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(54) **System for the construction of mixed wood and concrete floors**

Bausystem für Holzbetonverbunddecke

Système de construction pour planchers mixtes en bois et béton

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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 connec-

tors, 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] DE-C-673.556 discloses a system for making mixed wood and concrete floors, in which, for improving adherence between the two materials, a series of metal connectors are provided.

[0017] These connectors are inserted into seatings with undercuts provided in the wooden beams, and project from them for a certain distance, so that the projecting part can be embedded in the concrete.

[0018] No means is provided for locking the connectors in their seatings.

[0019] US-A-6.186.698 discloses connecting elements apt to connect a wooden beam and another structural element.

[0020] The connecting element is formed as a rail section and includes at least two elastic legs cooperating as a pair having a free outer end.

[0021] The legs are bendable to one another into a compressed condition. The outer sides of said legs are mutually divergent towards the free outer end, and are received in a groove where they resiliently engage the planar side wall portions of the groove of the construction member for holding the connecting element in the groove by friction. The connecting element also has one or more wings that project from the top of the beam.

[0022] This connection element is locked by means of metallic elements inserted into the connectors.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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.

[0035] 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.

[0036] When the connector is released the walls will tend to open, pressing against the walls of the seating and locking the connector in position.

[0037] 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.

[0038] 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.

[0039] 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.

25 Claims

1. 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 wooden beams (1), and a set of interconnection elements (3) are inserted into said seatings (4) and project from them for a certain distance, so that they are embedded in the concrete that completes the floor, **characterised in that** said seatings (4) cut into the wooden beams have a dovetailed cross-section, and said connectors are constituted by spring elements that present a rear wall (5) and a pair of side walls (6) which converge in a first section starting from said rear wall (5) and diverge in a second terminal section (7), the dimensions of the rear wall (5) and said first section of said walls (6) being substantially equal to the dimensions of the walls of the dovetailed seating (4).
2. System for the construction of mixed wood and concrete floors according to claim 1, **characterized in that** the inclination of first section (6) of the walls of said connectors (3) is less than the inclination of the walls of seating (4), so that the walls of said spring connectors (3) press elastically against the walls of the corresponding seating.
3. Construction system as claimed in claims 1 or 2, **characterized in that** said connecting elements (3) are open at the top to enable the concrete to penetrate into them, the space between the side walls thereof being large enough to allow the concrete to penetrate into the connectors.

4. 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.
5. 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.

Patentansprüche

1. Bausystem zur Realisierung von Decken aus Holz und Beton, wobei man, um das Holz und den Beton fest miteinander zu verbinden, in den Holzbalken (1) eine Vielfalt von Sitzen (4) realisiert, die Unterschnitte aufweisen; in besagte Sitze (4) werden eine Reihe von Verbindungselementen (3) eingefügt, die eine gewisse Strecke herausragen, so dass sie in dem Beton zur Vervollständigung der Decke versenkt werden können, **gekennzeichnet durch** die Tatsache, dass besagte Sitze (4), die in den Holzbalken realisiert wurden, einen Schwalbenschwanzquerschnitt aufweisen; besagte Verbindungen bestehen aus federnden Elementen, die eine Bodenwand (5) und ein Paar Seitenwände (6) aufweisen, die im ersten Abschnitt, ausgehend von besagter Bodenwand (5), konvergieren und im zweiten Endabschnitt (7) auseinander gehen, wobei die Ausmaße der Bodenwand (5) und von dem besagten ersten Abschnitt besagter Wände (6) im Wesentlichen gleich sind wie die Ausmaße der Wände des Schwalbenschwanzsitzes (4).
2. Bausystem zur Realisierung von Decken aus Holz und Beton nach Anspruch 1, **gekennzeichnet durch** die Tatsache, dass die Neigung des ersten Abschnitts (6) der Wände von besagten Verbindungen (3) geringer ist als die Neigung der Wände des Sitzes (4), so dass die Wände der besagten federnden Verbindungen (3) elastisch gegen die Wände des jeweiligen Sitzes drücken.
3. Bausystem nach Anspruch 1 oder 2, **gekennzeichnet durch** die Tatsache, dass besagte Verbindungselemente (3) oben offen sind, um dem Beton zu erlauben, in ihr Inneres einzudringen, denn der Raum zwischen ihren Seitenwänden ist groß genug, dass der Beton ins Innere der Verbindung eindringen kann.
4. Bausystem nach einem jeglichen der vorherigen Ansprüche, **gekennzeichnet durch** die Tatsache,

dass es Verbindungen vorsieht, die in Übereinstimmung mit den Kopfenden der Balken positioniert werden, wobei besagte Verbindungen mindestens einen Flügel (15) haben, der sich nach außen verlängert, um im Beton der Bordschwelle versenkt zu werden und um jedenfalls eine Armierung der besagten Bordschwelle in Anspruch zu nehmen.

5. Bausystem nach einem jeglichen der vorherigen Ansprüche, **gekennzeichnet durch** die Tatsache, dass der freie Rand der besagten Verbindungen (3) eine Vertiefung (8) aufweist, die geeignet ist, den Sitz für ein Rundeseisen der Armierung zu bilden, das ebenfalls dazu bestimmt ist, im Beton versenkt zu werden.

Revendications

1. Système constructif pour la réalisation de planchers mixtes en bois et béton où, pour unir durablement le bois et le béton, on pratique, dans des poutres en bois (1), plusieurs logements (4) présentant des contre dépouilles et, dans lesdits logements (4), on insère une série d'éléments d'interconnexion (3) qui dépassent en partie de ces derniers de façon à être noyés dans le béton qui parachève la dalle, **caractérisé par le fait que** lesdits logements (4) réalisés dans les poutres de bois présentent une section en queue d'aronde, et que lesdits éléments d'interconnexion sont constitués d'éléments à ressort dotés d'une paroi de fond (5), et de deux parois latérales (6) qui, dans un premier tronçon à partir de ladite paroi de fond (5) convergent et, dans un deuxième tronçon terminal (7), divergent, les dimensions de la paroi de fond (5) et dudit premier tronçon desdites parois (6) étant pratiquement identiques aux dimensions des parois du logement en queue d'aronde (4).
2. Système constructif pour la réalisation de planchers mixtes en bois et béton selon la revendication n° 1, **caractérisé par le fait que** l'inclinaison du premier tronçon (6) des parois desdits éléments de connexion (3) est moins importante que l'inclinaison des parois du logement (4), de façon que les parois desdits éléments de connexion à ressort (3) exercent une pression contre les parois de leur logement respectif.
3. Système constructif selon la revendication n° 1 ou 2, **caractérisé par le fait que** lesdits éléments de connexion (3) sont ouverts dans la partie supérieure pour permettre au béton de pénétrer à l'intérieur, l'espace entre leurs parois latérales étant suffisamment important pour permettre au béton de pénétrer à l'intérieur de l'élément de connexion.
4. Système constructif selon une quelconque des re-

ventions précédentes, **caractérisé par le fait** qu'il prévoit des éléments de connexion à placer à hauteur des extrémités des poutres, lesdits éléments de connexion ayant au moins une aile (15) qui se prolonge vers l'extérieur pour être noyée dans le béton de la bordure et, quoi qu'il en soit, pour s'engager dans une armature de ladite bordure.

5. Système constructif selon une quelconque des revendications précédentes, **caractérisé par le fait** que le bord libre desdits éléments de connexion (3) présente une cavité (8) constituant le siège d'un rond à béton lui-même destiné à être noyé dans le béton.

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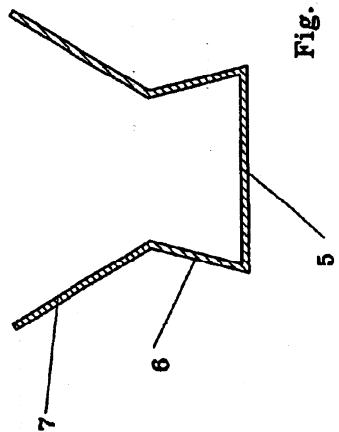


Fig. 1

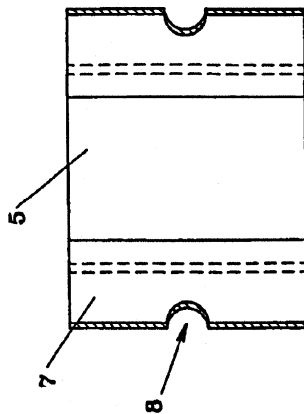


Fig. 3

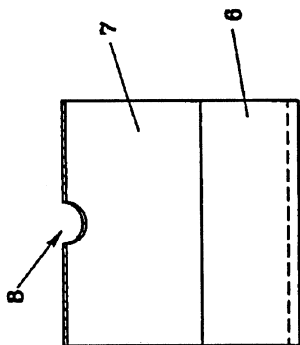


Fig. 2

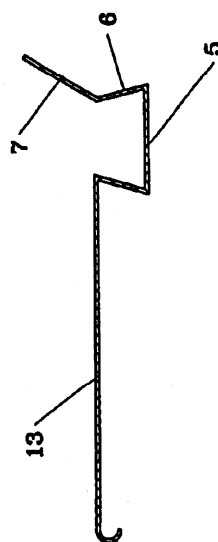
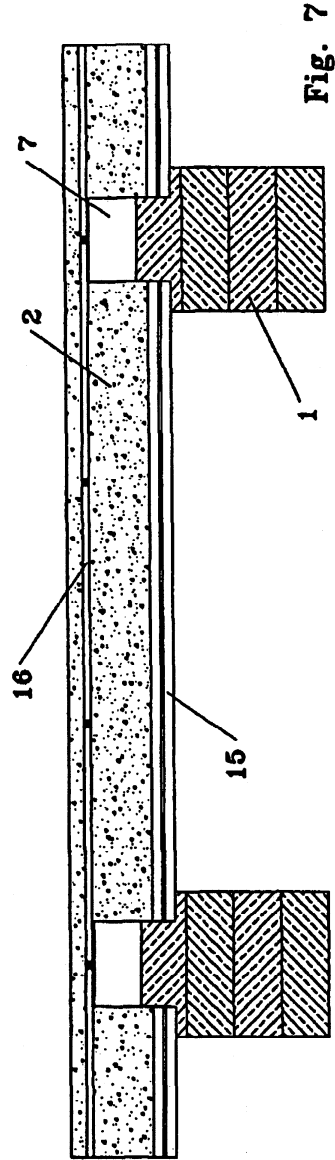
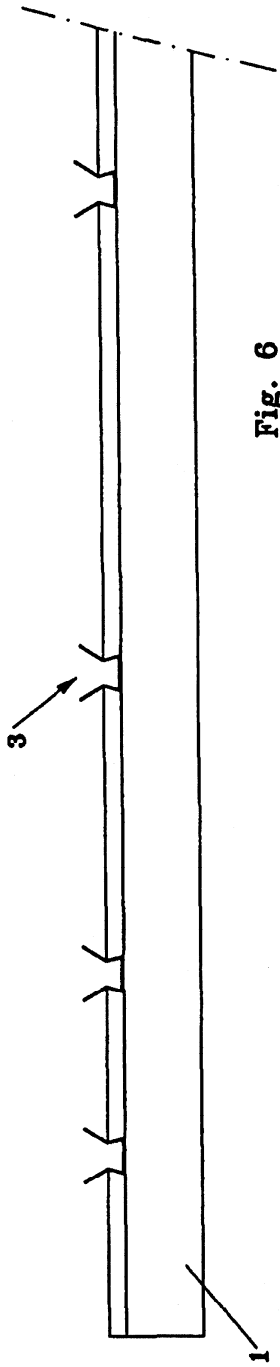


Fig. 4



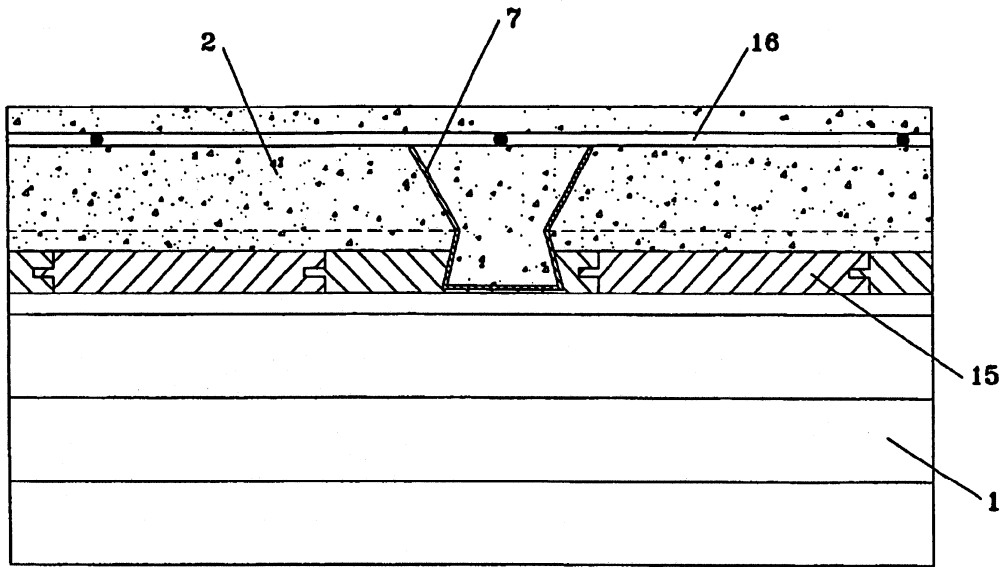


Fig. 8

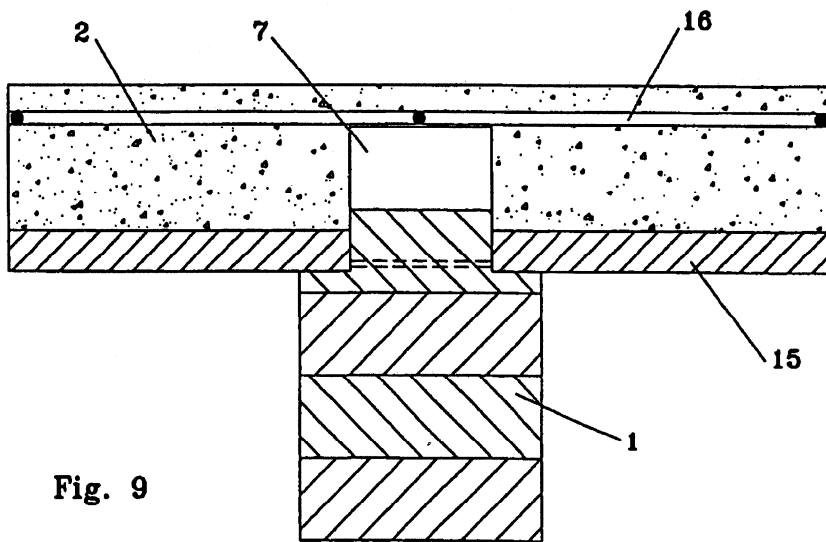


Fig. 9

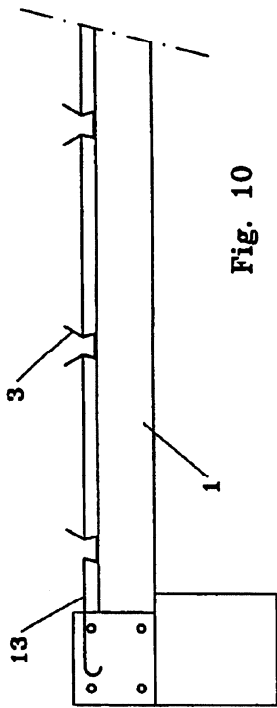


Fig. 10

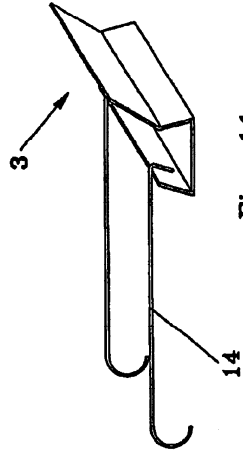


Fig. 11

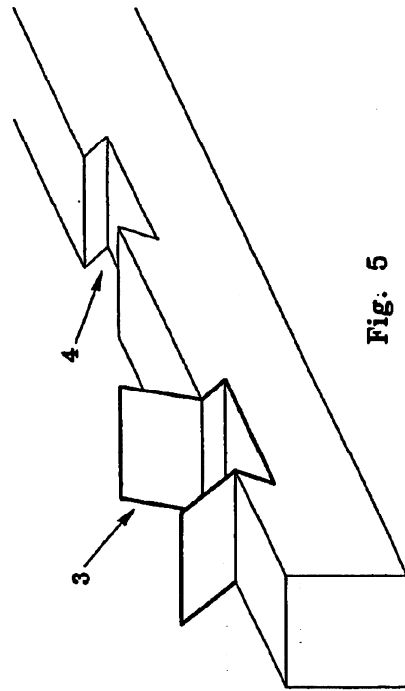


Fig. 5

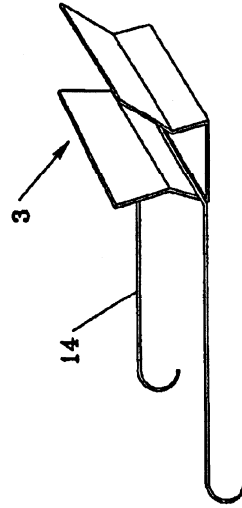


Fig. 12

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REFERENCES CITED IN THE DESCRIPTION

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