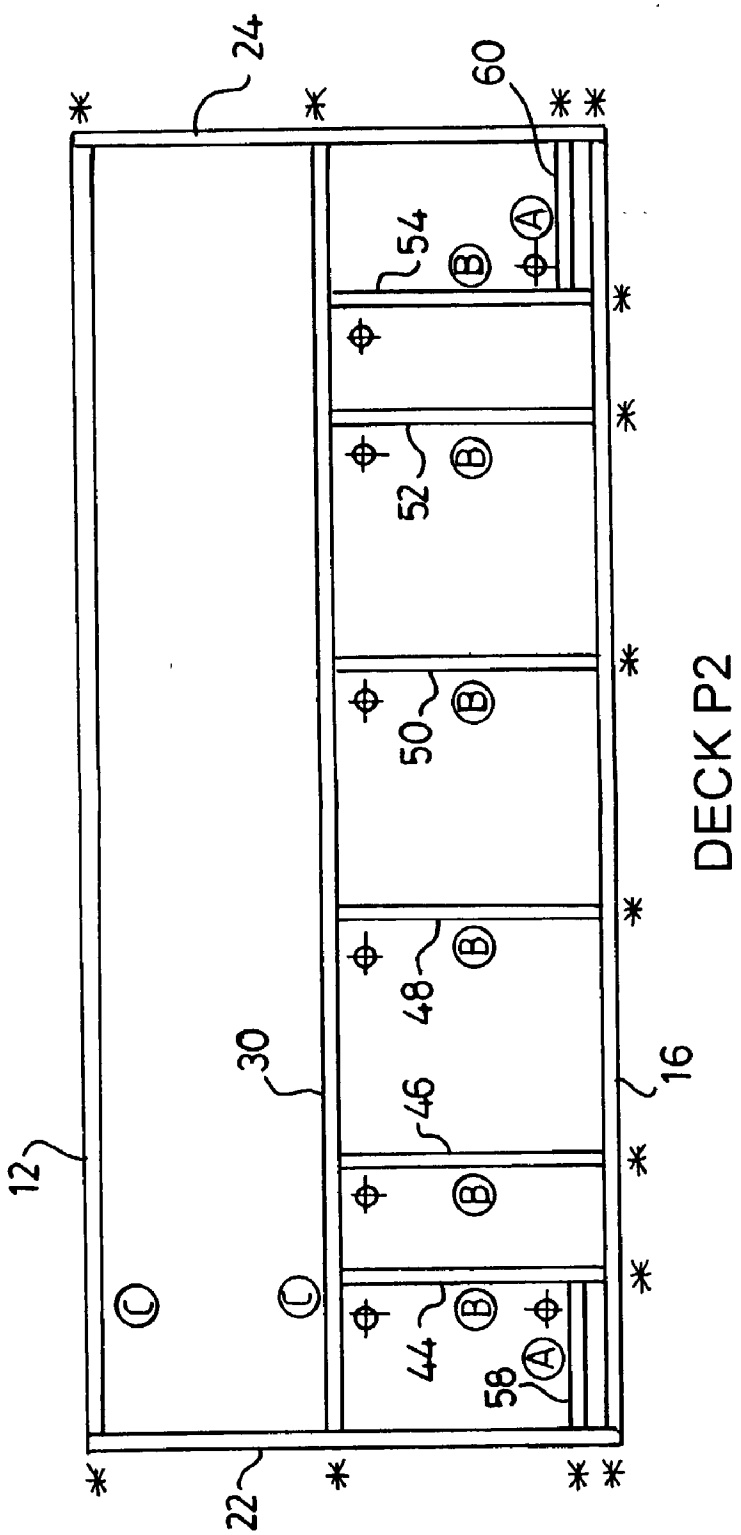
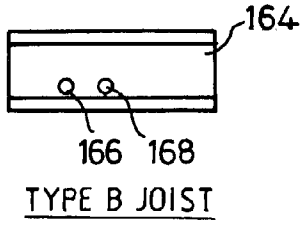


Fig. 14



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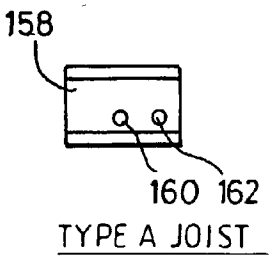
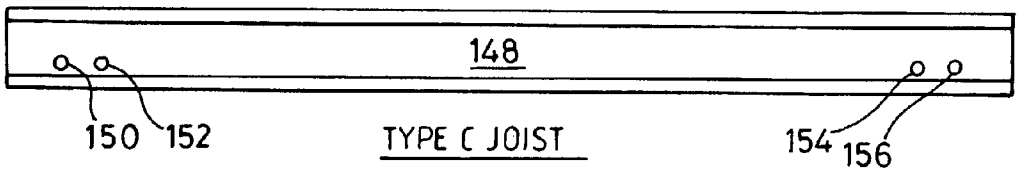


Fig. 16



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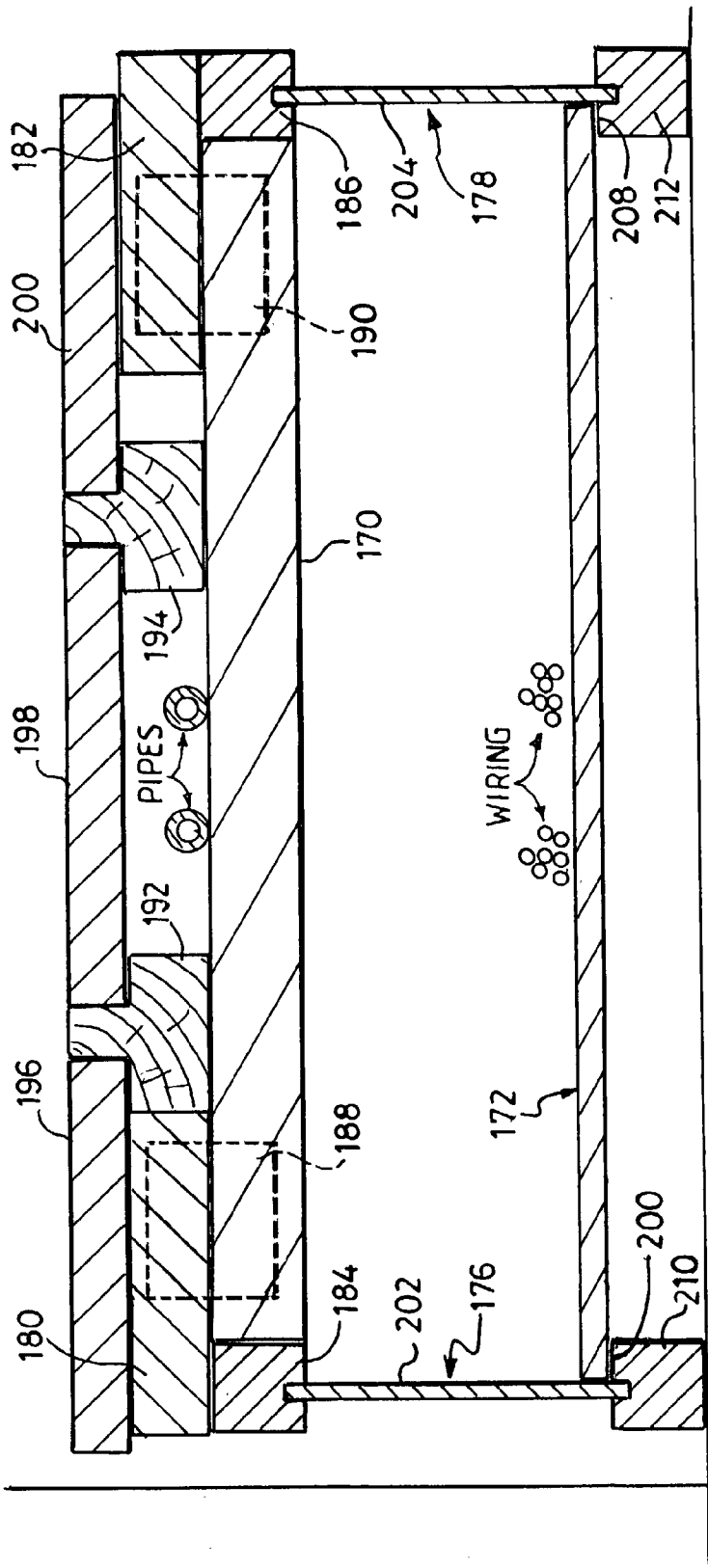
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Fig. 18

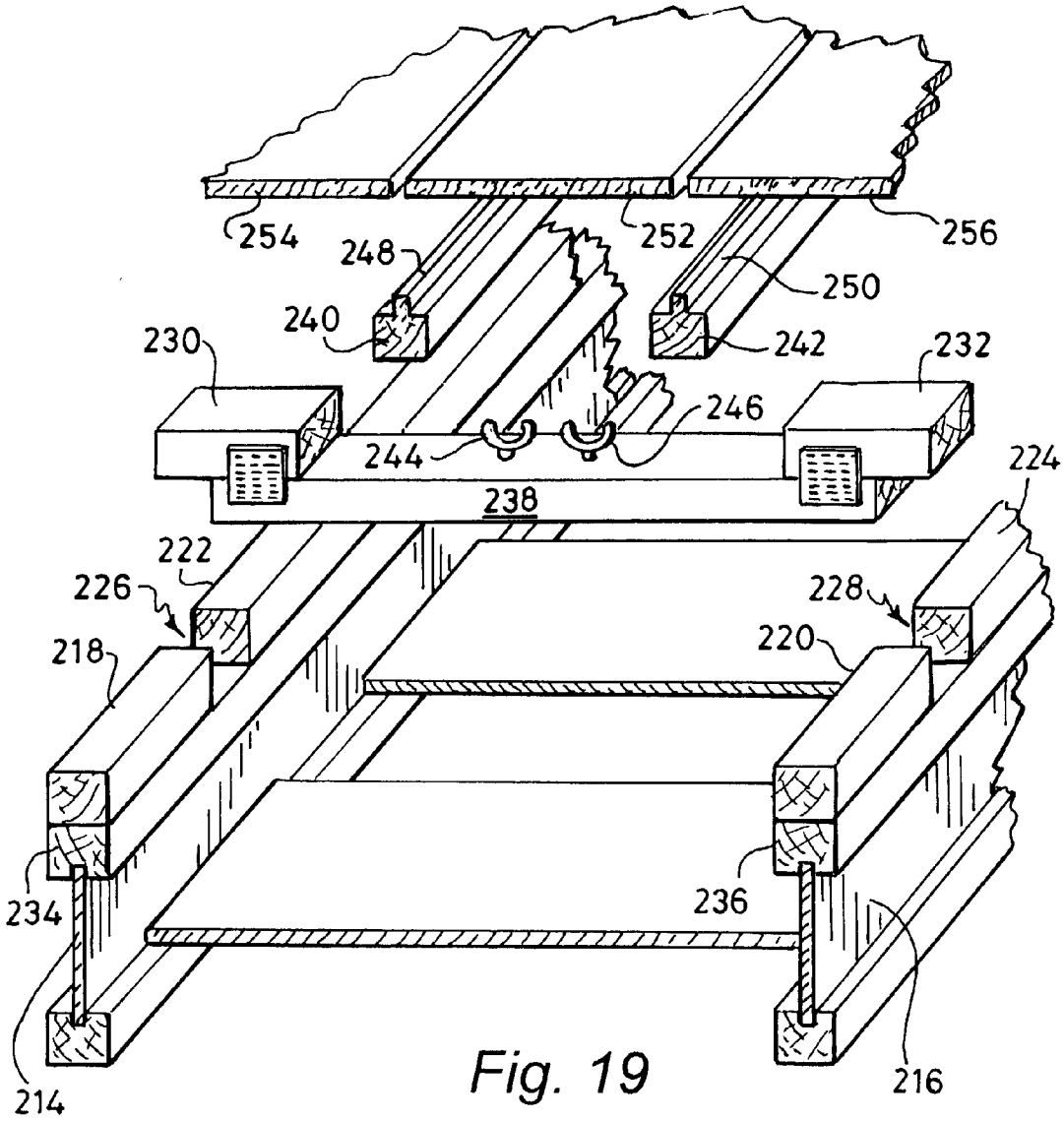
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Fig. 19

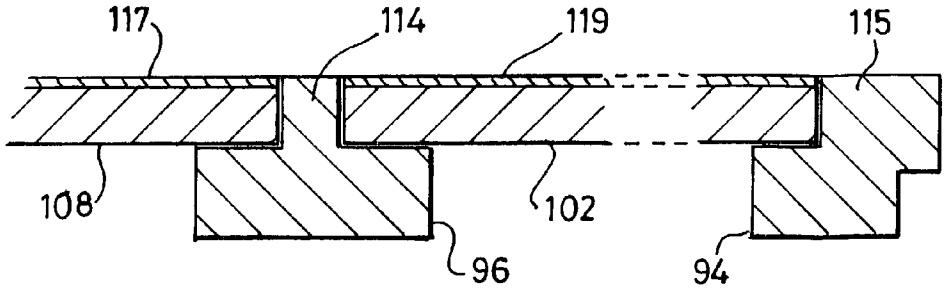
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Fig. 20

STRUCTURAL TIMBER FLOOR ASSEMBLY

FIELD OF INVENTION

[0001] This invention concerns structural assemblies of timber which serve as prefabricated roofs or floors (often referred to as decks) for buildings, particularly but not exclusively, timber framed buildings.

BACKGROUND TO THE INVENTION

[0002] Prefabricated timber buildings are generally delivered to site in the form of prefabricated wall panels and roof trusses. The ground floor wall panels, when erected, provide load-bearing supports for first-floor flooring, the peripheral regions of which will in general provide a bearing for the first floor load bearing wall panels.

[0003] Timber I-beams are now used in the construction industry as an alternative to solid timber beams, and comprise a thin vertical web, typically made from oriental strand board, and top and bottom chord members (rails or flanges) made from solid or laminated timber. The I-beam section is more structurally efficient than a solid rectangular section and can be made to larger dimensions than is available in solid timber.

[0004] Originating in the USA more than 20 years ago, they are now gaining acceptance in the UK and other European countries.

[0005] In most applications, these beams are used as a direct replacement for solid timber and are supplied to site as individual components for assembly by site carpenters.

[0006] The assembly details are very similar to those used for solid timber comprising mainly nails or screws for fixing members together with the use of metal joist hangers for load bearing construction.

[0007] Thus each flooring-panel or deck is constructed on site inter alia from a plurality of parallel spaced-apart fabricated timber I-beam joists each formed from a narrow web of timber and upper and lower rails or flanges formed from laminated veneer lumber, routed to accommodate the upper and lower edges of the web material. The I-beam joists are butt-jointed to the joists (sometimes called rim-beams) which extend orthogonally to the rims of the I-beam joists, with the rim joists cross-nailed on site to the ends of the I-beams. Bracing between the I-beam joists resists lateral movement or tilting of the I-beam joists, and where appropriate the flooring panel or deck may include areas in which I-beam joists run perpendicularly to other I-beam joists, and are butt-jointed at their ends to a rim-joist or another I-beam joist.

[0008] Such a structure is generally satisfactory when constructed on site as a first floor deck, sandwiched between ground floor and first floor wall panels. However the handling of such flooring panels or decks, after prefabrication, during storage, shipping from factory to site, and when lifted (usually by crane) into position at first floor level, can result in twisting and distortion of the panels, generating significant bending and shearing forces on the joints between the component parts. The result is that the flooring panel can become weakened and in particular joints between the ends of the I-beam joists and rim-joists can open-up.

[0009] It is an object of the present invention to provide an improved method of connecting I-beam joists to orthogonal timber components such as rim joists, to reduce the tendency for mis-handling and bending of the panel to open-up the joints between the joists.

SUMMARY OF THE INVENTION

[0010] According to the present invention a method of forming a joint between one end of a timber, flanged I-beam joist and a transverse closure such as a rim-joist, wherein the I-beam joist is arranged so that the web of the joist is generally vertical and the flanges of the I-beam sections are above and below the web comprises the steps of:

[0011] 1)forming two holes a short distance from the end of the I-beam which is to be butt-jointed to the closure, one hole in each of the upper and lower flanges of the flanged I-beam section,

[0012] 2) locating the closure in place and forming two further holes therethrough and into the abutting ends of the upper and lower flanges of the I-beam joist, the two further holes being generally perpendicular to, and intersecting, the first two holes,

[0013] 3) inserting two cross-dowels into the two first holes, each having a transverse threaded opening, and aligning the threaded openings with the intersecting holes, and

[0014] 4) inserting threaded bolts into the intersecting holes to engage in the threaded openings in the cross-dowels, and screwing the bolts into the dowels so as to draw the abutting end of the I-beam joist towards the closure, and thereby clamp it to the closure.

[0015] Where a roofing or flooring panel is comprised of two or more such I-beam joists in a parallel spaced apart array, with ends of the I-beam joists abutting a perpendicular closure or rim-joist, a similar joint made up of two cross-dowels and co-operating bolts, is provided between the ends of each said I-beam joist and the rim-joists.

[0016] The cross-dowels may be formed from metal, or from a rigid plastics material or from a composite material.

[0017] The bolts are typically formed from metal or a rigid plastics material.

[0018] A load spreading washer may be located between the head of each bolt and the rim-joist, or each bolt head may include an integral load spreading flange for increasing the area of the bolt head which is to make contact with the rim-joist.

[0019] The ends of the holes through the rim-joist through which the bolts pass into the rim-joist may be enlarged to accommodate the heads of the bolts, so that the latter are wholly contained within the rim-joist.

[0020] Where the upper and lower rails (flanges) of the I-beam joist are laminated, the holes which are to receive the cross-dowels preferably extend generally perpendicular to the laminations.

[0021] The invention also lies in a prefabricated timber roofing or flooring panel or deck, constructed inter alia from parallel spaced apart laminated timber I-beam joists butt-

jointed to the side faces of perpendicularly extending rim-joists at opposite ends of the I-beam joists, wherein the joints between the ends of the I-beam joists and the rim-joists are formed by bolts and cross-dowels, wherein the latter extend perpendicularly to the laminations forming the upper and lower rails (flanges) of the I-beam joists and the bolts extend transversely through the rim-joists and are threadedly engaged in the cross-dowels.

[0022] The invention also lies in a laminated timber I-beam joist having cross-dowels located transverse to the direction of the laminations forming the upper and lower rails (flanges) of the I-beam section, close to at least one end thereof, to enable the I-beam to be butt-jointed to a transversely extending rim-joist by means of bolts which in use extend through the rim-joist for threaded engagement in the cross-dowels in the I-beam joist.

[0023] The invention also lies in a cross-dowel adapted to be secured in a laminated flange of a timber I-beam joist, wherein the dowel is generally cylindrical in configuration and is formed an external screw thread profile the external diameter of which increases from the end of the dowel which is to be first introduced into the hole in the laminated flange, towards the other end thereof, and the said other end includes a screwdriver slot or other tool engaging means, to enable it to be screwed into the hole in the laminated flange of the I-beam joist.

[0024] The screw thread may be of the self-tapping variety.

[0025] The invention also lies in a cross-dowel adapted to be secured in a laminated flange of a timber I-beam joist, wherein the external surface of the dowel is formed with at least one annular barb, and preferably a plurality of such annular barbs, in the form of a fir tree, the external diameter of the barbs increasing from the end which is first intruded into the hole in the laminations, towards the other end thereof, whereby in use the dowel may be secured in the laminated rail by introducing the barbed end into a preformed hole in the laminated flange and driving the dowel into the hole using a hammer or mallet or a power driver.

[0026] Preferably the end of the dowel which is visible even after it has been driven into the flange of the I-beam joist, is formed with a screwdriver slot or other means whereby it can be rotated whilst embedded in the flange, to enable the transverse threaded opening therein to be aligned to receive a rim-joist securing bolt.

[0027] It has been found in practice that a roof or flooring panel constructed in accordance with the invention is less susceptible to distortion damage during handling, storage and/or shipment, than are similar flooring panels when constructed using conventional cross-nailing techniques.

[0028] A cross-dowel connection may be formed between the end of one rim-joist and an abutting face of an adjoining rim-joist at a corner of a roof or flooring panel embodying the invention.

[0029] The invention thus allows timber I-beams to be constructed into larger building sections. Thus for example, beams and sheeting can be made up into larger prefabricated floor decks or roofing panels and delivered to site for lifting into position by crane.

[0030] Site assembly techniques using nails, screws and metal joist hangers do not provide the strength and rigidity suitable for large prefabricated components subject to the loads imposed during handling and lifting. These loads are different from those encountered on site and in situ and require joints with additional rigidity and strength.

[0031] The invention provides a solution to these problems for use at the junction of I-beams with supporting rimboards or rim-joists and for the first time it is now possible to industrialise the assembly process of roofing and flooring decks etc.

[0032] The invention will now be described by way of example with reference to the accompanying drawing in which:

[0033] **FIG. 1** is an exploded perpendicular view of a joint between the end of a timber I-beam joist and a rim-joist, embodying the invention;

[0034] **FIG. 2** illustrates a cross-dowel, suitable for use in the joint of **FIG. 1**;

[0035] **FIG. 3** shows the initial stages of making the joint of **FIG. 1**; and

[0036] **FIG. 4** shows the completed joint.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENT

[0037] In **FIG. 1 a** timber I-beam joist **10** is shown formed from a relatively thin vertical web of timber/timber composite material **12**, the upper and lower longer edges of which are adhesively bonded into routed grooves in the upper and lower flanges or rails **14**, **16** each of which is formed by laminating a larger number of thin strips of timber, the laminations running parallel to the length dimension of the beam (as shown) and the stack being orientated generally at right angles to the web **12**. The laminations are denoted by reference numeral **18** in the case of the upper flange **14** and by **20** in the case of the lower rail **16**.

[0038] The end of the beam is cut square so that the cut ends **22**, **24** of the upper and lower rails occupy the same plane as does the cut end **26** of the web **12**.

[0039] A timber rim joist **28** is to be butt-joined to the end faces **22**, **24**, **26** of the I-beam joist **10**.

[0040] In accordance with the invention holes are formed in the upper and lower rails (only the upper one **30** being visible in **FIG. 1**) and cross-dowels such as **32**, **33** are located in each of the two holes, with a threaded transverse openings **34**, **35** in the dowels aligned with orthogonal holes **36** and **38** which intersect the holes in the upper and lower flanges.

[0041] The joint is completed by inserting two threaded bolts **40**, **42** through two pre-drilled holes **44**, **46** in the rim-joist **38**, so as to enter and pass through the holes **36** and **38** respectively, to engage in the threaded transverse openings (such as **34** in the case of dowel **32**) in the dowels. Tightening the bolts into the dowels draws the rim-joist into a tight fit on the ends **22**, **24**, **26** of the I-beam joist **10**.

[0042] A typical cross-dowel cast and machined from metal, is shown at **48** in **FIG. 2**.

[0043] **FIGS. 3 and 4** show in cross section how the bolt **42** and dowel **33** fit into the orthogonal holes **38** and **39** respectively.

[0044] Both holes **38** and **38** are conveniently formed by drilling and both are drilled beyond the region in which the two holes intersect, so as to accommodate the driven ends of the dowel and bolt respectively.

[0045] It is to be understood that the head of the bolt may be more like a flat nail head, to reduce the need for undercutting the hole **38**. In this event a screwdriver slot (which may to advantage be a crossed slot to receive a cross-headed screwdriver) is formed in the end face of the head of the bolt.

[0046] Although not shown the dowel may be tapered and/or formed with annular rims to create a barbed or firtree connection with the timber joist.

1. A method of forming a butt joint between one end of a timber, flanged I-beam joist and a transverse closure such as a rim-joist, wherein the I-beam joist is arranged so that the web of the joist is generally vertical and the flanges of the I-beam section are above and below the web, comprising the steps of:

1) forming two holes a short distance from the end of the I-beam which is to be butt-jointed to the closure, one hole in each of upper and lower flanges of the flanged I-beam section,

2) locating the closure in place and forming two further holes therethrough and into the abutting ends of the upper and lower flanges of the I-beam joist, the two further holes being generally perpendicular to, and intersecting, the first two holes,

3) inserting two cross-dowels into the two first holes, each having a transverse threaded opening, and aligning the threaded openings with the intersecting holes, and

4) inserting threaded bolts into the intersecting holes to engage in the threaded openings in the cross-dowels, and screwing the bolts into the dowels so as to draw the abutting end of the I-beam joist towards the closure, and thereby clamp it to the closure.

2. A building panel comprised of at least two I-beam joists and at least one perpendicular closure, the I-beam joists forming a parallel spaced apart array, with ends of the I-beam joists abutting the perpendicular closure, with a butt joint between the end of each of the I-beam joists and the closure, characterised by:

1) two holes formed a short distance from the end of the I-beam which is to be butt-jointed to the closure, one hole in each of upper and lower flanges of the flanged I-beam section,

2) two further holes through the abutting ends of the upper and lower flanges of the I-beam joist, the two further holes being generally perpendicular to, and intersecting, the first two holes,

3) two cross-dowels located in the two first holes, each having a transverse threaded opening aligned with the intersecting holes, and

4) threaded bolts engaged in and screwed into the threaded openings in the cross-dowels, so that the abutting end of the I-beam joist is drawn towards the closure, thereby to clamp it to the closure.

3. A building panel according to claim 2 wherein a load spreading washer is located between the head of each bolt and the closure.

4. A building panel according to claim 2 wherein each bolt head includes an integral load spreading flange for increasing the area of the bolt head which is to make contact with the closure.

5. A building panel according to claim 2 wherein the holes through the closure through which the bolts pass into the I-beam are enlarged at one end to accommodate the heads of the bolts, so that the latter are at least partly contained within the thickness of the closure.

6. A building panel according to claim 2 wherein the upper and lower flanges of the I-beam joist are laminated, and the holes which are to receive the cross-dowels extend generally perpendicular to the laminations.

7. A building panel according to claim 6 wherein the holes in the upper and lower flanges are generally aligned with the web of the I-beam section.

8. A building panel according to claim 6 wherein the holes in the flanges are co-axial.

9. A prefabricated timber building panel or deck, constructed from parallel spaced apart laminated timber I-beam joists butt-jointed to the side faces of perpendicularly extending rim-joists at opposite ends of the I-beam joists, wherein the joints between the ends of the I-beam joists and the rim-joists are formed by bolts and cross-dowels, wherein the latter extend perpendicularly to the laminations forming the upper and lower flanges of the I-beam joists, and the bolts extend transversely through the rim-joists and are threadedly engaged in the cross-dowels.

10. A laminated timber I-beam joist comprising a web between upper and lower laminated flanges, having cross-dowels located therein transverse to the direction of the laminations close to at least one end thereof, to enable the I-beam to be butt-jointed to a transversely extending closure by means of bolts which in use extend through the closure and are threadly engaged in the cross-dowels in the I-beam joist.

11. A cross-dowel adapted to be secured in a laminated flange of a timber I-beam joist to enable the I-beam joist to be secured to a closure in accordance with the method of claim 1, wherein the dowel is generally cylindrical in configuration, is formed with an external screw thread profile, and one end of the dowel includes tool engaging means to enable it to be screwed into a hole in the laminated flange of the I-beam joist.

12. A cross-dowel according to claim 11 wherein the external screw thread profile is a self-tapping thread.

13. A cross-dowel according to claim 11, wherein the external diameter of the screw thread profile increases from the end of the dowel which is to be first introduced into the hole in the laminated flange, towards the other end which includes the tool engaging means.

14. A cross-dowel adapted to be secured in a laminated flange of a timber I-beam joist to enable the I-beam joist to be secured to a closure in accordance with the method of claim 1, wherein the external surface of the dowel is formed with at least one annular barb for retaining the dowel in a hole in the laminated flange.

15. A cross-dowel according to claim 14 wherein the dowel is formed at one end with a tool engaging means such

as a screwdriver slot whereby it can be rotated whilst embedded in the flange, to enable the transverse threaded opening therein to be aligned to receive a securing bolt.

16. A flooring or roofing panel according to claim 2 wherein the panel edges are formed by elongate closures, and a cross-dowel connection is formed between the end of one closure and an abutting face of an adjoining closure at each corner of the panel.

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