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(54) **CONSTRUCTION ELEMENT**

(57) The present invention relates to a structural element which is at least partly made from wood, such as a pile or plank, which element may be placed in the ground or in water and then partly protrudes above the

ground or above the water. The aforementioned element comprises at least two wooden components which are in principle non-releasably connected to each other.

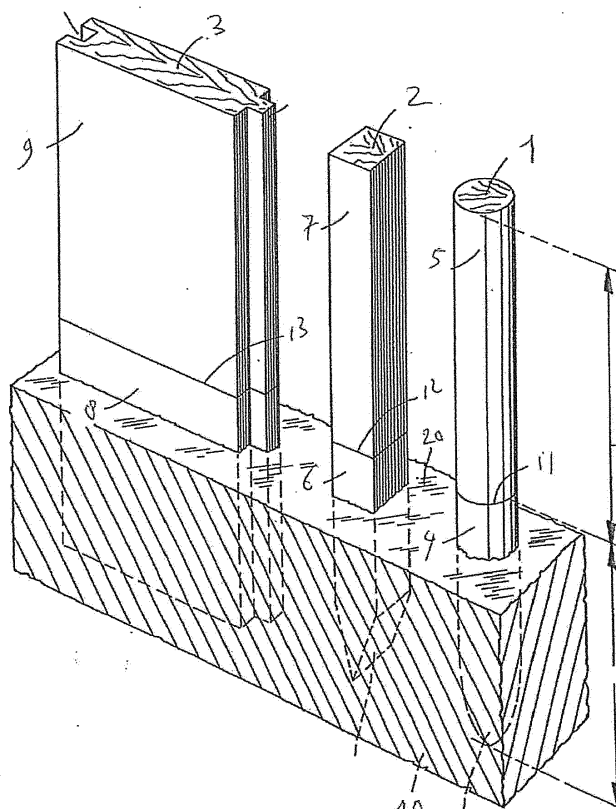


FIG. 1

Description

[0001] The present invention relates to a structural element which is made from wood, such as a pile or plank, which element may be placed in the ground or in water and then partly protrudes above the ground or above the water. The aforementioned element comprises at least two wooden components which are in principle non-releasably connected to each other.

[0002] Such an element is known, for example, from NL 1014570 in the name of the present Applicant. The structural element disclosed therein is made from wood and consists of at least two components of different types of wood which differ in terms of durability, viewed vertically, which components are in principle non-releasably connected to each other. The component which is placed in water is not preserved by chemical agents in order to prevent preserving agent from leaching out of the component and ending up in the water. According to this Dutch patent, the types of wood to be used are optionally preserved European softwood or hardwood. Hardwood may be tropical or European wood originating from trees which have been grown in Europe.

[0003] A similar structural element is also known from Dutch patent 1006984. The structural element disclosed therein is intended for making a bulkhead in order to protect banks and shores, which bulkhead consists of planks which are connected to connecting elements at regular intervals, with some planks being made from wood and some other planks being made of plastic. A disadvantageous aspect of the bulkheads constructed in this way is the fact that two fundamentally different materials are incorporated into one element, that is to say wood and plastic, which materials have different mechanical properties, such as for example bending strength, which may lead to undesirable situations, for example fracture.

[0004] A similar structural element is also known from Dutch patent 1014970. The structural element disclosed therein is configured such that a first part protrudes above ground level and a second part is at least partly situated below ground level, with the first part comprising wood of a first durability and the second part comprises a material of a second durability which is greater than the first durability of the first part. The second part is made of a plastic, with the plastic being obtained from a recycling process.

[0005] A similar structural element is also known from Dutch patent NL1031945. The structural hydraulics-engineering element disclosed therein comprises a first part and a second part which are tightly connected to each other by means of a connection comprising a melamine-containing adhesive, with the second part being intended to be arranged at least partly under water and with at least the second part comprising wood.

[0006] German Patent DE 808 280 discloses a wooden mast, in particular for electric cables, whose bottom part, which is situated in the ground and comes into contact with the ground part, is impregnated with a synthetic resin

and cured, with the bottom part impregnated with synthetic resin being cured using a press in heated form.

[0007] Next, structural elements made of wood, which are placed in the ground or in the water, are also known from German publication DE 41 31 941, US patent US 5,674,338 and British publication 167,948.

[0008] Usually, wood is divided into two main groups, that is to say hardwood (obtained from deciduous trees (forming part of the flowering plants or angiosperms)), and softwood (obtained from coniferous trees (forming part of the gymnosperms)) and it should be noted that, in general, softwood is softer than hardwood. The main group of softwood includes, inter alia, the following types of wood: pinewood (*Pinus silvestris*), larchwood (*Larix decidua* and *spp.*), Douglas-fir (*Pseudotsuga menziesii*), spruce (*Picea*), hemlock (*Tsuga spp.*), Parana pine (*Araucaria angustifolia*), maritime pine (*Pinus pinaster*), pitch pine (*Pinus spp.*).

[0009] A disadvantageous aspect of the commercially available structural elements is the fact that when two different main groups of wood are used in the same structural element, for example a combination of (tropical) hardwood and softwood, two materials with significantly differing mechanical properties are tightly connected to each other. As a result of these different mechanical properties, it is possible for stress concentrations to occur around this connection when it is subjected to loads, which may, in exceptional cases, result in fracture. This disadvantageous effect may occur, for example, in cases of overloading. A drawback of the structural elements which are commercially available is their fragility in case of overloading. This significantly increases the risk of fracture which constitutes a considerable limitation with regard to enjoyment and service life of the product. Because the dimensioning of wooden sheet pile structures and campsheeting is not always based on a thorough geological survey and a thorough calculation and because uncertainties always remain, even after a geological survey, there is a risk of failure. It is therefore desirable to reduce the aforementioned stress concentrations, in turn reducing the risk of failure which results in an increase in the enjoyment, the service life and the possible uses of structural elements.

[0010] Thus, when tropical hardwood and softwood are used in the same structural element, problems may occur which are linked to the bending moment of the wood. If a large force is applied to such a structural element, the element (usually) fractures just below the connecting area of the two types of wood.

[0011] Sheet piling and piles in which fir and tropical hardwood are combined, are an accepted alternative to (wooden) sheet piling and piles which are entirely made in one type of wood. Due to the fact that the mechanical properties of the types of wood from which such sheet piling and piles are composed are very different, it is possible that effects occur during installation and during use which were not anticipated by the constructor and the contractor. The reason for this is that constructors use

computing programs which do not, or not to a sufficient degree, take the different mechanical properties of the constituent parts into account. During installation of the sheet piling, the contractor, who is used to having to work with homogeneous planks or piles is also confronted with the different mechanical properties. The result thereof is a greater risk of failure than is desirable.

[0012] It is thus an object of the present invention to provide a structural element which lacks the abovementioned drawback, or an element in which the abovementioned drawback has been significantly reduced.

[0013] The structural element according to the present invention thus provides a structural element which is at least partly made from wood, such as a pile or plank, which element may be placed in the ground or in water and then partly protrudes above the ground or above the water, wherein the aforementioned element comprises at least two, in principle non-releasably connected wooden components, characterized in that the aforementioned components are made from the same main group of wood, wherein the one component is an untreated type of wood from the aforementioned main group of wood and the other component is a treated type of wood from the aforementioned main group of wood.

[0014] By using such a structural element, one or more objectives are met. In particular, the flexibility of the final structural element will increase by the use of two types of wood from the same main group. The aforementioned flexibility is inter alia due to a combination of mechanical properties, in particular a combination of, inter alia, bending strength and E modulus, which combination of mechanical properties ensures a significantly reduced risk of fracture. The present inventors have found that a structure which has been produced using such an element, for example a pile or sheet piling, has a greater resistance to fracture as the strength properties are more homogeneous than those achieved by using the commercially available structural elements.

[0015] In an embodiment of the present structural element, the aforementioned components are thus made from the same main group of wood. Such a choice of material makes it possible to use components having similar mechanical properties in one and the same structural element, thus improving the bending strength properties compared to those of a structural element in which different main groups of wood, for example softwood and hardwood, which each have their own, greatly differing E modulus and/or permissible bending strength, are used. In the present structural element, the aforementioned components are made from the same main group of wood, which also includes recycled materials.

[0016] As a suitable type of wood for use in the present structural element as a treated type of wood, the group of chemically modified wood is mentioned, in which case, in particular softwood Accoya (trademark) made of *Pinus Radiata* may be mentioned.

[0017] In the present structural element, one component is made from an untreated type of wood and the

other component is made from a treated type of wood, both forming part of the same main group of wood.

[0018] As an example of a treated type of wood, a modified type of wood is mentioned. It should be noted here that modification is a significantly different method than preservation. Modification means changing the properties of the material by adding one or more other substances, the aim of the modification being to improve the properties, for example improve the capacity to withstand the weather conditions and the environment. Modified wood does not obtain its good properties through toxicity, as is the case when preserving by means of copper-containing agents, but has become highly inert to biological attack as a result of the modification. Two methods of modifying wood may be mentioned. Thus, a chemical modification may be mentioned which modifies the structure of the wood. Thus, for example, with acetylated wood, the hydroxyl groups have been replaced by acetyl groups. And in the case of thermal modification the structure of the wood is also modified, often under pressure.

[0019] In an embodiment of the present structural element, none of the components have been preserved using chemical wood preservatives. The expression chemical preservation is understood to mean that the wood is able to withstand the activities of decomposing fungi, bacteria and insects. When preserving by means of biocides, a 'skin' of preserved wood is produced, as it were, without having to impregnate the wood to the core. The impregnated skin ensures that no insects can penetrate and that fungi do not find any nutrient medium for their growth. The thickness of the impregnated zone and the amount of active substances differs according to the type of wood and the application. It can thus be assumed that when preserving the wood, fungi and insects are kept at a distance and killed by the preservative (by the preserved wood being eaten by fungi and insects). During modification, the cell structure and molecular composition of the wood are changed in such a manner that fungi and insects no longer recognise the wood as being wood.

[0020] In an embodiment of the present structural element, the aforementioned two components of wood are in principle non-releasably connected to each other using a finger joint. The present inventors have thus realized that two components of the same main group of wood which have been connected to each other via finger joints, with only one part having been modified using an (environmentally friendly) agent, provide a unique durability and greatly improved results of the end product. The combined or assembled product of, for example, modified softwood has an expected service life of more than 40 years. With the known prior art combination using tropical hardwood, durability class 1, the service life is approximately 25 years. According to the present invention, the service life is thus nearly doubled (40 years compared to 25 years). As a result of this extension, the ground will also have to be disturbed less often and this has a significant ecological advantage. Examples of

structural elements according to the present invention which may be mentioned are: combinations of, for example, pine and fir, pine and larch, larch and fir, or other combinations of types of wood from the same main group of wood, but also the use of only one type of wood from the same main group of wood, for example only pine or only fir.

[0021] Research has shown that selection criteria for the modified wood are necessary in order to ensure that the mechanical properties of the chemically modified wood and the untreated wood match one another as closely as possible.

[0022] The requirements which are desirable for sorting the modified wood will thus, according to the present inventors, lead to sheet piling and piles of strength classes between C18 and C24. Thus, it is preferable in certain embodiments for the chemically modified wood to satisfy one or more of the following conditions:

- The maximum allowable gnarl size is 50 mm. This gnarl is uninterrupted.
- Gnarl has to be at a distance of at least 150 mm from the end which is to be finger-jointed (3x maximum gnarl size). At the head-end side, no minimum distance is necessary.
- Gnarl which are not uninterrupted (knotted gnarl) are not subject to any maximum gnarl size.

[0023] In this case, it is desirable for all gnarls to be fixed. In addition, it is desirable that no gnarls should be present in the fingerjointing area. From a mechanical point of view, it is preferable for uninterrupted open defects (ingrown bark, etc.) and resin ducts (from side to side) to be absent.

[0024] In order not to eventually end up with a structural element which has unsatisfactory mechanical properties, it is desirable for the maximum permissible gnarl size to be at most 50 mm in the aforementioned two wooden components, in particular gnarls of the continuous or uninterrupted type.

[0025] In one embodiment of the present structural element, it is desirable for gnarls to be at a minimum distance of 150 mm from the area in which the one wooden component is connected to the other wooden component.

[0026] In one embodiment of the present structural element, it is desirable for at most two gnarls having a diameter of at most 30 mm to be situated in one line, at right angles to the direction of the fibres of the type of wood used.

[0027] The present inventors have thus found that, by connecting two types of wood from the same main group of wood, the failure threshold of such a structural element is much higher than is the case with a structural element which is composed of two types of wood from different main groups of wood. By using a structural element according to the present invention, risk of failure during installation and the period of use is also reduced. Another

advantage is the fact that the weight of the structural element according to the present invention is less, as a result of which contractors can place the product using equipment which is less heavy, in which case it becomes simpler to place the sheet piling / piles. With regard to production, it should be noted that, after finger-jointing, the structural element according to the present invention is less fragile on the production line because both components of the structural element have a similar weight. In particular, it furthermore holds true that by adding selection criteria for the chemically modified wood, the mechanical properties of the chemically modified wood and the untreated (soft)wood correspond to each other as much as possible.

[0028] The present invention thus provides a sheet piling made from one or more structural elements as described above.

[0029] Furthermore, the present invention provides a pile made from one or more structural elements as described above.

[0030] The present invention also provides a ground structure in which one or more structural elements as described above are situated, wherein the transition between the aforementioned two components from the same main group of wood is situated aboveground. In the embodiment comprising a finger joint, this is preferably situated aboveground.

[0031] The present invention also provides a structure in an aqueous environment, that is to say a water structure, in which one or more structural elements as described above are situated, wherein the transition between the aforementioned two components from the same main group of wood is situated below the water level. In the embodiment comprising a finger joint, this is preferably situated below the water level.

Fig. 1 shows a structural element according to the present invention, installed in a ground structure.

Fig. 2 shows a structural element according to the present invention, installed in water.

Example

[0032] The attached Fig. 1 shows two piles 1, 2 and a plank 3, arranged in a ground structure 10 up to level 20. As is illustrated in the figure, the structural element 1 has a circular shape and the structural element 2 has a square shape. The piles 1 and 2 and plank 3 each consist of two components, that is to say 4, 5, respectively, 6, 7, respectively, and 8, 9, respectively, wherein the components 4, 6 and 8 are each made from a treated type of wood, that is to say modified, and the other components 5, 7 and 9 comprise an untreated type of wood, both types of wood belonging to the same main group of wood. The components 4 and 5 are preferably connected to each other via a finger joint 11. The same type of connection is used for components 6 and 7, via a finger joint 12, and for components 8 and 9, via a finger joint 13.

With the application in a ground structure, the finger joint has to be aboveground, as is illustrated in Fig. 1.

[0033] In the attached Fig. 2, which shows a positioning in an aqueous environment, for example a canal, two piles 1, 2 and a plank 3 are installed in an aqueous environment up to level 25. Piles 1, 2 and plank 3 are placed in solid ground 30, which ground 30 is situated under the aqueous environment. As is illustrated in Fig. 2, the structural element 1 has a round shape, the structural element 2 has a square shape and the structural element 3 has a rectangular shape. The piles 1 and 2 and plank 3 each consist of two components, that is to say 14, 22, respectively, 16, 23, respectively, and 18, 24, respectively, wherein the components 22, 23 and 24 are each made from a treated wood group, in particular by modification, and the other components 14, 16 and 18 comprise an untreated wood group, in which both wood groups are the same. The components 22 and 14 are preferably connected to each other via a finger joint 19. The same type of connection is used for components 16 and 23, via a finger joint 26 and components 18 and 24, via a finger joint 21. With the application in an aqueous environment, the finger joint 19, 26, 21 always has to be below the water level, as is illustrated in Fig. 2. In Fig. 2, component 14 is, for example, composed of untreated pine and component 22 of modified pine. In Fig. 2, component 16 is, for example, composed of untreated fir and component 23 of modified Radiata pine. In Fig. 2, component 18 is, for example, composed of untreated fir and component 24 of modified larch.

Claims

1. Structural element, at least partly made from wood, such as a pile or plank, which element may be placed in the ground or in water and then partly protrudes above the ground or above the water, wherein the aforementioned element comprises at least two, in principle non-releasably connected wooden components, **characterized in that** the aforementioned components are made from the same main group of wood, wherein the one component is an untreated type of wood from the aforementioned main group of wood and the other component is a treated type of wood from the aforementioned main group of wood.
2. Structural element according to Claim 1, **characterized in that** the aforementioned treated type of wood is to be understood to be a modified type of wood.
3. Structural element according to Claim 2, **characterized in that** the aforementioned modified type of wood is a chemically modified type of wood.
4. Structural element according to one or more of Claims 1-3, **characterized in that** the aforementioned main group of wood comprises the group of softwoods.
5. Structural element according to one or more of Claims 1-4, **characterized in that** none of the components are chemically preserved.
6. Structural element according to one or more of the preceding claims, **characterized in that** the aforementioned two components from the same main group of wood are in principle non-releasably connected to each other using a finger joint.
7. Structural element according to one or more of the preceding claims, **characterized in that**, in the aforementioned two components from the same main group of wood, the maximum gnarl size allowed is at most 50 mm, in particular gnarls of the continuous or uninterrupted type.
8. Structural element according to one or more of the preceding claims, **characterized in that**, in the area where the one component from the same main group of wood is connected to the other component from the same main group of wood, no gnarls are allowed to be at a distance of less than 150 mm from the aforementioned area.
9. Structural element according to one or more of the preceding claims, **characterized in that** at most two gnarls having a diameter of at most 30 mm are to be situated in one line, at right angles to the direction of the fibres of the main group of wood used.
10. Sheet piling made from one or more structural elements, as described in one or more of the preceding Claims 1-9.
11. Pile made from one or more structural elements as described in one or more of the preceding Claims 1-9.
12. Ground structure in which one or more structural elements as described in one or more of the preceding Claims 1-9 are situated, wherein the transition between the aforementioned two components from the same main group of wood is situated aboveground.
13. Water structure in which one or more structural elements as described in one or more of the preceding Claims 1-9 are situated, wherein the transition between the aforementioned two components from the same main group of wood is situated below the water level.

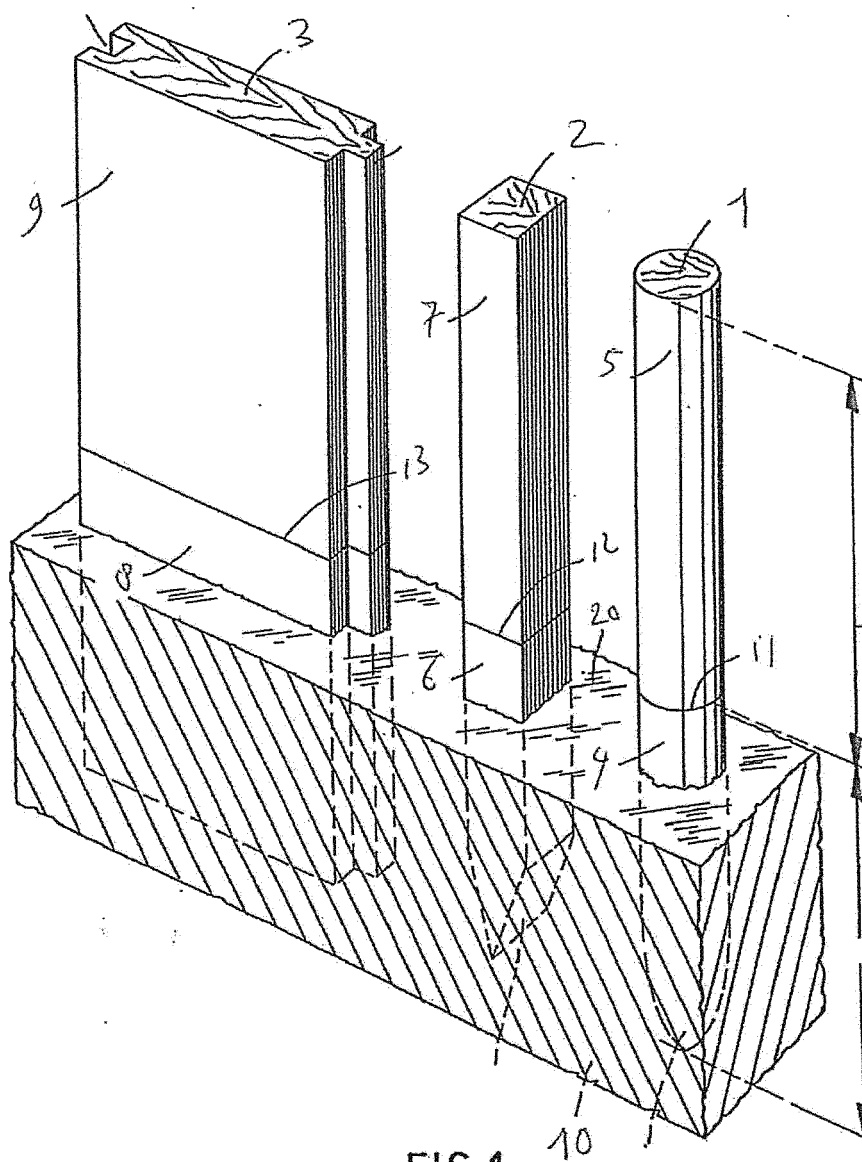


FIG. 1

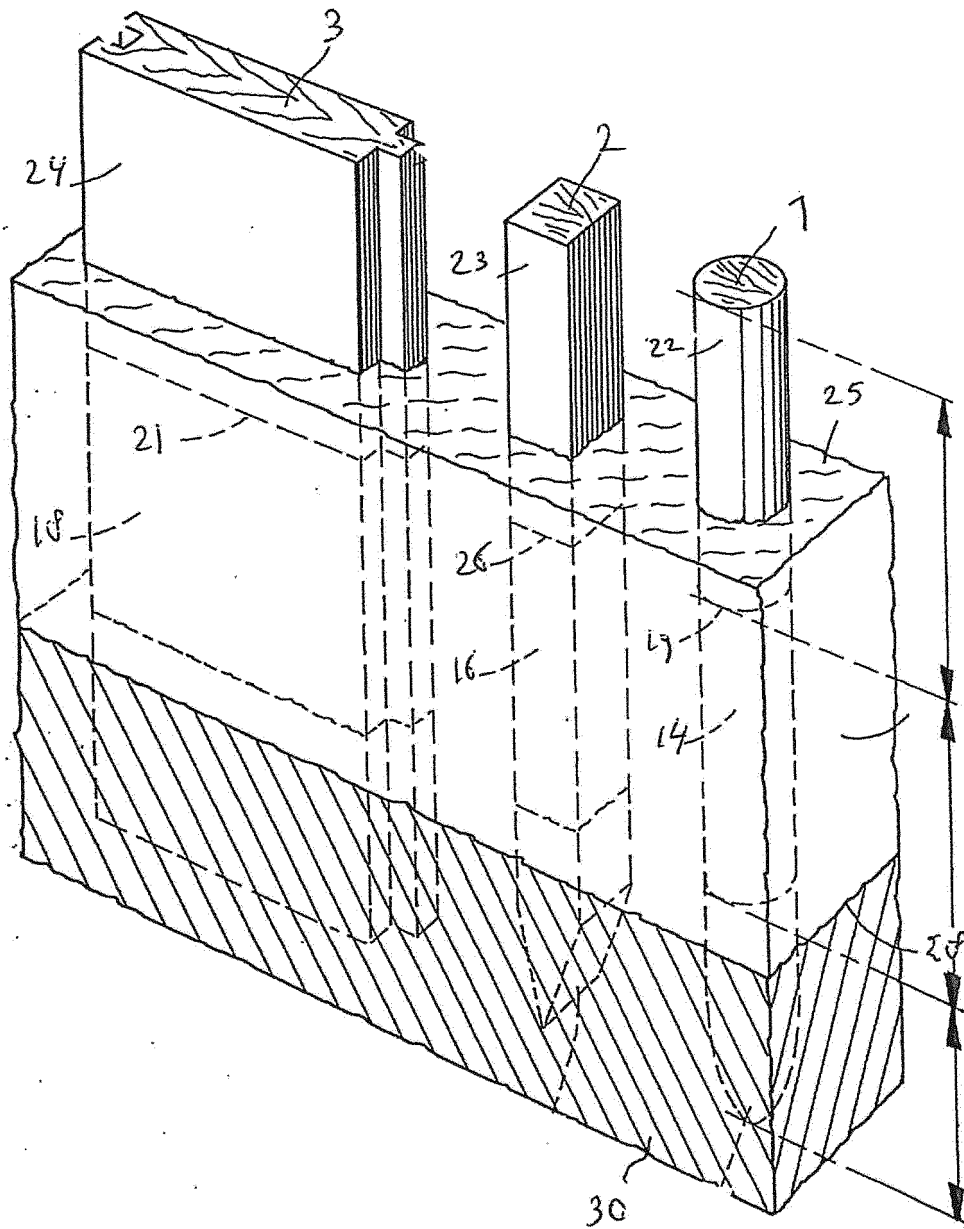


FIG. 2



EUROPEAN SEARCH REPORT

 Application Number
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EPO FORM 1503 03.82 (P04C01)

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 November 2019	Examiner Geiger, Harald
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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