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(54) **System for the construction of mixed wood and concrete floors, and the components required to join the two materials**

(57) This invention relates to a system for the construction of mixed floors, of the type in which a concrete slab is supported by wooden beams.

In particular, the invention relates to A System for the construction of mixed wood and concrete floors, wherein in order to join the wood and concrete firmly, a plurality of seatings (4) with undercuts are cut into the wooden beams, and a set of interconnection elements (3) are inserted into said seatings and project from them for a certain distance, so that they are embedded in the concrete that completes the slab.

The seatings (4) cut into the wooden beams have a dovetailed cross-section, said connectors (3) are shaped so that they can be inserted like a spring into said seatings, with ends (7) projecting from the seatings so that they are embedded in the concrete, and said elements are elastically deformed by bringing the wings closer together so that they can be inserted in said seatings.

As the connectors are fitted simply by inserting them by hand into their seatings, with no need for the use of tools or the like, the work is accelerated, and the system is not only cheaper but also accelerates floor construction operations.

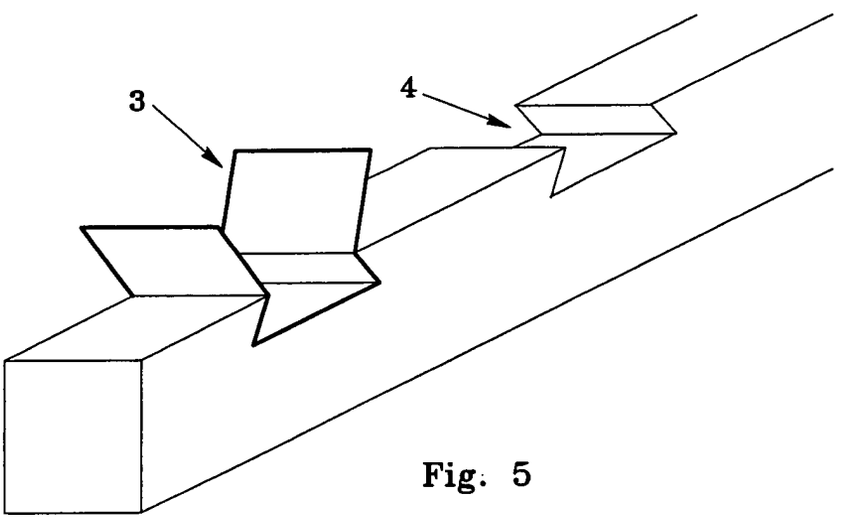

Fig. 5

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Description

[0001] This invention relates to a system for the construction of mixed floors, of the type in which a concrete slab is supported by wooden beams.

[0002] In particular, the invention relates- to the system of connecting the two materials; a plurality of seatings with undercuts, in particular seatings with a dovetailed cross-section, are formed in the beams, and connectors with wings that project upwards, so that they are embedded in the subsequent concrete casting that completes the slab, are inserted like a spring into said seatings.

[0003] The concrete also penetrates into said connectors, locking them in position.

[0004] As the connectors are fitted simply by inserting them by hand into their seatings, with no need for the use of tools or the like, the work is accelerated, and the system is not only cheaper but also accelerates floor construction operations.

[0005] In recent years, following improvements in woodworking technologies and the subsequent introduction of laminated wood structures into the construction industry, this material has become very popular, and is used increasingly often in the civil construction field to make floors.

[0006] The known technology involves laying the beams on the supporting structure of the building, inserting suitable partition elements, such as panels or the like, between the beams, laying reinforcement, and completing the floor by casting a concrete slab.

[0007] The problem faced by experts working in this field is to join the wood and concrete firmly, because the moment of inertia of the sections, and consequently the stress in the various materials, can only be increased by consolidating these elements.

[0008] The adherence between the concrete and the wood is insufficient to ensure the necessary strength, so various systems have been designed which involve inserting into the wooden beams metal elements which project from the top of said beams and are embedded in the concrete to absorb the shearing stresses.

[0009] Various technologies which enable this result to be achieved are known in the state of the art.

[0010] In some cases steel mesh is inserted into a groove in the beam and secured with resins to ensure the necessary adherence to the concrete.

[0011] In other cases metal connectors are secured to the beams; the threaded section of said connectors is screwed into the wood, while the remainder projects from the top of the beam and is embedded in the concrete slab.

[0012] However, the strains that these connection elements transmit to the wood may cause bearing stress, with consequent loss of the rigidity of the structure and the associated drawbacks.

[0013] Italian patent no. 1,278,262 describes composite products made of wood and concrete of the type comprising small wooden beams joined to complementary structural concrete elements by means of metal connectors, wherein said connectors are applied dry, each connector being constituted by a lag screw and a substantially two-dimensional element applied to the beam at the point of application of the lag screw, in order to counteract the bearing stress on the wood.

[0014] The connectors illustrated in this patent consist of a threaded stem which is screwed into the wood and a plate, integral with said stem, which compresses the wood at the point where the lag screw is inserted.

[0015] These known systems require rather laborious work to fit the connectors, because holes of suitable dimensions need to be drilled in the beams and the connectors then inserted and screwed into them.

[0016] The present invention, which falls into this sector, offers a system for the construction of floors with a mixed wood and concrete structure, wherein the two materials are joined by connectors applied to the beam by inserting them by means of elastic deformation into dovetailed seatings, without the aid of tools or instruments.

[0017] This invention will now be described in detail, by way of example but not of limitation, by reference to the annexed figures wherein:

- figures 1, 2 and 3 show a front view, side view and plan view respectively of a connector used in the construction system according to the invention;
- figure 4 shows a cross-section of a headpiece connector used in the construction system according to the invention;
- figure 5 schematically illustrates in perspective view a wooden beam in which is a connector according to the invention is inserted;
- figures 6 and 7 show two sections of a floor made with the construction system according to the invention, along two directions which are orthogonal to one another;
- figures 8 and 9 show two enlarged details of the floor illustrated in figures 6 and 7;
- figures 10, 11 and 12 schematically illustrate, the first in cross-section and the other two in perspective view, a particular embodiment of a connector according to the invention, designed to be used in the headpiece, when wooden beams need to be anchored to the edge of the construction.

[0018] As shown in figures 4 to 6, the construction system according to the invention involves joining wooden beams 1 to a concrete slab 2 by means of connectors 3.

[0019] For this purpose a set of grooves 4, having a dovetailed cross-section or another cross-section that presents an undercut, each of which said grooves is designed to house a connector 3, is cut into the beam, for example by milling with machine tools.

[0020] Seatings 4 are orthogonal to beam 1, and are

spaced sufficiently far apart to ensure that the intermediate section of beam is large enough to guarantee that the wood will withstand sliding stresses.

[0021] The connectors are made of sheet metal such as steel or another suitable material, and have the shape more clearly shown in figures 1-3.

[0022] In practice, each of said connectors has a base wall 5 and two side walls 6, which converge slightly upwards and are connected to a pair of divergent wings 7.

[0023] The dimensions of base 5 and side walls 6 are substantially equal to the dimensions of the groove into which the connector is inserted, with wings 7 projecting above the beam.

[0024] The inclination of walls 6 is slightly less than that of the corresponding walls of the groove, so that when the connector has been inserted, the elastic force that tends to reopen walls 6 locks the connector into its seating.

[0025] Wings 7 are designed to be embedded in the subsequent concrete casting. On the upper edge of wings 7 there is a cavity 8 which can act as a seating for the floor reinforcement mesh or rods, which are thus retained at a certain height, ensuring a sufficiently thick covering.

[0026] Connectors located close to the headpieces of the beams may present a wing 13 which is long enough to be anchored in the concrete edge, as illustrated in figure 10.

[0027] Alternatively, brackets 14 may be fitted, as shown in figures 11 and 12; said brackets 14 hook onto the connector of the beam headpiece on one side and are embedded in the concrete edge on the other.

[0028] To fit the connectors to the beams, it is sufficient to deform them slightly, overcoming the elastic force of the material to bring the side walls closer together, and then insert the connector into the dovetailed seating in the beam.

[0029] When the connector is released the walls will tend to open, pressing against the walls of the seating and locking the connector in position.

[0030] With the solution described, the connectors can be attached to the wood without the use of the mechanical or chemical fixing elements required by the systems according to the prior art.

[0031] In order to construct the floor, when the beams have been positioned on the load-bearing structure, the panels or partition elements of the ceiling, shown as no. 15 in figures 7, 8 and 9, are rested on the edge of the beams, the reinforcement of the slab is positioned by resting steel rods and/or mesh 16 on the upper edge of connector wings 7, and the slab is completed with a concrete casting. If steel rods are used, they can be rested in cavities 8 in the edge upper of the wings, which will thus keep them raised by a few centimetres, ensuring that they are sufficiently covered with concrete.

[0032] An expert in the field could devise various modifications and variations, all of which should be deemed to fall within the ambit of this invention.

Claims

1. System for the construction of mixed wood and concrete floors, **characterised in that** in order to join the wood and concrete firmly, a plurality of seatings (4) with undercuts are cut into the wooden beams, and a set of interconnection elements (3) are inserted into said seatings and project from them for a certain distance, so that they are embedded in the concrete that completes the slab.

2. Construction system as claimed in claim 1, **characterised in that** said seatings (4) cut into the wooden beams have a dovetailed cross-section, said connectors (3) are shaped so that they can be inserted like a spring into said seatings, with ends (7) projecting from the seatings so that they are embedded in the concrete, and said elements are elastically deformed by bringing the wings closer together so that they can be inserted in said seatings.

3. Construction system as claimed in claim 2, **characterised in that** said wings of said connectors are divergent and said connectors are shaped so as to press elastically against the inclined walls of the dovetailed seatings.

4. Construction system as claimed in claim 2, **characterised in that** said connectors are constituted by spring elements that present a rear wall (5) and a pair of side walls which converge in a first section (6) starting from said rear wall and diverge in a second terminal section (7), the dimensions of base (5) and said first section (6) of said walls being substantially equal to the dimensions of the walls of the dovetailed seating (4), and the inclination of first section (6) of the walls of said connector being less than the inclination of the walls of seating (4), so that the walls of said spring connector press elastically against the walls of the corresponding seating.

5. Construction system as claimed in any of the preceding claims, wherein said connecting elements (3) are open at the top to enable the concrete to penetrate into them.

6. Construction system as claimed in any of the preceding claims, **characterised in that** it includes connectors designed to be positioned at the headpieces of the beams, which said connectors have at least one wing (13) that extends outwards, so that it is embedded in the concrete edge and in any event engages with the reinforcement of said edge.

7. Construction system as claimed in any of the preceding claims, **characterised in that** the free edge of said connectors (3) contains a cavity (8), suitable to constitute the seating for a reinforcing rod which

is also designed to be embedded in the concrete.

8. Construction system as claimed in claim 1, **characterised in that** said connection elements are applied without the aid of mechanical or chemical fixing elements.

9. Elements designed to connect a wooden beam and a concrete slab in order to construct floors with a mixed structure, **characterised in that** they consist of steel springs having, in cross-section, a first section (5, 6) with a dovetailed shape suitable to be inserted into corresponding seatings (4) in the wooden beams, and one or more wings (7) which project from the top of the beam, and are designed to be embedded in the concrete.

10. Connection elements as claimed in claim 8, **characterised in that** the space between the side walls thereof is a large enough to allow the concrete to penetrate into the connector.

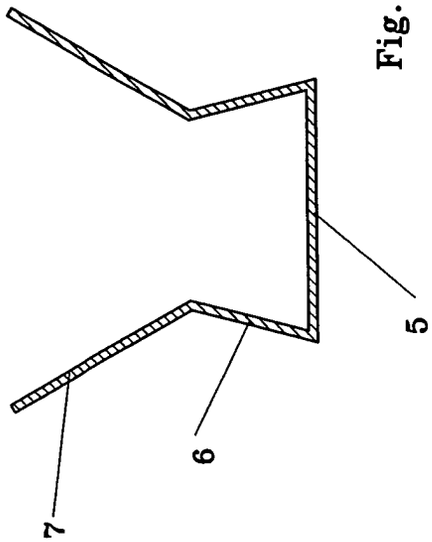

Fig. 1

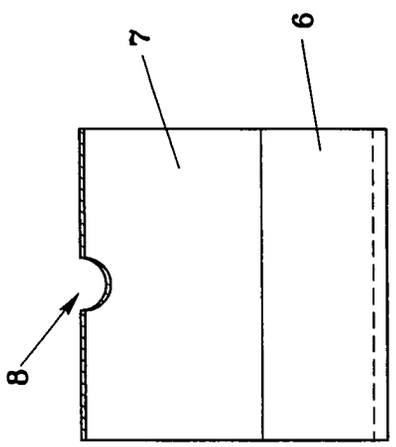

Fig. 2

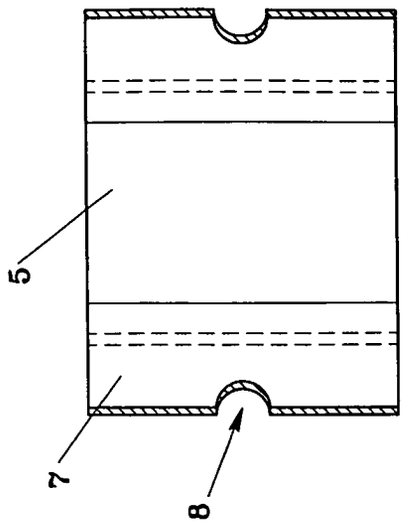

Fig. 3

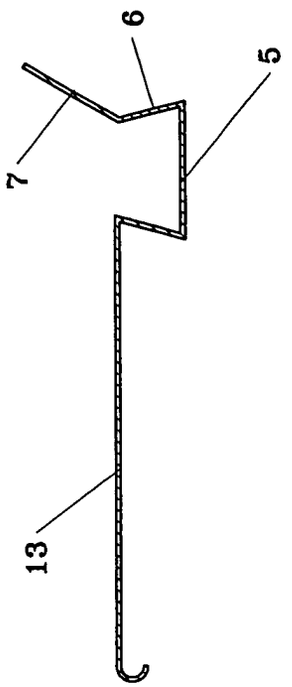

Fig. 4

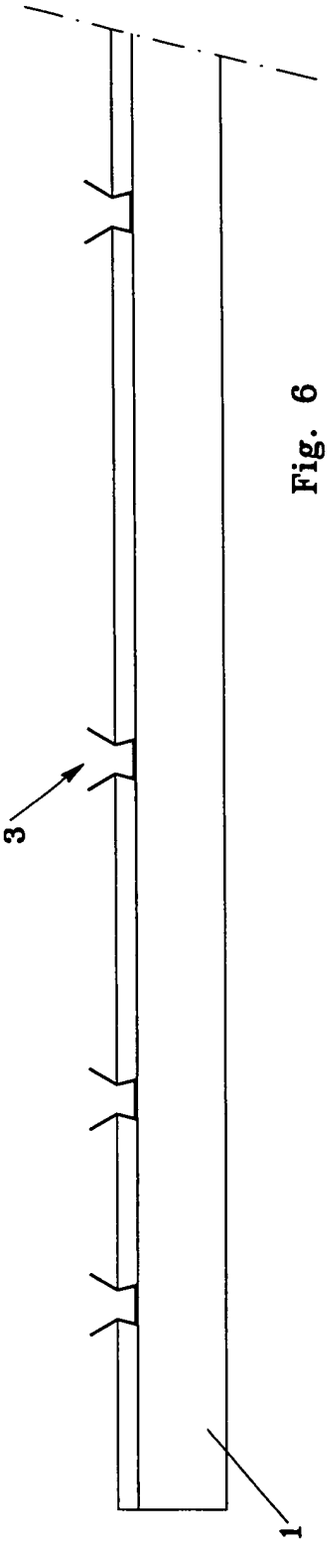

Fig. 6

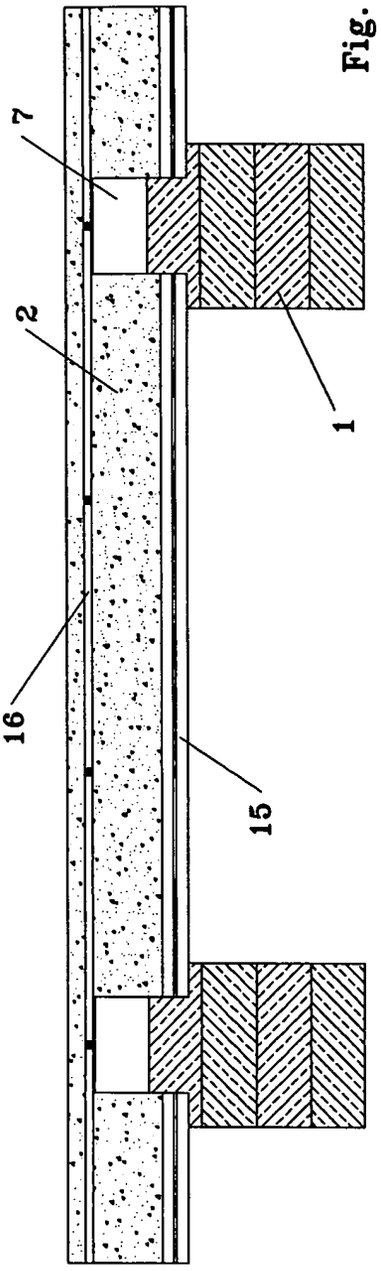

Fig. 7

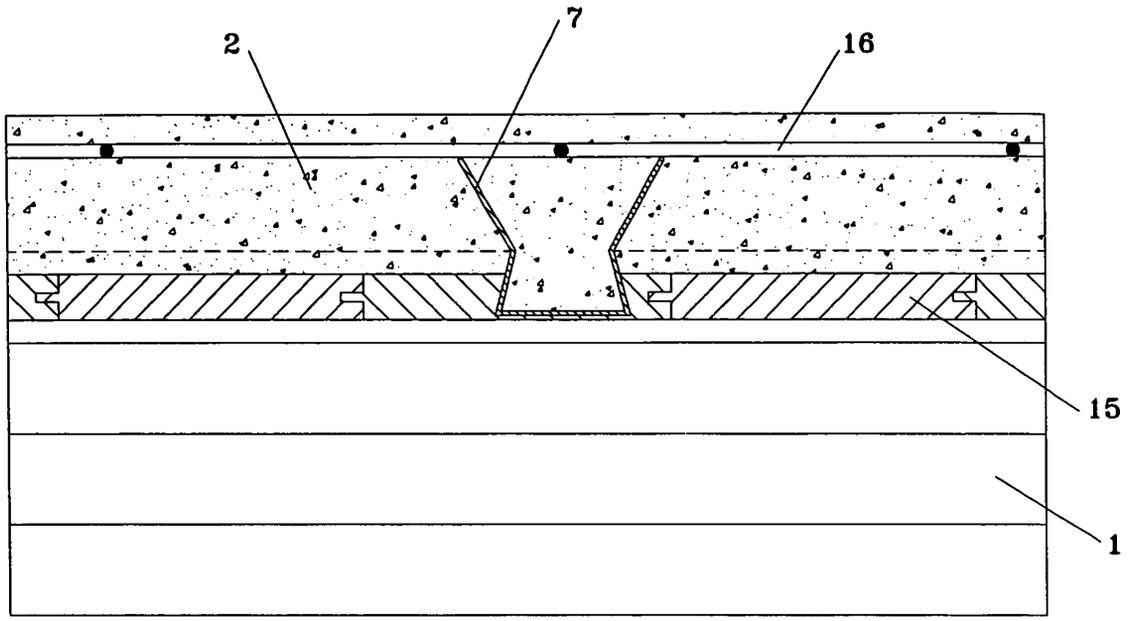

Fig. 8

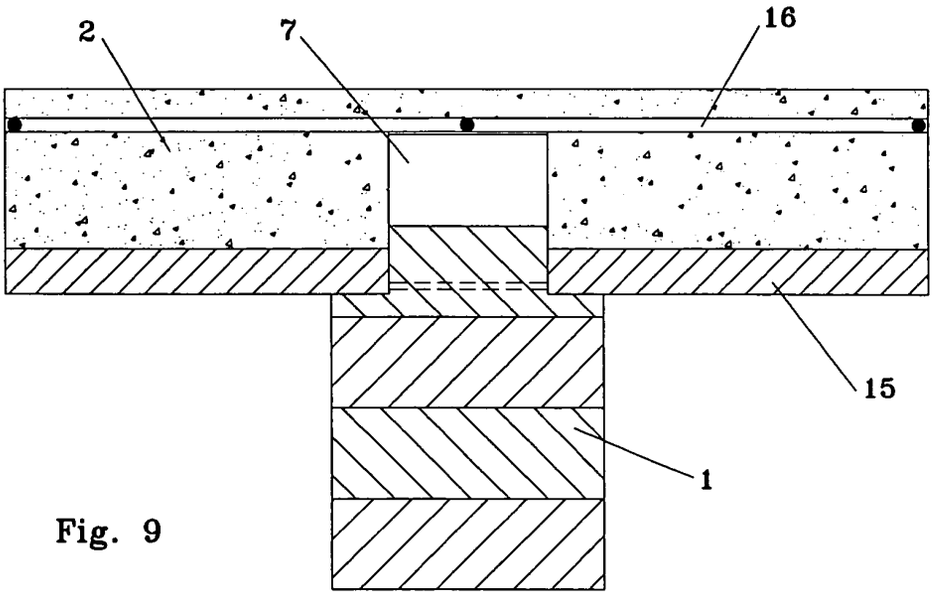

Fig. 9

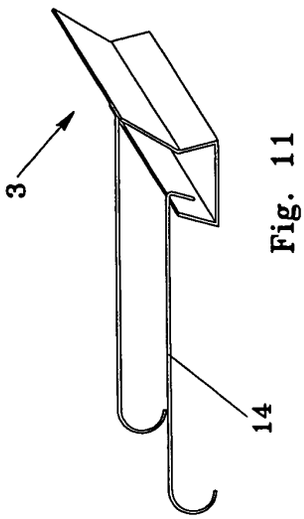

Fig. 11

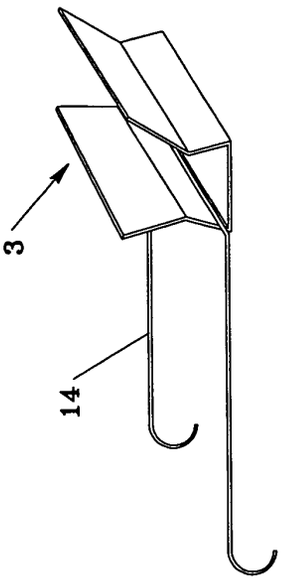

Fig. 12

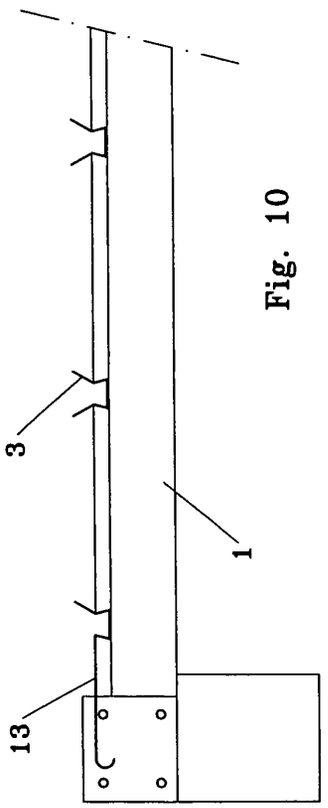

Fig. 10

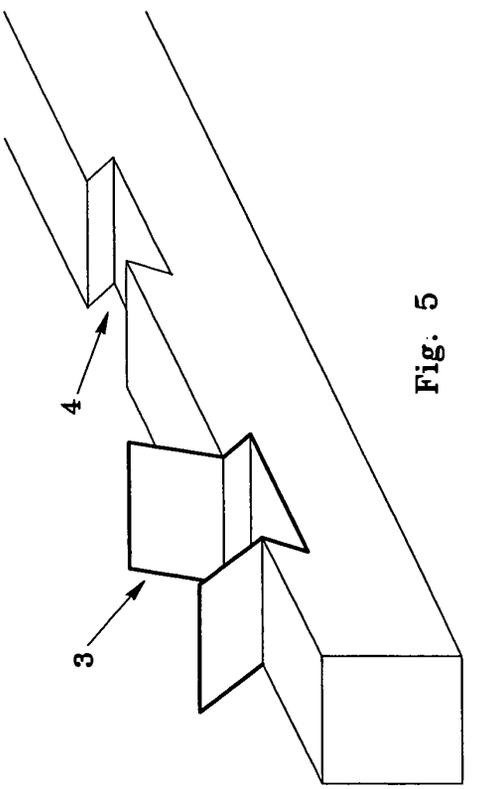

Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 00 4976

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 June 2005	Hendrickx, X

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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