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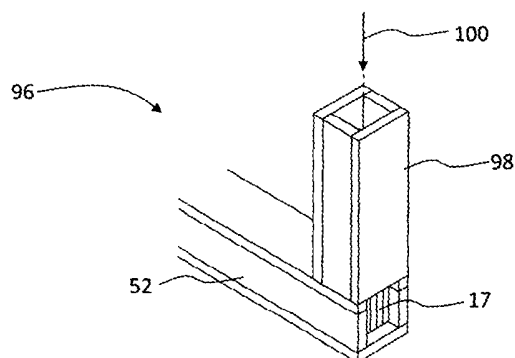
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(54) Title of the Invention: **Timber-framed building structures**
Abstract Title: **Corner joint for timber-framed building structures**

(57) A corner joint for a timber-framed building structure comprises first and second hollow beams 52, 98 and an insert 17 having two arms. Each arm is located in each hollow beam 52, 98 for securing the beams 52, 98 together. The first beam 52 has a cutaway at an end and in a sidewall so that one arm of the insert 17 is located in the first beam 52 and at least part of the other arm is located in the cutaway.



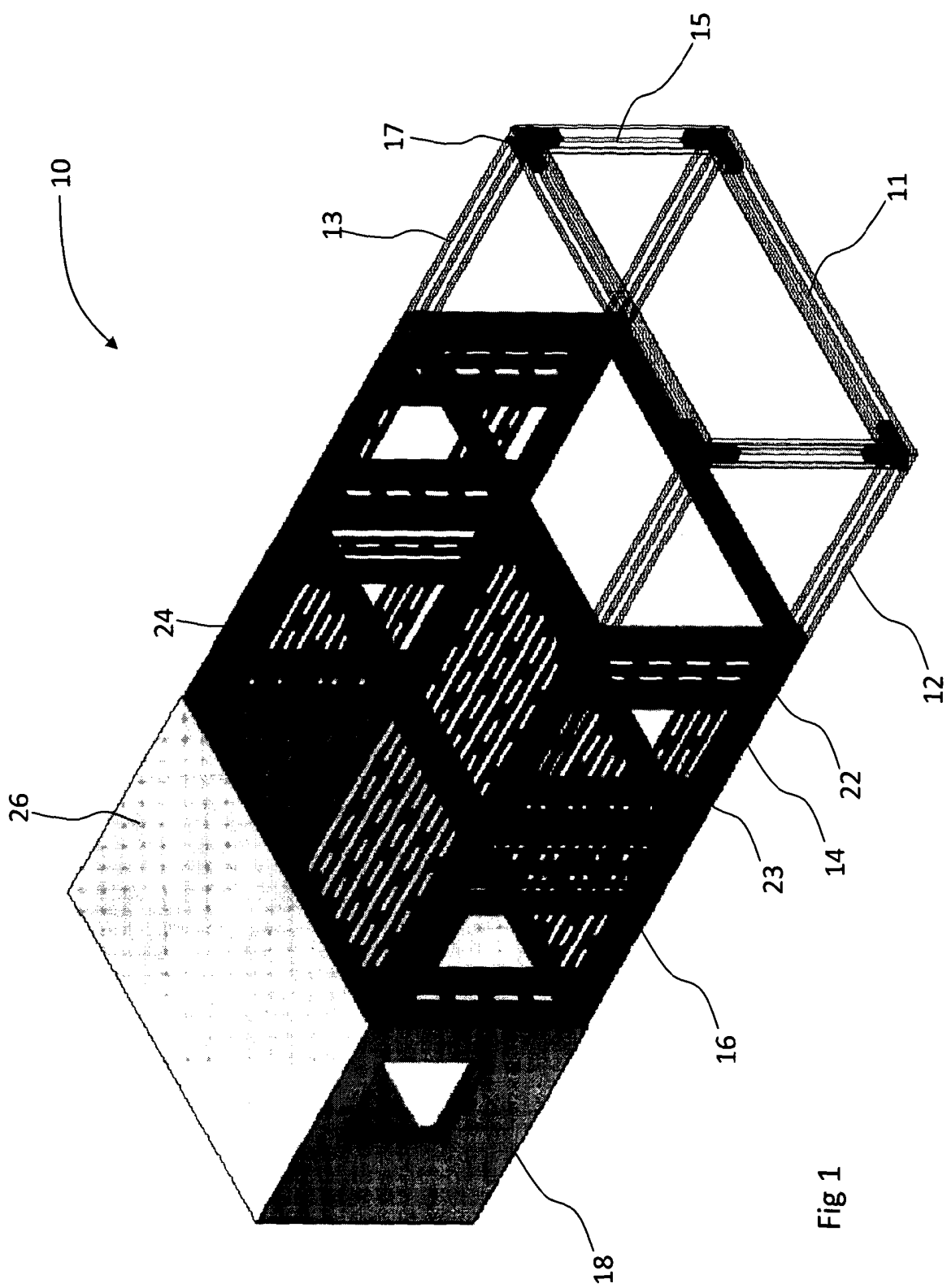


Fig 1

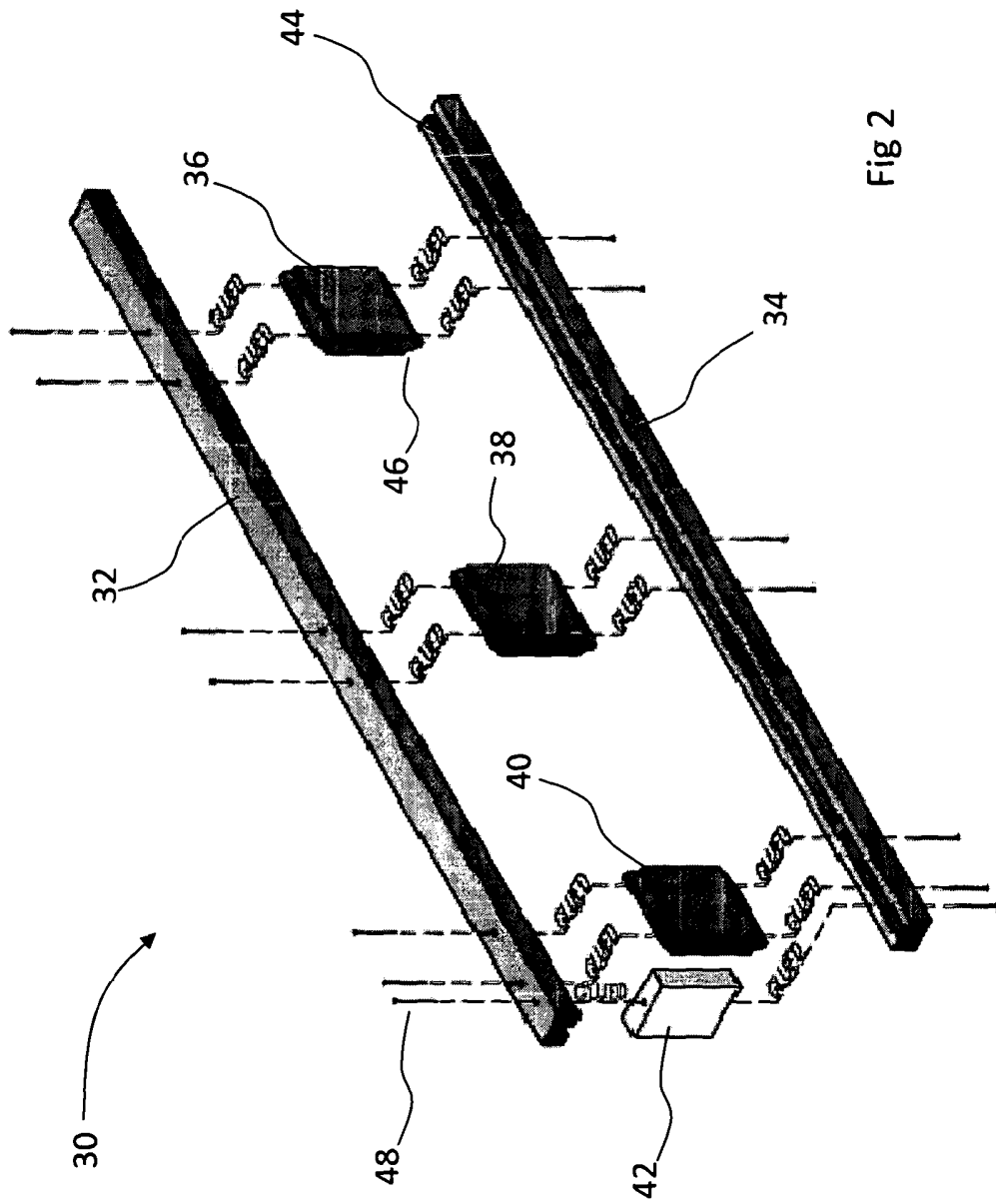


Fig 2

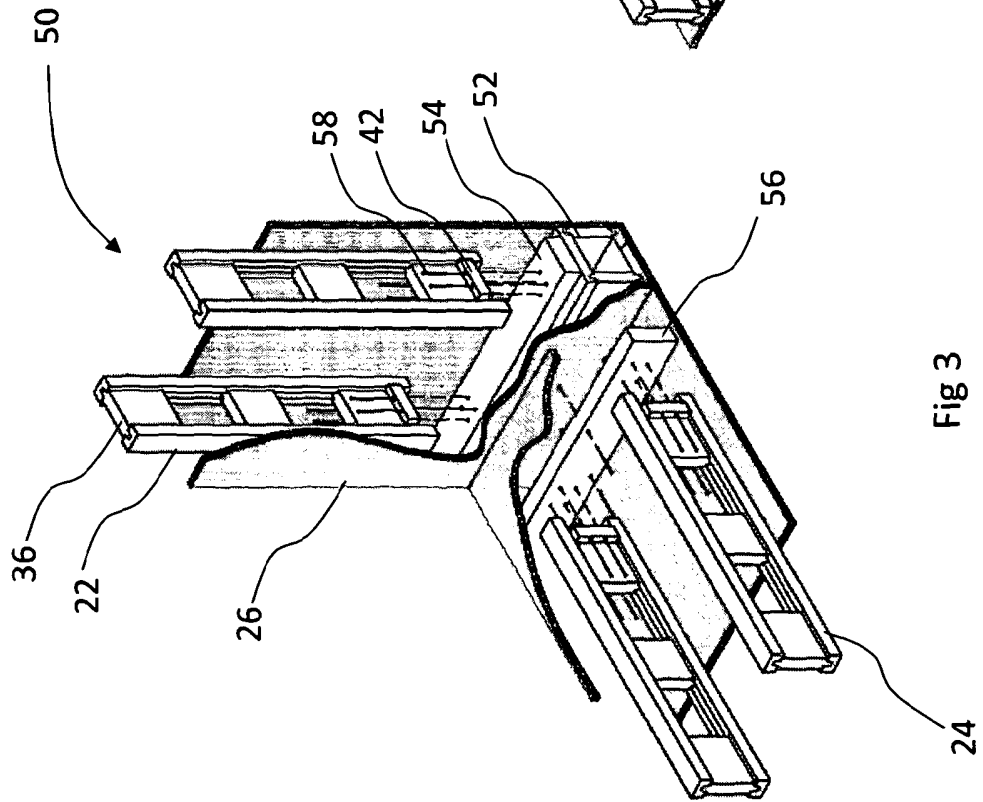


Fig 3

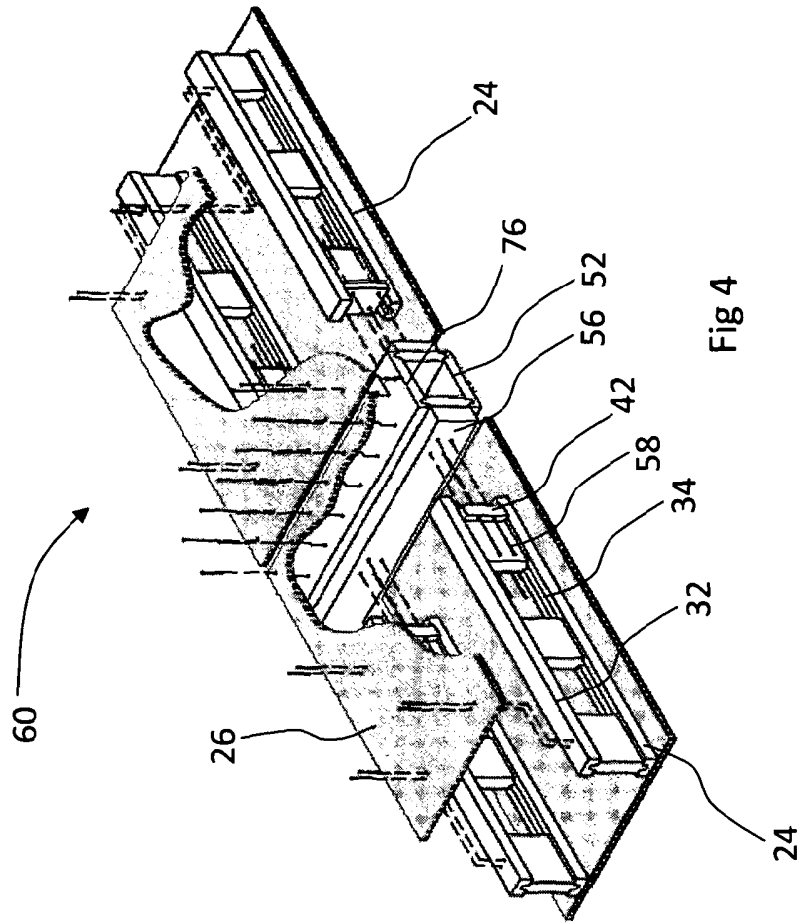


Fig 4

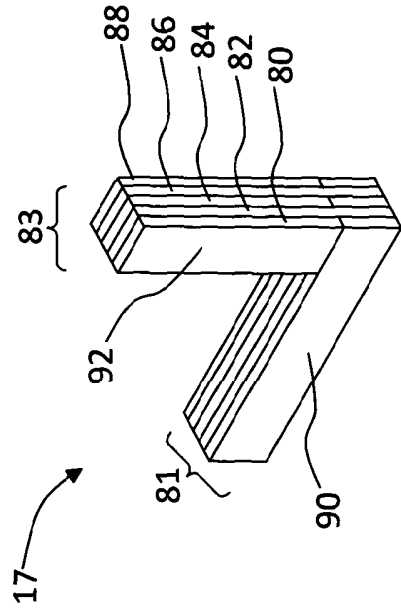


Fig 6

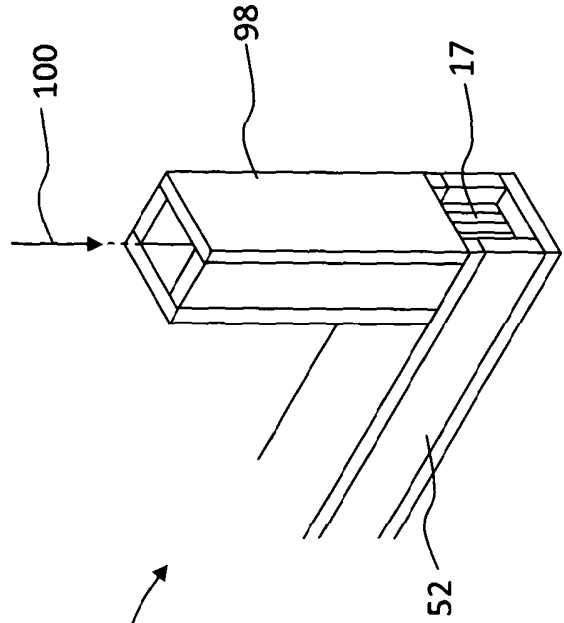


Fig 8

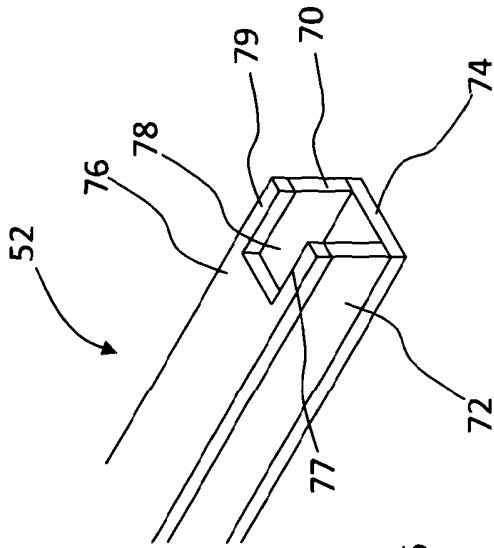


Fig 5

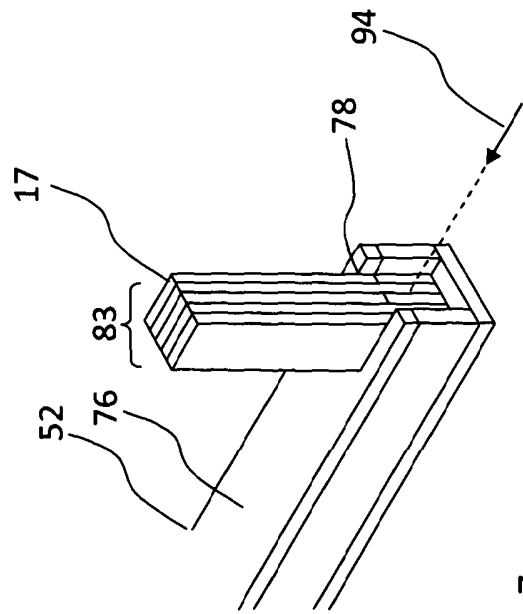
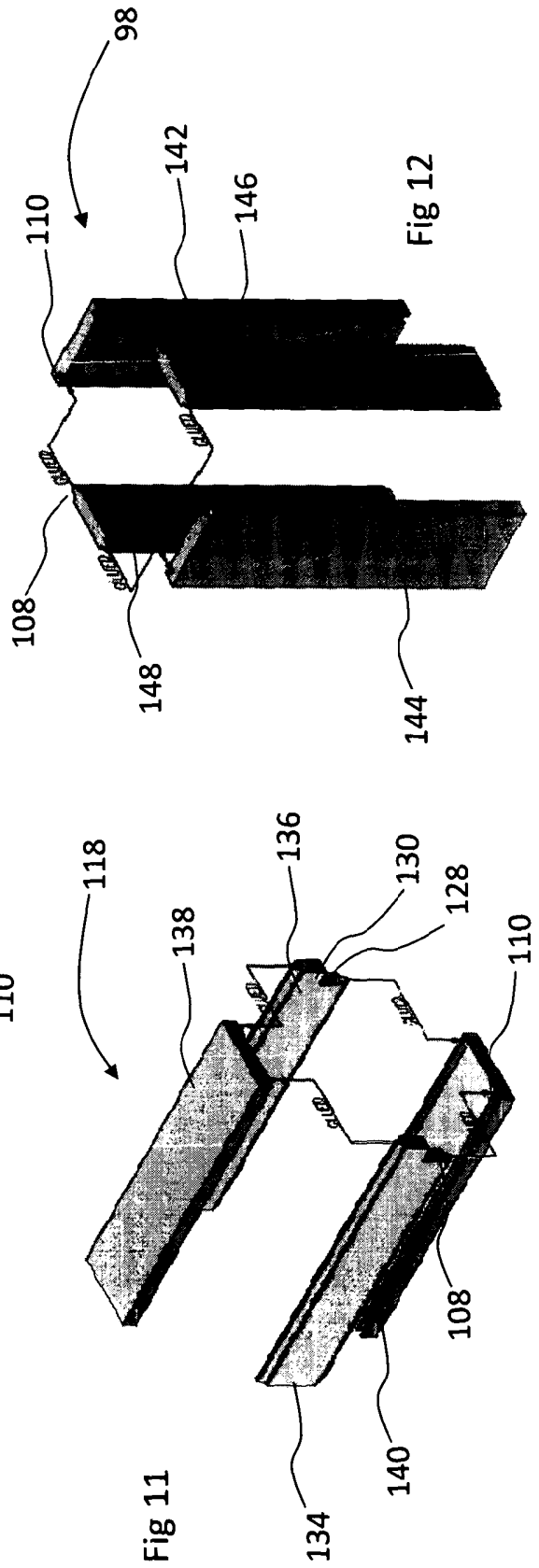
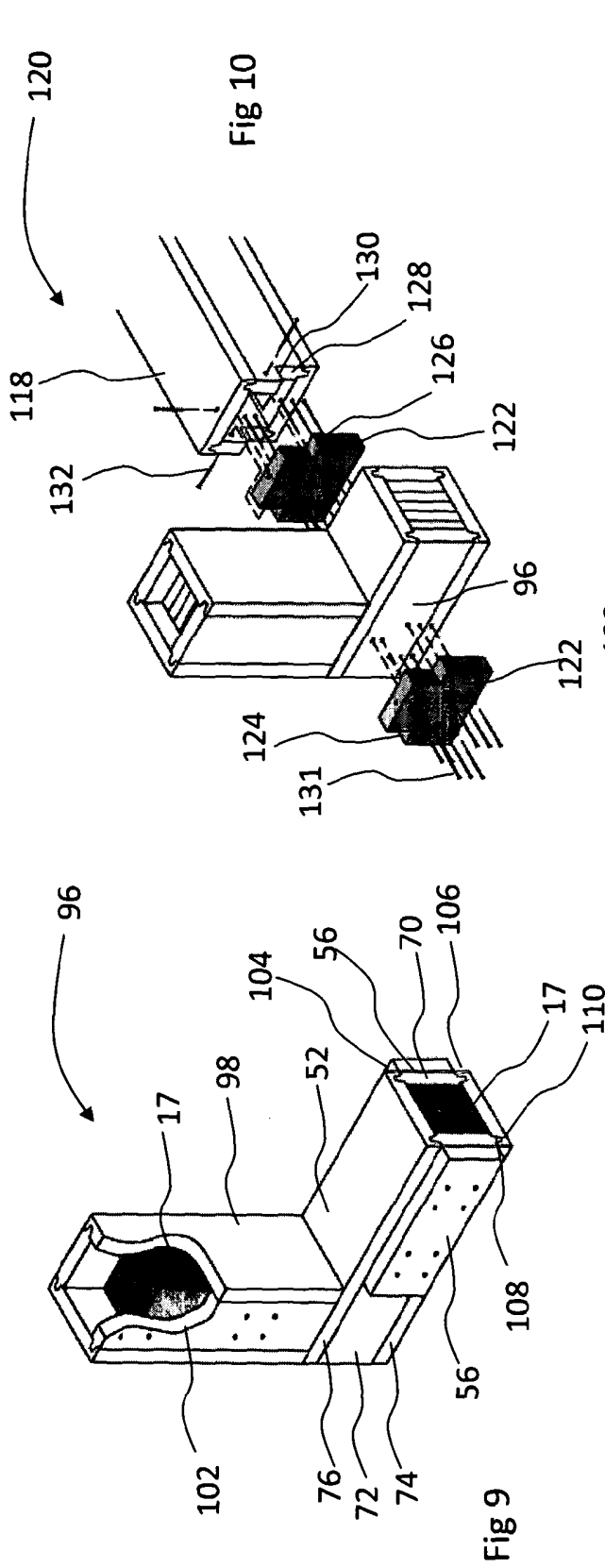


Fig 7



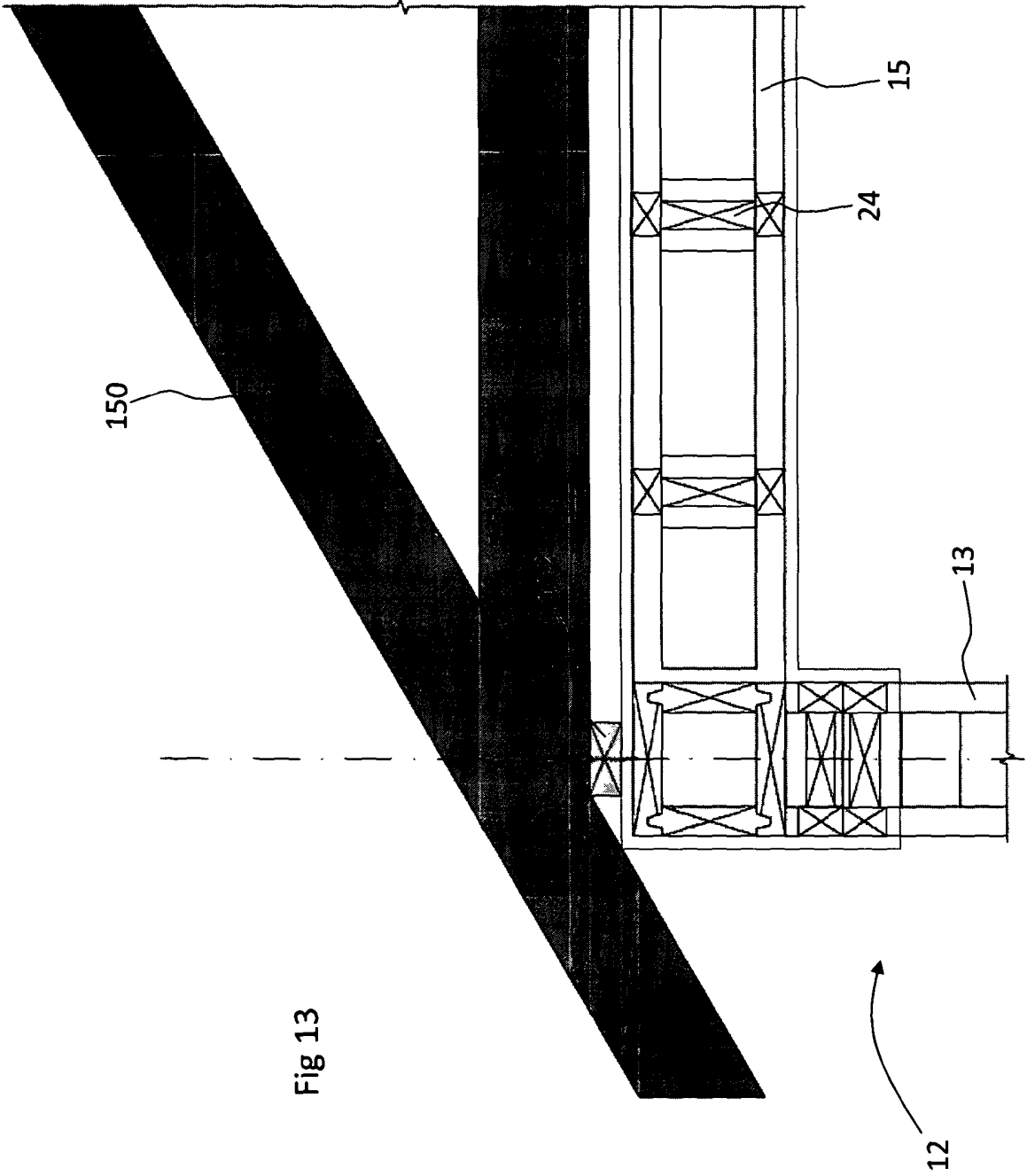


Fig 13

Timber-Framed Building Structures

Technical Field

The invention relates to timber-framed building structures, and in particular to
5 improvements in or relating thereto.

Background

Timber-framed building structures for buildings such as houses, offices, and hotels have many advantages when compared to more traditional building structures primarily
10 constructed of bricks or blocks. These advantages typically include speed of construction, improved overall efficiency of construction, improved final building quality, and reduced cost.

It is known to provide a timber-framed structure for a building which may comprise
15 component parts such as wall sections, floor sections, ceiling section, and roof trusses that are pre-manufactured at a factory. The component parts are transported to a building site for assembly into a building on pre-prepared concrete foundations. Once the finished timber frame is in place the fixtures and fittings of the building are installed to complete the building. Such timber-framed buildings may typically be constructed
20 with the required strength to support the weight of the floors and the roof for buildings up to about four storeys.

The known timber-framed buildings are generally constructed in a similar manner to traditional brick or block buildings whereby the building is designed, and the

component parts of the building are transported to a building site and assembled to construct the building. Whereas such a construction technique allows buildings to be assembled more quickly when compared to traditional brick or block buildings there are still numerous disadvantages and problems using the known way of constructing
5 timber-framed buildings.

Building sites are notoriously difficult places in which to operate, and to project manage the construction of buildings in an efficient manner. It would be desirable to undertake additional stages of the manufacture of the building in a more controlled environment
10 such as a factory, or yard. It would be further desirable to make more use of common components in buildings, such as structural elements, so that the requirement for manufacturing bespoke buildings is reduced.

Buildings are increasingly being subject to ever demanding legislation relating to
15 improved energy efficiency, and the use of sustainable building materials. This is particularly the case for new-build domestic housing. Sustainable building materials may include timber from a sustainable source such as a managed forest, which may typically have softwood trees which may grow more rapidly than hardwood trees. It would be desirable to utilise such a sustainable source of wood for the timber-framed
20 building structure.

It is broadly an object of the present invention to address one or more of the above mentioned disadvantages of previously known timber-framed structures for buildings.

Summary

What is required is a way of readily permitting timber-framed building structures to be manufactured away from a building site using a sustainable source of timber, which
5 may reduce or minimise at least some of the above-mentioned problems.

According to a first aspect of the invention, there is provided a corner joint for a timber-framed building structure comprising a first hollow beam, a second hollow beam, and an insert having two arms, each arm being located in each hollow beam for securing the
10 first and second hollow beams together, the first hollow beam having a cutaway at an end thereof and in a side-wall thereof, one arm of the insert being located in the first hollow beam so that at least a part of the other arm is located in the cutaway.

Such a corner joint permits the timber-framed building structure to be manufactured
15 with an improved strength permitting buildings to be manufactured and finished away from a building site, and then transported to the building site. Such an improved corner joint also has the advantage of being able to be manufactured from a sustainable source of wood, such as a soft wood of a suitable engineering grade. Using such a soft wood further permits the timber-framed building structure to be manufactured to an
20 appropriate cost. The building may therefore be manufactured with a reduced environmental impact.

Preferably the insert comprises a laminated structure. Preferably each laminate comprises a first part and a second part, said parts comprising the arms of the insert.

Preferably the first and second parts of adjacent laminates overlap at a corner of the insert. The laminated structure may be glued and/or fastened together. Such an insert improves the strength of the connection between the two beams.

- 5 Preferably the two arms are perpendicular. Preferably the arms of the insert are of substantially equal length.

Preferably at least one of the first hollow beam and the second hollow beam comprises four panels to form a box, a first opposing two of the four panels abutting perpendicular
10 edge surfaces of a second opposing two of said four panels.

Preferably the cutaway is provided in one of said first opposing panels.

Preferably adjacent panels are provided with a channel and groove arrangement for
15 securing them together. The panels may be secured together with glue and/or fasteners.

Preferably an end of the second hollow beam abuts a side surface of the first hollow beam.

- 20 The first and/or second hollow beams may be secured to the insert with fasteners.

The corner joint may further including at least one fixing plate secured to a side thereof.
The at least one fixing plate providing a shoulder on the corner joint. Such a fixing plate

is a useful feature for securing a joist to the first hollow beam or the second hollow beam.

According to a second aspect of the invention there is provided a method of assembling
5 a corner joint for a timber-framed building structure comprising a first hollow beam having a cutaway at an end thereof and in a side-wall thereof, a second hollow beam, and an insert having two arms for securing the first and second hollow beams together, the method including:

inserting one arm of the insert into the first hollow beam so that at least a part of
10 the other arm is located in the cutaway; and

inserting the other arm into the second hollow beam.

Such a method of assembling a corner joint provides a straight forward way of assembling the timber-framed building structure, having an improved strength. This
15 permits buildings to be manufactured and finished away from the building site, and then transported to the building site. The method has the advantage of being able to manufacture the corner joint from a sustainable source of wood, such as a soft wood of a suitable engineering grade. This permits the timber-framed building structure to be manufactured to an appropriate cost, and with a reduced environmental impact.

20

Preferably the method further includes securing the first hollow beam and/or the second hollow beam to the insert using at least one fastener.

Preferably the two arms are perpendicular.

According to a third aspect of the invention there is provided a corner joint for a timber-framed building structure comprising a first beam, a second beam, and a connector to secure the first beam to the second beam, the connector being dispersed between the first beam and the second beam and located on a side of the first beam, the connector having at least one shoulder for abutment of at least one bearing surface of the second beam.

Such a corner joint permits two horizontal beams to be secured together in an effective manner, and permits the timber-framed building structure to be manufactured with an improved strength. This further assists the assembly of buildings away from the building site. The corner joint also has the advantage of being able to be manufactured from a sustainable source of wood, such as a soft wood of a suitable engineering grade. Using such a soft wood further permits the timber-framed building structure to be manufactured to an appropriate cost, and with a reduced environmental impact.

Preferably the at least one shoulder is provided by a first cutaway of the connector. Preferably the connector has two cutaways on either side of the connector to provide two shoulders.

20

Preferably the at least bearing surface is provided by a second cutaway of the second beam. Preferably the second beam has two cutaways on either side to provide two bearing surfaces.

Preferably the first beam is perpendicular to the second beam.

The connector may be secured to the first beam with fasteners and/or glue.

- 5 The second beam may be secured to the corner joint with fasteners and/or glue.

Preferably at least one of the first beam and the second beam comprises four panels to form a box, a first opposing two of the four panels abutting perpendicular edge surfaces of a second opposing two of said four panels:

10

Preferably the at least one cutaway of the second box beam is provided in at least one of said second opposing two of said four panels.

- Preferably adjacent panels are provided with a channel and groove arrangement to
15 secure them together.

Preferably the corner joint further includes at least one fixing plate secured to a side thereof. The at least one fixing plate providing a shoulder on the corner joint. Such a fixing plate is a useful feature for securing a joist to the first beam or the second beam.

20

According to a fourth aspect of the invention, there is provided a method of assembling a corner joint for a timber-framed building structure comprising a first beam, a second beam, and a connector to secure the first beam to the second beam, the connector

dispersed between the first beam and the second beam and having at least one shoulder,
the method including:

securing the connector to the first beam on a side of the first beam; and

- abutting the second beam to the connector so that at least one bearing surface of
5 the second beam abuts the at least one shoulder.

Such a method permits two horizontal beams to be secured together in an effective
manner, and permits the timber-framed building structure to be manufactured with an
improved strength. This further assists the assembly of buildings away from the
10 building site. The method may use timber from a sustainable source of wood, such as a
soft wood of a suitable engineering grade. Using such a soft wood further permits the
timber-framed building structure to be manufactured to an appropriate cost, and with a
reduced environmental impact.

- 15 The method may further include securing the second beam to the connector using at
least one fastener.

Preferably the first beam is perpendicular to the second beam.

- 20 According to a fifth aspect there is provided a corner joint comprising the corner joint of
the first aspect of the invention, and the corner joint of the third aspect of the invention,
or manufactured according to the second or third aspect of the invention.

According to a sixth aspect of the invention, there is provided a joist comprising two substantially parallel elongate members spaced apart from each other by at least one connecting member, the at least one connecting member to secure the elongate members together, wherein the connecting member is suitable for fixing the joist in position in a timber-framed building structure.

Such a joist permits the timber-framed building structure to be manufactured with an improved strength permitting buildings to be manufactured and finished away from a building site, and then transported to the building site. Such an improved joist also has the advantage of being able to be manufactured from a sustainable source of wood, such as a soft wood of a suitable engineering grade. Using such a soft wood further permits the timber-framed building structure to be manufactured to an appropriate cost. The building may therefore be manufactured with a reduced environmental impact.

Preferably the joist further includes at least one fixing member substantially at an end of the joist to further secure the two elongate members together, wherein the connecting member or the fixing member is suitable for fixing the joist in position in a timber-framed building structure.

Preferably the elongate members and the connecting members are comprised of natural wood having a wood grain, wherein the wood grain of the elongate members and the connecting members runs substantially along the length of the joist. Preferably the fixing member is comprised of natural wood having a wood grain running substantially perpendicularly to the elongate members. These arrangements have the advantage of

providing an improved strength to the joist, and allow the joist to be manufactured from non-engineered natural wood.

Preferably one of the at least one connecting member and one of the elongate members
5 is provided with a channel, and the other of the at least one connecting member and one
of the elongate members is provided with a tongue, the tongue and channel for
cooperation with each other for securing the at least one connecting member to the at
least one elongate member.

10 The elongate members and the at least one connecting member may be secured together
by glue and/or fasteners. The elongate members and the fixing member may be secured
together by glue and/or fasteners.

Preferably the joist further includes a plurality of connecting members. Preferably the
15 plurality of connecting members are spaced apart along the length of the joist.

The joist may further include an elongate fixing plate for fixing the joist in position in a
timber-framed building structure, the elongate fixing plate abutting the fixing member,
wherein the elongate fixing plate and the joist are substantially perpendicular to each
20 other.

Preferably the fixing member is set back from an end of the joist so that the fixing
member and free ends of each elongate member form a hand. Preferably the hand is
arranged to hold the elongate fixing plate.

Preferably the joist is manufactured as a prefabricated building component.

According to a seventh aspect of the invention there is provided a wall, floor, or ceiling
5 manufactured according to the second or fourth aspect of the invention, or comprising a
corner joint according to the first or third aspect of the invention, or comprising a joist
according to the sixth aspect of the invention.

According to an eighth aspect of the invention there is provided a building
10 manufactured according to the second or fourth aspect of the invention, or comprising a
corner joint according to the first or third aspect of the invention, or a joist according to
the sixth aspect of the invention.

According to a ninth aspect of the invention there is provide a timber-framed building
15 structure manufactured according to the second or fourth aspect of the invention, or
comprising a corner joint according to the first or third aspect of the invention, or a joist
according to the sixth aspect of the invention.

Brief Description of the Drawings

20 Other features of the invention will be apparent from the following description of
preferred embodiments shown by way of example only with reference to the
accompanying drawings, in which;

Figure 1 shows a diagram of a timber-framed building structure showing embodiments of the invention;

Figure 2 shows an exploded diagram of a ladder beam of Figure 1 according to an embodiment of the invention;

5 **Figure 3** shows an exploded view of a corner joint of the timber-framed building structure of Figure 1 according to an embodiment of the invention;

Figure 4 shows an exploded view of a floor or ceiling joint of the timber-framed building structure of Figure 1 according to an embodiment of the invention;

Figure 5 is a diagram of an end of a box beam shown in Figure 3 and 4;

10 **Figure 6** is a diagram of a local strengthening insert shown in Figure 1;

Figure 7 is a diagram of a local strengthening insert of Figure 6 located in an end of a box beam of Figure 5;

Figure 8 is a diagram of a complete corner joint according to an embodiment of the invention;

15 **Figure 9** is a diagram of the corner joint of Figure 8;

Figure 10 is a diagram of the corner joint of Figure 9 with a further horizontal box beam according to an embodiment of the invention;

Figure 11 shows an exploded diagram of a further horizontal beam of Figure 10;

Figure 12 shows an exploded diagram of a vertical box beam of Figure 8; and

20 **Figure 13** shows a diagram of a roof truss secured to a building component shown in Figure 1.

Detailed Description

Figure 1 shows a diagram of a timber-framed building structure showing embodiments of the invention, generally designated 10. The timber-framed building structure 10 comprises four building components 12, 14, 16, 18 secured in position next to one another to form one internal living space. Each building component 12, 14, 16, 18 is substantially a rectangular cuboid in shape having four wall faces, one ceiling face and one floor face whereby opposite faces of the rectangular cuboid are substantially equal in size. The building components 12, 14, 16, 18 may alternatively be termed modules. Each building component 12, 14, 16, 18 is connected to an adjacent building component along a long wall face. The building components 12, 14, 16, 18 are shown in successive stages of their manufacture. The first building component 12 shows a concept of construction whereby four floor beams 11 are connected together to form a rectangular floor, and four ceiling beams 13 are connected together to form a rectangular ceiling. The floor and ceiling are connected together with four upright beams 15 at corners thereof. A local strengthening insert 17 is also shown at each corner joint, or node, of the first building component 12. The floor beams 11, the ceiling beams, the upright beams 15 and the local strengthening insert 17 are all structural parts of the building components 12, 14, 16, 18.

The second building component 14 shows the next stage of manufacture whereby a plurality of vertical ladder beams 22 are inserted between the floor beams 11 and the ceiling beams 13. A plurality of horizon ladder beams 23 are also shown to form a window opening in the second building component 14. In the arrangement of Figure 1 the horizontal and vertical ladder beams 22, 23 are only included in the short side walls

of the second building component 14, and the long side walls are left open to connect the spaces within the first building component 12 and the third building component 16. The ladder beams 22, 23 form an internal structure for the short walls and strengthen the connection between the floor beams 11 and the ceiling beams 13.

5

The third building component 16 shows a plurality of ladder beams 24 inserted between the ceiling beams 13. A plurality of horizontal ladder beams 24 are also shown inserted between floor beams 11. This arrangement forms the floor and ceiling of the third building component 16. Also shown at one short wall of the third building component 16 is a door opening which is formed by vertical ladder beams 22. The fourth building component 18 shows the short end walls, one long end wall, the ceiling, and the floor covered or clad in 0.018m thick Grade 3 Oriented Strand Board (OSB) which is an engineered wood product formed of layered strands of wood in specific orientations. The floor beams 11, the ceiling beams 13, the upright beams 15, the local strengthening insert 17, and the ladder beams 22, 23, 24 are of timber such as C16 Welsh Sitka Spruce or Douglas fir which is a readily available natural wood timber from a sustainable source such as a managed forest. The ladder beams 22, 23, 24 are all structural parts of the building components 12, 14, 16, 18.

20 It will be appreciated that typically all of the building components 12, 14, 16, 18 would be built as per the building component 12 before they are secured together. Once secured together the building components 12, 14, 16, 18 would be finished with OSB as per the building component 18. Once assembled, the timber-framed building structure 10 comprises the two middle building components 14, 16 which only have cladding 26

on their short wall faces, and the two end building components 12, 18 which have cladding 26 on their short wall faces and at a respective one of the long wall face. The floor beams 11, the ceiling beams 13, the upright beams 15, the local strengthening inserts 17, the ladder beams and the OSB cladding 26 are all structural load bearing parts of the timber-framed building structure 10.

Figure 2 shows an exploded diagram of the ladder beam of in Figure 1 according to an embodiment of the invention, generally designated 30. In Figure 2 the ladder beam 30 is a generalised version of the horizontal and vertical ladder beams 22, 23, 24 of Figure 1. In Figure 2, the ladder beam 30 is comprised of two parallel elongate members 32, 34 which are spaced apart from each other by connecting members 36, 38, 40 which are spaced along the length of the ladder beam 30. A fixing member 42 is also provided at one end of the ladder beam 30, which also connects the two elongate members 32, 34, and which can be used to fix the ladder beam 30 to other components of the timber-framed building structure 10. Also shown, are grooves 44 which are formed on opposing faces of each elongate member 32, 34, and which are 0.02m deep chamfered grooves along the full length of each elongate member 32, 34. Each groove 44 cooperates with corresponding tongues 46 which are formed on adjacent edges of each connecting member 36, 38, 40.

20

The elongate members 32, 34, the connecting members 36, 38, 40 and the fixing member 42 are all of natural wood and not engineered wood. It will be appreciated that the tongues 46 and grooves 44 may be formed in any suitable way, for example using a router. The wood grain of the elongate members 32, 24 and the connecting members 36,

38, 40 is arranged to run along the length of the ladder beam 30. It has been discovered that arranging the wood grain in this manner greatly improves the structural performance of the ladder beam 30. The elongate members 32, 34 and the connecting members 36, 38, 40 lie substantially in the same plane with their wood grain substantially aligned to the plane. The fixing member 42 lies substantially in a plane perpendicular to the plane of the elongate members with its wood grain substantially aligned to the perpendicular plane. In an alternative embodiment the fixing member 42 is omitted and the ladder beam 30 comprises only the elongate members 32, 34 and the connecting members 36, 38, 40.

10

It will be appreciated that wood grain is generally non-uniform, and that deviations from the above described directions of wood grain are envisaged and to be expected with the proviso that the wood grain of the elongate members 32, 34 and the connection members 36, 38, 40 are substantially in the same direction. In the embodiment having the fixing member 42, the wood grain of the fixing member 42 lies in a substantially perpendicular direction to the wood grain of the elongate members 32, 34. The elongate members 32, 34, the connecting members 36, 38, 40 and the fixing member 42 are connected together by screws 48 and glue between joints as indicated in Figure 2. The ladder beam 30 may alternatively be termed a joist, a stud, or a beam.

20

A horizontal or vertical ladder beam 22, 24 used for the wall face, the ceiling face or the floor face may be 2.7m in length, 0.21m in depth, and 0.10 in width. A horizontal ladder beam 23 to form a window may typically be 1.5m in length, 0.21m in depth, and 0.10 in width. The elongate members 32, 34 may be spaced apart at a distance of 0.13m along

the beam. Each connecting member 36, 38, 40 may be 0.14m in length along the wood grain, 0.13m in width across the wood grain, and have a thickness of 0.04m. The connecting member 36, 38, 40 may be spaced apart at a distance of 0.46m along the length elongate members 32, 34. The fixing member 42 may be 0.13m in length
 5 between the elongate members 32, 34 along the wood grain, 0.1m in width across the wood grain, and have a thickness of 0.04m. Such an arrangement permits the ladder beam 30 to be manufactured with the required strength and weight. Such an arrangement permits the ladder beam to be manufactured with the required strength to weight ratio.

10

Figure 3 shows an exploded view of a corner joint of the timber-framed building structure 10 of Figure 1, according to an embodiment of the invention, generally designated 50. In Figure 3 like features to the arrangements of Figures 1 and 2 are shown with like reference numerals. In Figure 3 a generalised box beam 52 is shown
 15 which may be the floor beam 11, or the ceiling beam 13 which is manufactured to a Euro Code 5 building standard. The upright beam 15 may also be manufactured to the same standard. The box beam 52 is shown with the horizontal ladder beams 24, and the vertical ladder beams 22 for fixing thereto with a respective fixing plate 54, 56. The fixing plates 54, 56, alternatively termed sole plates or sill plates, run along the length
 20 of a top surface and a side surface of the box beam 52 respectively, and are used to attach ladder beams 22, 24 to the box beam 52. The fixing plate 54 that runs along the top surface of the box beam 52 is between each vertical ladder beam 22 and the box beam 52. The fixing plate 56 that runs along the side surface of the box beam 52 is between each horizontal ladder beam 24 and the box beam 52. The ladder beams 22, 24

are secured to their respective fixing plate 54, 56 using screws 58 which pass through respective fixing members 42 of the ladder beams 22, 24, the fixing plates 52, 54 and into the box beam 52 as indicated in Figure 3. Once secured together the fixing members 42 of the ladder beams 22, 24 abut the associated fixing plate 54, 56 on the
5 box beam 52.

Figure 3 also shows that the fixing member 42 of each ladder beam is set back from the end of each ladder beam 22, 24 by about 0.04m. This permits the elongate members 32, 34 of the ladder beam to form a hand to fit around the fixing plate 54, 56. For the
10 vertical ladder beam 22 this is useful because it provides a way of locating the ladder beam 22 on the box beam 52 prior to fixing with the screws 58, and also helps with transferring load from the vertical ladder beam to the box beam 52. For the horizontal ladder beam 24 this is useful because it provides a way of locating the ladder beam 24 on the box beam 52 prior to fixing with the screws 58, and also helps with transferring
15 load from the elongate members 32, 34 to the box beam 52.

Figure 4 shows an exploded view of the floor or the ceiling joint of the timber-framed building structure 10 of Figure 1, according to an embodiment of the invention, generally designated 60. In Figure 4 like features to the arrangements of Figures 1, 2
20 and 3 are shown with like reference numerals. The floor or ceiling joint 60 is, for example, a connection between the first and second building components 12, 14 shown in Figure 1. In Figure 4 the box beam 52 is shown with horizontal ladder beams 24 on either side of it. In this arrangement the box beam is provided with fixing plates 56 on either side so that the horizontal ladder beams 24 can be fixed on either side of it using

screws 58. It can be seen in Figure 4 that the fixing plates 56 are shown to run the length of the box beam 52 and on each side of it. The fixing plates 56 are not as deep as the box beam 52 so that when the fixing plates 56 are attached to the box beam 52 there exists a free space above and below the fixing plate 56 where the hand, or free ends, of the elongate members 32, 34 of the ladder beam 24 are located. This arrangement provides a flush fit between an elongate top plate 76 (shown in Figure 5) and the elongate member 32, and between an elongate bottom plate 74 (shown in Figure 5) and the elongate member 34. It will be appreciated that the box beam 52 has the same depth as the combined elongate members 32, 34 and the depth of the fixing plate 56.

10

Figures 5 – 8 show an arrangement for a corner joint between a vertical beam and a horizontal beam, such as between an upright beam 15 and a floor beam 11 or a ceiling beam 13 shown in Figure 1. Figure 5 is a diagram of an end of the box beam 52 shown in Figure 3 and 4. In Figure 5 the box beam 52 comprises two elongate side plates 70, 72, an elongate bottom plate 74 and an elongate top plate 76 that form an elongate four-sided hollow box. The plates 70, 72, 74, 76 are fixed together using glue and screws such that the elongate top plate 76 abuts a side, or edge, surface of each elongate side plate 70, 72. Similarly the elongate bottom plate 74 abuts a side surface of each elongate side plate 70, 72. It can be seen that the elongate side plates 70, 72 are wholly between the elongate top plate 76 and the elongate bottom plate 74. A rectangular cutaway 78 is provided in the elongate top plate 76 at an end of the box beam 52. It will be appreciated that the rectangular cutaway 78 is a piece that has been removed from the top plate 76. Prior to the rectangular cutaway 78 being removed the elongate top plate 76 was rectangular in shape, and after the rectangular cutaway 78 is removed the

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elongate top plate 76 has fingers 77, 79 either side of the rectangular cutaway 78 and at an end of the elongate top plate 76. The plates 70, 72, 74, 76 may alternatively be termed panels.

5 Figure 6 is a diagram of the local strengthening insert 17 shown in Figure 1. The insert 17 is L-shaped having a first arm 81 and a second arm 83 of equal length. Typically each arm is 0.5m in length. The insert 17 comprises a laminated structure of five layers 80, 82, 84, 86, 88 of natural wood which are glued and/or screwed together. Each layer 80, 82, 84, 88 comprises a first rectangular part 90 and a second rectangular part 92, 10 whereby the first rectangular part 90 is longer than the second rectangular part 92. In the first layer 80 the first rectangular part 90 extends along the whole length of the first arm 81, and the second rectangular part 92 extends along the remaining length of the second arm 83. In the second layer 82, the first rectangular part 90 is perpendicular to the first part 90 of the first layer 80. In the second layer 82, the second rectangular part 92 is 15 perpendicular to the second part 92 of the first layer 80. In the third layer 84 and the fifth layer 88, the first rectangular part 90 and the second rectangular part 92 have the same orientation as the first layer 80. In the fourth layer the first rectangular part 90 and the second rectangular part 92 have the same orientation as the second layer 82. This manner of constructing the insert 17 provides an overlap between successive first and 20 second rectangular parts 90, 92 of different layers 80, 82, 84, 86, 88 at the corner of the insert 17. This manner of construction greatly improves the strength of the insert 17.

Figure 7 is a diagram of the local strengthening insert 17 of Figure 6 located in the end of the box beam 52 of Figure 5. In Figure 7 like features to the arrangement of Figures 5

or 6 are shown with like reference numerals. In Figure 7, the first arm 81 of the L-shaped insert 17 is shown to be inserted inside the hollow space of the box beam 52 so that the second arm 83 of the L-shaped insert 17 is located inside the cutaway 78 of the elongate top plate 76. An arrow 94 shows the direction of inserting the insert 17 into the hollow space of the box beam 52. It will be appreciated that the arm 81 is a close fit inside the box beam 52. The second arm 83 is also a close fit inside the cutaway 78.

Figure 8 is a diagram of a complete corner joint, generally designated 96. In Figure 8 like features to the arrangement of Figures 5, 6 or 7 are shown with like reference numerals. In Figure 8, a vertical box beam 98, such as the upright beam 15, is located over the second arm 83 of the L-shaped insert 17 so that the second arm 83 is inserted inside the hollow space of the vertical box beam 98. A lower end of the vertical box beam 98 abuts a top surface of the elongate top plate 76. An arrow 100 shows the direction of locating the vertical box beam 98 over the second arm 83 of the insert 17. Once the box beam 52, the insert 17, and the vertical box beam 98 have been assembled they are fixed together by screws inserted through side plates 70, 72 of the box beams 52, 98. It will be appreciated that the arm 83 is a close fit inside the vertical box beam 98. The corner joint 96 may alternatively be termed a node.

Figure 9 is a diagram of the corner joint 96 of Figure 8 shown from a different angle. In Figure 8 like features to the arrangement of Figures 3, 5 and 9 are shown with like reference numerals. In Figure 8 a part 102 of the vertical box beam 98 is shown to be removed so that the insert 17 in the hollow space of the vertical box beam 98 can be seen. Also shown is the arrangement of the fixing plates 56 on either side of the box

beam 52 which provides a shoulder 104, 106 on either side of each fixing plate 56 for the elongate members 32, 34 of the ladder beam 24. Also shown is the construction of the box beam 52, whereby tongues 108 are provided on the two elongate side plate 70, 72 for cooperation with grooves 110 provided on the elongate bottom plate 74 and the
 5 elongate top plate 76. The tongue and groove joints 108, 110 are glued and/or screwed together and provide a convenient way for manufacturing the box beam 52 or other box beams described in this specification.

Figure 10 is a diagram of the corner joint of Figure 9 with a further horizontal box beam
 10 118 according to an embodiment of the invention, generally designated 120. In Figure 10 like features to the embodiments of Figures 1 and 9 are shown with like reference numbers. In Figure 10, the further horizontal box beam 118 may be the floor beams 11 or the ceiling beams 13. Also shown are two connector parts 122 which are fixable to either side of the corner joint 96 and which are used to secure the further horizontal box
 15 beam 118 to the corner joint 96. Each connector part 122 has two cutaways 124 to provide two respective shoulders 126 on either side of each connector part 122. The further horizontal beam 118 is provided with a corresponding cutaway 128 to provide a bearing surface 130 to cooperate with the shoulder 126 of the connector part 122. Each connector part 122 is secured to the corner joint 96 with screws 131. The further
 20 horizontal box beam 118 is then secured to the corner joint 96 using screws 132 which pass through the further horizontal box beam 118 and into the connector part 122. Once secured together the arrangement 120 comprises the box beam 52, the vertical box beam 98, and the further horizontal box beam 118 which are orthogonal to each other. It will be appreciated that the corner joint 120 may be arranged for a floor connection or a

ceiling connection shown in Figure 1. If the arrangement 120 is a ceiling connection it will be appreciated that the connector parts 122 and the further horizontal beam 118 should lie in the same orientation shown in Figure 10 to provide the shoulders 126 and the bearing surfaces 130.

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Figure 11 shows an exploded diagram of the further horizontal beam 118 of Figure 10. Like features to the arrangement of Figures 9 and 10 are shown with like reference numerals. In Figure 11 the further horizontal beam 118 comprises two elongate side plates 134, 136, an elongate top plate 138, and an elongate bottom plate 140 which are
 10 secured together form an elongate four-sided hollow box. A tongue 108 and groove 110 arrangement is also shown for securing the elongate side plate 134, 136 to the elongate top plate 138 and the elongate bottom plate 140 in a similar manner to the box beam 52 in Figure 9. In Figure 11 the plates 134, 136, 138, 140 are fixed together using glue and screws such that the elongate top plate 140 abuts a side surface of each elongate side
 15 plate 134, 136. Similarly the elongate bottom plate 138 abuts a side surface of each elongate side plate 134, 136. It can be seen that the elongate side plates 134, 136 are wholly between the elongate top plate 140 and the elongate bottom plate 138. Also shown are the cutaway 128 and the bearing surface 138, which are provided in each elongate side plate 134, 136. The cutaways 128 are rectangular in shape such that each
 20 cutaway 128 forms the bearing surfaces 130.

Figure 12 shows an exploded diagram of the vertical box beam 98 of Figure 8. In Figure 12 features similar to the arrangement of Figure 8 and 11 are shown with like reference numerals. In Figure 12 the vertical box beam 98 comprises four plates or panels 142,

144, 146, 148 to form an elongate four-sided hollow box. The tongue 108 and groove 110 arrangement is also shown for securing the first panels 142, 144 to the second panels 146, 148 in a similar manner to the further box beam 118 in Figure 11. In Figure 11 the panels 142, 144, 146, 148 are fixed together using glue and screws such that the first panels 142, 144 abut side surfaces of each second panel 146, 148. It can be seen that the second panels 146, 148 are wholly between the first panels 142, 144. The first panels 142, 144 have a cross section of 0.04m X 0.21m in dimension. The second panels 146, 148 have a cross section of 0.04m X 0.13m in dimension.

Figure 13 shows a diagram of a roof truss 150 secured to the building component 12 in Figure 1, generally designated 150. In Figure 13 like features to the arrangements of Figure 1 are shown with like reference numerals. In Figure 13 the ceiling beam 15 and the upright beam 13 of the building component 12 are shown. A wall plate 152 is secured to the top of the building component, and the roof truss 150 is secured to the wall plate 152.

The above embodiments describe ways for constructing the building components 12, 14, 16, 18 using ladder beams 22, 23, 24 and box beams 11, 13, 15, 52, 98, 118. It will be appreciated that once assembled into the timber-framed building structure 10, the building components 12, 14, 16, 18 can be joined together as required to form living spaces such as a bathroom, a shower room, a kitchen, a staircase, a bedroom, a dining room, or a living room. Such a building structure 10 may be assembled into a complete building of up to three or more storeys.

The manner of construction of the complete building described above permits the building to be manufactured at a factory location, such as a warehouse or a yard, and then transported by lorry to a building site. The complete building can then be lifted into place on a foundation base, such as a concrete base, using a crane. It will be appreciated
5 that the manner of construction of the complete building provides the structural integrity and suitable weight to permit the completed building to be lifted onto a lorry and then lifted onto foundations at a building site. It will also be appreciated that the building may also be provided with house fixtures, fittings and furnishings at the factory location and prior to transporting the completed building to the building site.

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It will also be appreciated that the manner of construction described herein provides additional benefits to the building process, and to the finished building itself. These additional benefits may include an improved health and safety record for manufacture of the building because it is made in a factory environment which is a more controlled and
15 safer environment. With the prior art way of construction accidents may be more likely to happen because building sites are more difficult environments in which to control health and safety factors. With embodiments of the invention the improvements to the finished building may include an improved thermal efficiency when compared to the prior art because the building has been manufactured in a more controlled environment.
20 Furthermore, the finished building may be able to be manufacture with reduced wastage of materials, such as off cuts of wood, because waste is more easily controllable in a factory environment.

- Manufacture and assembly of a building in such a manner means that complete houses can be manufactured on a production line at a factory location. This is a more efficient manner of constructing a building than assembling the building at the building site and provides the advantage of reducing the time to assemble the building. Such a manner of
- 5 construction is further assisted by the use of softwood, which is a lightweight building material when compared to conventional bricks and blocks. The softwood is an engineering grade timber such as C16 Welsh Sitka Spruce or Douglas fir which is a readily available timber from a sustainable source such as a managed forest. The use of such a softwood timber is made possible using the building techniques described herein.
- 10 Using such a softwood timber reduces the environmental impact of constructing the building, and may improve the overall energy efficiency for such a building. This may further improve the overall efficiency and reduced environmental impact for the building over its lifetime.

CLAIMS

1. A corner joint for a timber-framed building structure comprising a first hollow beam, a second hollow beam, and an insert having two arms, each arm being located in
5 each hollow beam for securing the first and second hollow beams together, the first hollow beam having a cutaway at an end thereof and in a side-wall thereof, one arm of the insert being located in the first hollow beam so that at least a part of the other arm is located in the cutaway.
- 10 2. A corner joint according to claim 1, wherein the insert comprises a laminated structure.
3. A corner joint according to claim 2, wherein each laminate comprises a first part and a second part, said parts comprising the arms of the insert.
- 15 4. A corner joint according to claim 3, wherein first and second parts of adjacent laminates overlap at a corner of the insert.
5. A corner joint according to any of claims 2 - 4, wherein the laminated structure
20 is glued and/or fastened together.
6. A corner joint according to any preceding claim, wherein the two arms are perpendicular.

7. A corner joint according to any preceding claim, wherein at least one of the first hollow beam and the second hollow beam comprises four panels to form a box, a first opposing two of the four panels abutting perpendicular edge surfaces of a second opposing two of said four panels.

5

8. A corner joint according to claim 7, wherein the cutaway is provided in one of said first opposing panels.

9. A corner joint according to claim 7 or 8, wherein adjacent panels are provided with a channel and groove arrangement for securing them together.

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10. A corner joint according to claim 7, 8 or 9, wherein the panels are secured together with glue and/or fasteners.

11. A corner joint according to any preceding claim, wherein said arms of the insert are of substantially equal length.

15

12. A corner joint according to any preceding claim, wherein an end of the second hollow beam abuts a side surface of the first hollow beam.

20

13. A corner joint according to any preceding claim, wherein the first and/or second hollow beams are secured to the insert with fasteners.

14. A corner joint according to any preceding claim, and further including at least one fixing plate secured to a side thereof.

15. A corner joint according to claim 14, wherein the at least one fixing plate
5 provides a shoulder on the corner joint.

16. A method of assembling a corner joint for a timber-framed building structure comprising a first hollow beam having a cutaway at an end thereof and in a side-wall thereof, a second hollow beam, and an insert having two arms for securing the first and
10 second hollow beams together, the method including:

inserting one arm of the insert into the first hollow beam so that at least a part of the other arm is located in the cutaway; and

inserting the other arm into the second hollow beam.

15 17. A method according to claim 16, and further including securing the first hollow beam and/or the second hollow beam to the insert using at least one fastener.

18. A method according to claim 16 or 17, wherein the two arms are perpendicular.

20 19. A corner joint for a timber-framed building structure comprising a first beam, a second beam, and a connector to secure the first beam to the second beam, the connector being dispersed between the first beam and the second beam and located on a side of the first beam, the connector having at least one shoulder for abutment of at least one bearing surface of the second beam.

20. A corner joint according to claim 19, wherein the at least one shoulder is provided by a first cutaway of the connector.

5 21. A corner joint according to claim 19 or 20, wherein the at least bearing surface is provided by a second cutaway of the second beam.

22. A corner joint according to claim 19, 20 or 21, wherein the connector has two cutaways on either side of the connector to provide two shoulders.

10

23. A corner joint according to any of claims 19 - 22, wherein the second beam has two cutaways on either side to provide two bearing surfaces.

24. A corner joint according to any of claims 19 - 23, wherein the first beam is
15 perpendicular to the second beam.

25. A corner joint according to any of claims 19 - 24, wherein the connector is secured to the first beam with fasteners and/or glue.

20 26. A corner joint according to any of claims 19 - 25, wherein and the second beam is secured to the corner joint with fasteners and/or glue.

27. A corner joint according to any of claims 19 - 26, wherein at least one of the first beam and the second beam comprises four panels to form a box, a first opposing

two of the four panels abutting perpendicular edge surfaces of a second opposing two of said four panels.

28. A corner joint according to claim 27 when appended to claim 21, wherein the at
5 least one cutaway of the second box beam is provided in at least one of said second opposing two of said four panels.

29. A corner joint according to claim 27 or 28, wherein adjacent panels are provided with a channel and groove arrangement to secure them together.

10

30. A corner joint according to any of claims 19 - 29, and further including at least one fixing plate secured to a side thereof.

31. A method of assembling a corner joint for a timber-framed building structure
15 comprising a first beam, a second beam, and a connector to secure the first beam to the second beam, the connector dispersed between the first beam and the second beam and having at least one shoulder, the method including:

securing the connector to the first beam on a side of the first beam; and

abutting the second beam to the connector so that at least one bearing surface of
20 the second beam abuts the at least one shoulder.

32. A method according to claim 31, and further including securing the second beam to the connector using at least one fastener.

33. A method according to claim 31 or 32, wherein the first beam is perpendicular to the second beam.

34. A corner joint comprising the corner joint of any of claims 1 – 15, and the
5 corner joint of any of claims 19 – 30, or manufactured according to any of claims 16 - 18, or claims 31 - 33.

35. A joist comprising two substantially parallel elongate members spaced apart from each other by at least one connecting member, the at least one connecting member
10 to secure the elongate members together, wherein the connecting member is suitable for fixing the joist in position in a timber-framed building structure.

36. A joist according to claim 35, and further including at least one fixing member substantially at an end of the joist to further secure the two elongate members together,
15 wherein the connecting member or the fixing member is suitable for fixing the joist in position in a timber-framed building structure.

37. A joist according to claim 35 or 36, wherein the elongate members and the connecting members are comprised of natural wood having a wood grain, wherein the
20 wood grain of the elongate members and the connecting members runs substantially along the length of the joist.

38. A joist according to any of claims 35 - 37, when appended to claim 36, wherein the fixing member is comprised of natural wood having a wood grain running substantially perpendicularly to the elongate members.

5 39. A joist according to any of claims 35 - 38, wherein one of the at least one connecting member and one of the elongate members is provided with a channel, and the other of the at least one connecting member and one of the elongate members is provided with a tongue, the tongue and channel for cooperation with each other for securing the at least one connecting member to the at least one elongate member.

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40. A joist according to any of claim 35 - 39, wherein the elongate members and the at least one connecting member are secured together by glue and/or fasteners.

41. A joist according to any claims 35 - 40, when appended to claim 36, wherein the
15 elongate members and the fixing member are secured together by glue and/or fasteners.

42. A joist according to any of claims 35 - 41, further including a plurality of connecting members.

20 43. A joist according to claim 42 where the plurality of connecting members are spaced apart along the length of the joist.

44. A joist according to any of claims 35 - 43 when appended to claim 36, and further including an elongate fixing plate for fixing the joist in position in a timber-

framed building structure, the elongate fixing plate abutting the fixing member, wherein the elongate fixing plate and the joist are substantially perpendicular to each other.

45. A joist according to any of claims 35 - 44, when appended to claim 36, wherein
5 the fixing member is set back from an end of the joist so that the fixing member and free ends of each elongate member form a hand.

46. A joist according to claim 45 when appended to claim 43, wherein the hand is arranged to hold the elongate fixing plate.

10

47. A joist according to any of claim 35 – 46, manufactured as a prefabricated building component.

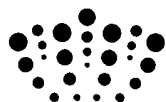
48. A joist, or a corner joint as substantially described herein with reference to
15 Figures 1, 2, 3, and 13, or 1 and 3 - 13 of the accompanying drawings.

49. A wall, floor, or ceiling manufactured according to any of claims 16 - 18, or claims 31 – 33, or comprising a corner joint according to any of claims 1 - 15 or 19 - 30, or comprising a joist according to any of claims 35 – 47.

20

50. A building manufactured according to any of claims 16 - 18, or claims 31 – 33, or comprising a corner joint according to any of claims 1 - 15 or 19 - 30, or a joist according to any of claims 35 - 47.

51. A timber-framed building structure manufactured according to any of claims 16 - 18, or claims 31 – 33, or comprising a corner joint according to any of claims 1 - 15 or 19 - 30, or a joist according to any of claims 35 - 47.



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Claims searched: 1 - 18

Date of search: 5 February 2010

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1 - 3, 5, 6, 11, 12, 16, 18	US 5494369 A (STOCK) see especially figures 2 and 5

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^X:

Worldwide search of patent documents classified in the following areas of the IPC

F16B

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
F16B	0007/04	01/01/2006