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(54) Glued laminated timber beam or slab

(57) A glued laminated timber beam or slab (10) comprises one beam body (11) and one or two adjacent strips or sheets (12), separated by an adhesive interface (13) each, wherein the height of the adjacent strip (s) or sheet (s) (12) is between 15 and 25% of the height of the beam or slab (10).

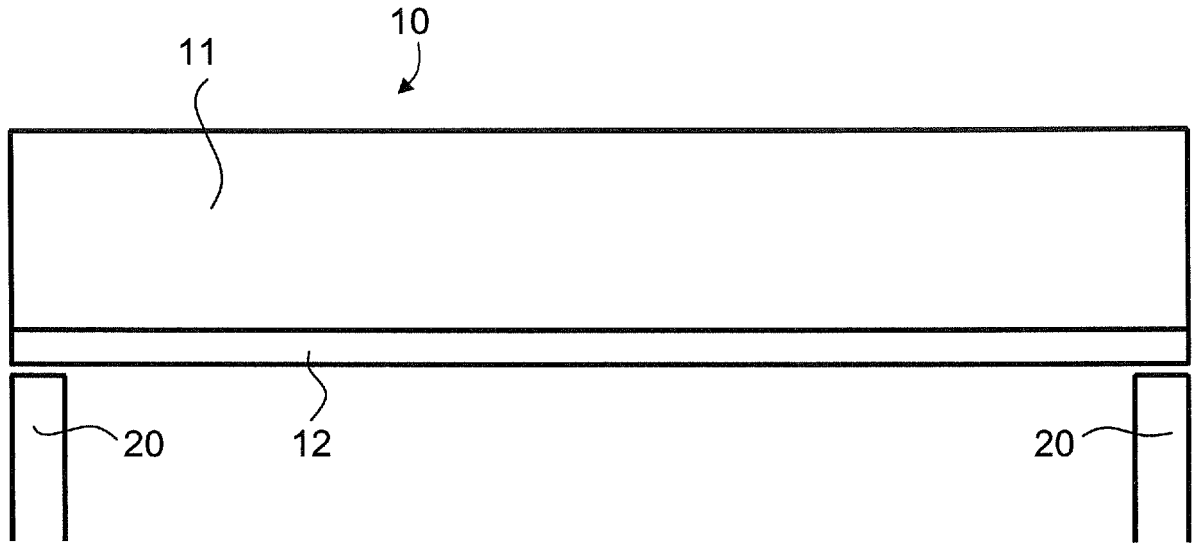

FIG. 1

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Description

Technical field of the invention

[0001] The invention is concerned with glued laminated timber beams, posts or slabs.

Technical background of the invention

[0002] EP 1 586 430 discloses a structural member constructed of a plurality of wood strips glued together wherein a layer of adhesive is provided between every two adjacent wood strips. The advantage of the said glued laminated timber beams or in short glulam beams is the improvement of the load-bearing behavior of such a structural beam.

[0003] However, it has to be noted that the advantage of such an improved load-bearing behavior necessitates some preparation work to prepare a beam comprising 8 to 20 of such glued wood strips.

Summary of the invention

[0004] Based on such prior art, it is an object of the present invention to provide a simpler and more economic glulam beam which shows the desired improved load-bearing behavior.

[0005] Additionally it is a further object of the invention to provide an improved method for repairing or strengthening beams which may show structural damage as e.g. disclosed in "Glulam beam repair /Reinforcement" by Gary W. Gray and Paul C. Gilham in "Structure Magazine", September 2006, pages 11 to 15.

[0006] It is a further object of the invention to provide an improved load-bearing behaviour for continuous beams with two or more spans.

[0007] Based on the structural beam as disclosed in the preamble of claim 1 a solution is provided comprising the features of claim 1 or claim 5.

Short description of the drawings

[0008] The invention is now described with reference to the enclosed drawings. These drawings show:

- Fig. 1 a schematic elevation of a simply supported beam or slab,
- Fig. 2 a schematic cross section of a beam according to an embodiment of the invention,
- Fig. 3 a further second embodiment of a beam according to the invention,
- Fig. 4 a schematic elevation of a two-span beam according to the invention,
- Fig. 5 a perspective view of an embodiment similar to Fig. 4 showing a continuous slab according to the invention, and
- Fig. 6 a schematic view of a slab on columns according to a further embodiment of the invention.

Detailed description of preferred embodiments

[0009] Fig. 1 shows a schematic elevation of the arrangement of a beam 10 according to the invention over two spans. The beam 10 comprises two parts 11 and 12 which are shown with their specific dimensions in Fig. 2. Beam 10 has a length allowing its use on two columns or walls 20 having a predetermined distance. Such a distance can be chosen between e.g. 5 and 25 meters. As known in prior art the beam 10 is arranged on the upper section of the wall or column 20. Beam 10 may extend beyond the wall 20 but is not supported in said section. In other words, only the portions shown in Fig. 1 are used for the simply supported beam.

[0010] Reference signs in Fig. 2 relate to the dimensions of the beam 10. The width b of the beam 10 is e.g. between 5 and 30 centimeters. The height of the beam 10 has received the reference sign h and can especially be chosen between 10 and 100 centimeters. In exceptional cases heights of over 1 meter may be possible. Said beam 10 comprises a lower thinner strip 12 and an upper major strip 11. The height of the lower strip is h_1.

[0011] The inventors have found that it is possible to obtain an improvement in bending resistance of the beam of about 20% if the beam 10 is made out of two wood strips wherein a thinner wood strip comprises a height h_1 being chosen between 10 and 25% of the overall height h of the beam 10.

[0012] It has been found that an improvement of load can be improved by 20% if h_1 is 17.5% of the height h of the beam 10. The calculation of the bending resistance of such a glued laminated timber shows that said property is always greater than 118% of a single beam if the height h_1 is between 15 and 25% of the height h of the entire beam 10.

[0013] The two wood strips 11 and 12, i.e. the main beam portion 11 and the thinner wood strip 12, are joined using an adhesive having the properties of the adhesive disclosed and used in EP 1 586 430. The adhesive for the adhesive interface 13 is preferably an adhesive showing a specific stiffness k/b, i.e. the stiffness k [N/mm^2] in relation to the width of the beam being covered by the adhesive b [e.g. 100 mm], depending on the relation L/h, i.e. free span length L of the beam 10 over the height h of the beam, L/h being usually between 15 and 25. Thus a preferred value of k/b is 0.3 for a value of L/h of around 20. A specific preferred shear modulus of the adhesive is between 40 and 80 N/mm, especially between 50 and 70 N/mm and one embodiment was tested with an adhesive having a shear modulus of 60 N/mm.

[0014] Fig. 3 shows a different embodiment of the invention, wherein the lower beam portion 12 is made out of two separate wood strips 21 and 22. The height of the two strips is h_1 and h_2, respectively. The sum of h_1 and h_2 is according to preferred embodiment almost equivalent to the height h_1 of the single wood strip of the embodiment according to Fig. 2. The adhesive interfaces 13 are identical to the single adhesive interface 13 of Fig.

1.

[0015] It is also possible to use other adhesives, especially adhesives from prior art, but an adhesive showing an extensive gliding under heavy loads is preferred.

[0016] The said improvement of about 20% of the bending resistance behavior may result in a loss of rigidity of about 20% as compared to conventional glulam. Thus in comparison to conventional glulam, the new product fails at a deformation increase of about 50%. Said results allows to use such an improved beam where a greater charge has to be accepted and in cases where a greater deformability is desired. Such beams are therefore especially suitable for the construction of bridges and/or constructions of roofs of all kind of halls. This is especially true for constructions in earthquake endangered areas.

[0017] A further object of the invention is related to a beam according to Fig. 4, showing a schematic side view of a two-span beam according to the invention.

[0018] The glued laminated timber beam 10 of Fig. 4 comprises one beam body 11 and one (or two) adjacent strip(s) 31, separated by different sections of an adhesive interface 32 and 33 as explained below, wherein the height of the adjacent strip(s) 31 is between 15 and 25% of the height of the entire beam 10.

[0019] The beam according to Fig. 4 is intended to be used in connection with a continuous beam of two or more spans, i.e. using side walls or columns 20 and one or more intermediate supporting portions 25. Fig. 4 only shows one intermediate supporting portion 25, but the beam 10 can also be supported at two or more intermediate positions and this has an influence on the adhesive interfaces 32 and 33.

[0020] Fig. 4 shows a schematic view of these interfaces 32 and 33. The beam 10 is positioned with its main body 11 on the supporting elements 20 and 25. The additional wood strip 31 is provided on the opposite side. At every supporting position the additional wood strip 31 is glued on the main body according to the same principles as shown in connection with the embodiments of Fig. 1 to 3, i.e. using an adhesive interface 33 allowing for a gliding connection, and, possibly, use of a so called elastic adhesive with a shear modulus between 40 and 80 N/mm. The length of the interface 33 stretches over an area between 1/10 and 1/3 of the span on both sides of the intermediate columns 25: thus each stretch has a total length of 2/10 - 2/3 of the span. The reminder of the adhesive interface 32 is a conventional rigid interface, especially using a rigid adhesive or a thinner glue layer. This is represented by the dotted line. As such a rigid adhesive Mirapur 9521 from Geistlich Ligamenta can be used, being an adhesive on polyurethane prepolymer basis.

[0021] Beside use of a different, more rigid, adhesive in the areas 32 in comparison to the areas 33, it is also possible to provide a recess of e.g. 0.5 to 1 millimeter within the body 11 to create room for a thicker glue layer in comparison to the interfaces 32, thus realizing the shear modulus as requested for.

[0022] Said reinforcement of the beam body 11 on the upper side reflects the different loading of a two-span beam construction, which suffers smaller shear stresses at midspan, whereas the greater shear stresses are concentrated in the areas directly over the supports.

[0023] Fig. 5 shows a perspective view of an embodiment similar to Fig. 4 showing a continuous slab 100 according to the invention. The slab 100 comprises a lower sheet 11 and a cover sheet 31 (not distinguished in Fig. 5), wherein the adhesive interface 33 is provided and schematically shown between said elements 11 and 31 in a region over the intermediate wall 25. The width of the adhesive interface 33 is preferably three to seven times the width of the intermediate wall 25.

[0024] Fig. 6 shows a schematic view of a slab 100 on columns 125 according to a further embodiment of the invention. The nine columns 125 are provided under the slab 100, which is positioned in a way that the adhesive surface 133 is centered on the columns. Preferably the adhesive surface 133 is circular or square and has a width between covers an area of between 1/10 to 1/3 of the span on both or all of the supporting columns 25.

[0025] The adhesive surface 133 corresponds to the areas 33 of the embodiment of Fig. 4 and 5, e.g. either provided within a recess of e.g. 0.5 to 1 millimeter within the body 11 of the slab 100 to create a room for a thicker glue layer in comparison to the interfaces 32, thus realizing the shear modulus as requested for. The surfaces beside the illustrated surfaces 133 are the conventional rigid adhesive interface areas.

[0026] Beside using the so called elastic adhesive having a shear modulus, preferably, between 40 and 80 N/mm, it is also possible to use a ductile adhesive as mentioned in EP 1 586 430, having an initial shear modulus of about 500 to 1000 N/mm for a range up to e.g. 0.1 to 0.3 millimeters. Said length provides a threshold value. For lengths beyond said threshold value the shear modulus becomes very small, e.g. changes to a value below 10 N/mm. Therefore an almost constant force between e.g. 100 and 200 N is available for additional lengths, i.e. it is possible to use an adhesive showing the properties according to Fig. 4 of EP 1 586 430.

[0027] Either approach results to an increase of the bending resistance in comparison to a conventional glulam beam by up to approx. 20%. Such a beam also exhibits 50% more deformability before failure, which is advantageous for constructions in regions with important risks of earthquake activity.

Reference signs

[0028]

10	beam
11	first part
12	second part
13	adhesive interface
20	wall / column

21 lower second part
22 upper second part
25 intermediate support
31 first portion
32 outer adhesive interface
33 supported adhesive interface
35 non-supported region
100 slab
125 column
133 column supported adhesive interface

Claims

1. Glued laminated timber beam or slab (10), comprising one beam body (11) and one or two adjacent strips or sheets (12; 21, 22), separated by an adhesive interface (13) each, wherein the height of the adjacent strip(s) or sheet(s) (12; 21, 22) is between 15 and 25% of the height (h) of the beam or slab (10).

2. Beam or slab (10) according to claim 1, wherein the adjacent strip(s) (12; 21, 22) are made from the same wood as the beam body (11).

3. Beam or slab (10) according to claim 1 or 2, wherein the shear modulus of the adhesive is between 40 and 80 N/mm, especially between 50 and 70 N/mm.

4. Beam or slab (10) according to claim 1 or 2, wherein the shear modulus of the adhesive starts with a value between 500 to 1000 N/mm for a range up to a threshold value of between 0.1 to 0.3 millimeters, then essentially changing to a value below 10 N/mm for length beyond said threshold value.

5. Beam or slab (10) according to one of claims 1 to 4 for use as a single-span beam, wherein the beam can be positioned with its strip (12; 21) on the supporting elements (20).

6. Beam or slab (100) according to one of claims 1 to 4 for use as a multi-span, especially two-span, beam or slab, wherein the beam can be positioned with its strip (31) on the opposite side of supporting elements (20), especially of intermediate supporting element (s) (25, 125).

7. Beam or slab (100) according to one of claims 1 to 4 and 6, wherein the adhesive interface (33, 133) opposite to any intermediate supporting element (25, 125) uses an adhesive comprising a shear modulus between 40 and 80 N/mm, especially between 50 and 70 N/mm.

8. Beam or slab (100) according to claim 6 or 7, wherein the adhesive interface (33, 133) opposite to any intermediate supporting element (25, 125) has a width covering an area of between 1/10 to 1/3 of the span on both or all of the supporting columns (25, 125).

9. Beam or slab (100) according to one of claims 6 to 8, wherein the adhesive interface (33, 133) opposite to any intermediate supporting element (25, 125) is provided within a recess, especially within a recess of 0.5 to 1 millimeters depth within the body of the beam or slab (100).

10. Beam or slab (100) according to one of claims 6 to 9, wherein outside the adhesive interface (33, 133) a thinner glue layer of the same adhesive as within the adhesive interface (33, 133) is provided.

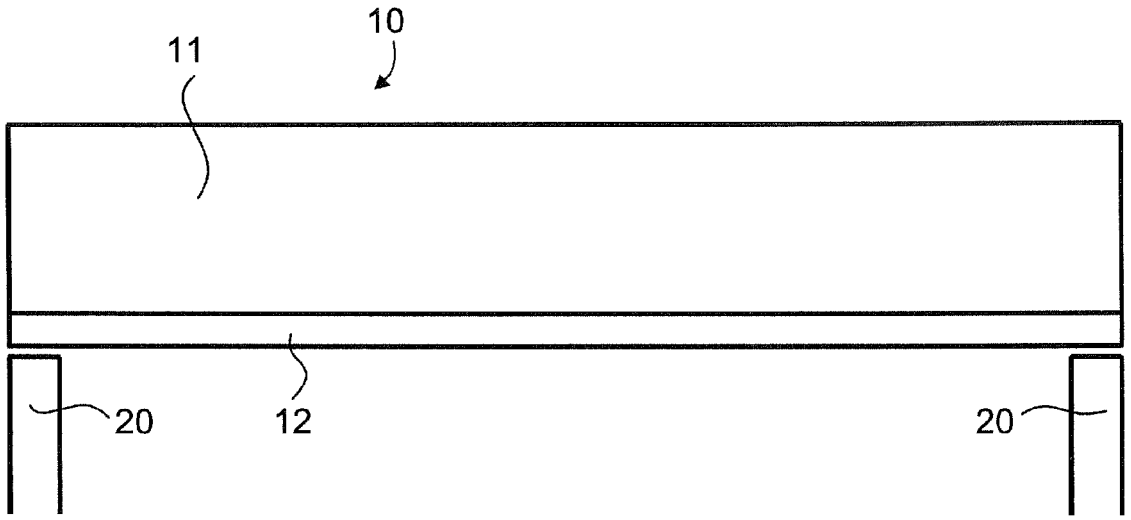

FIG. 1

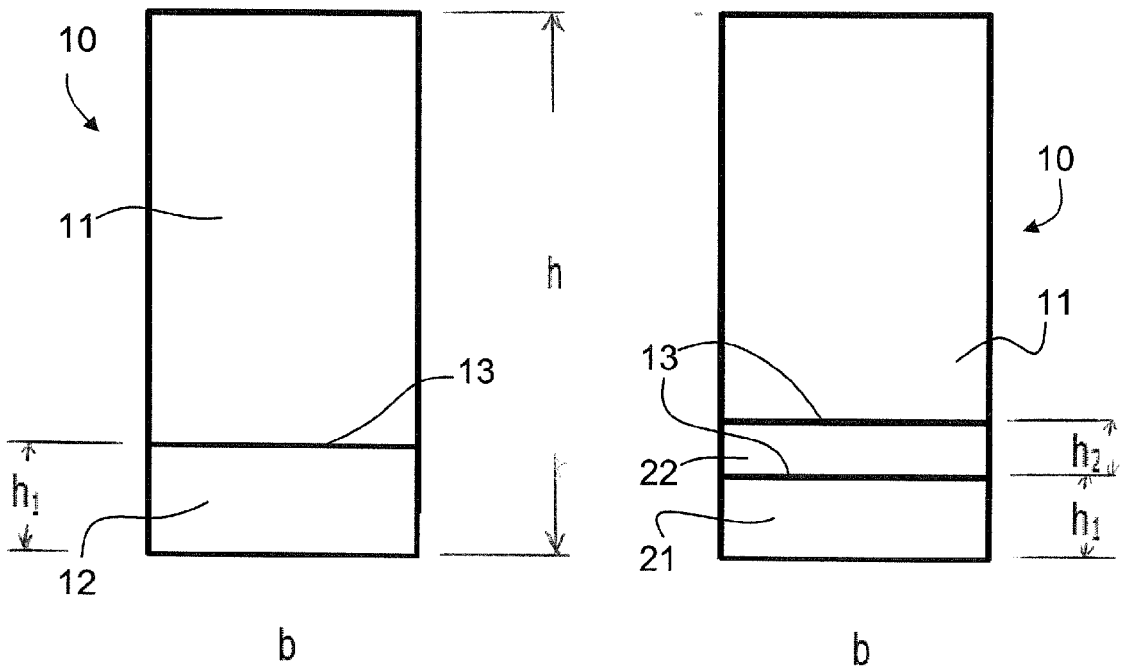

FIG. 2

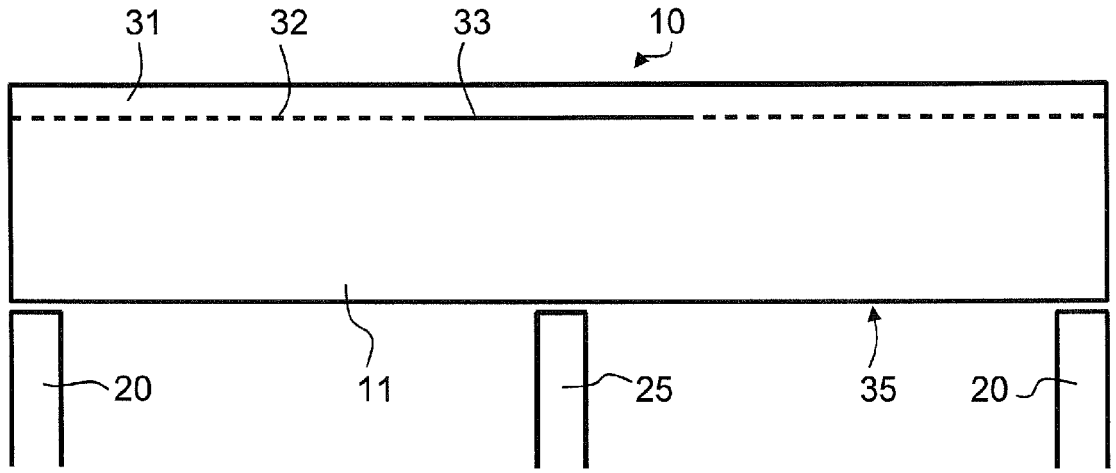

FIG. 4

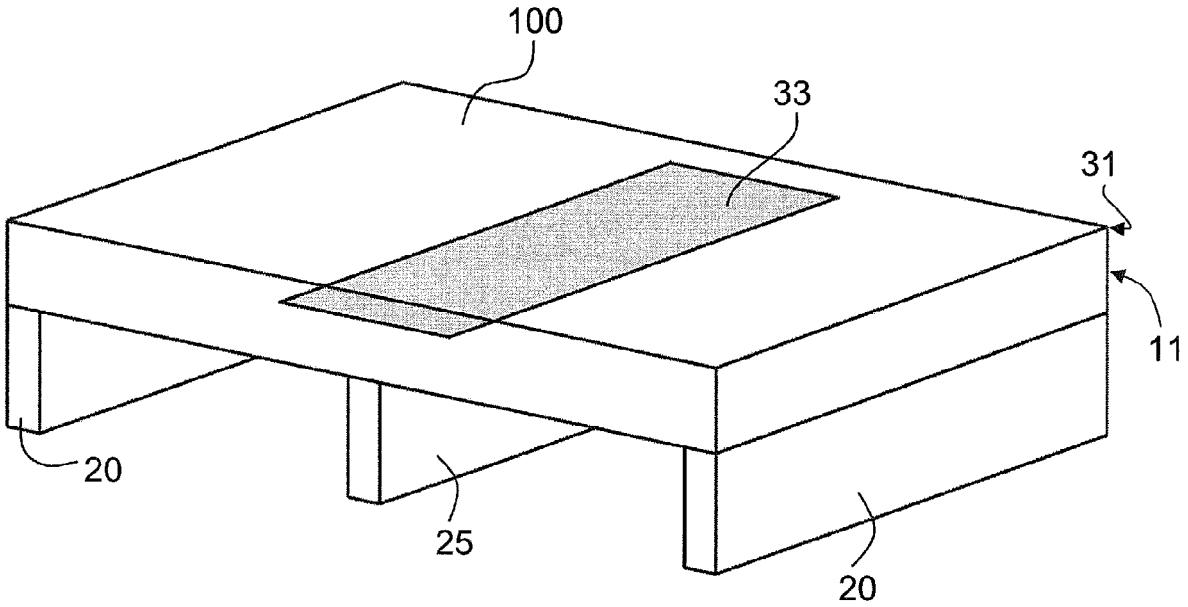

FIG. 5

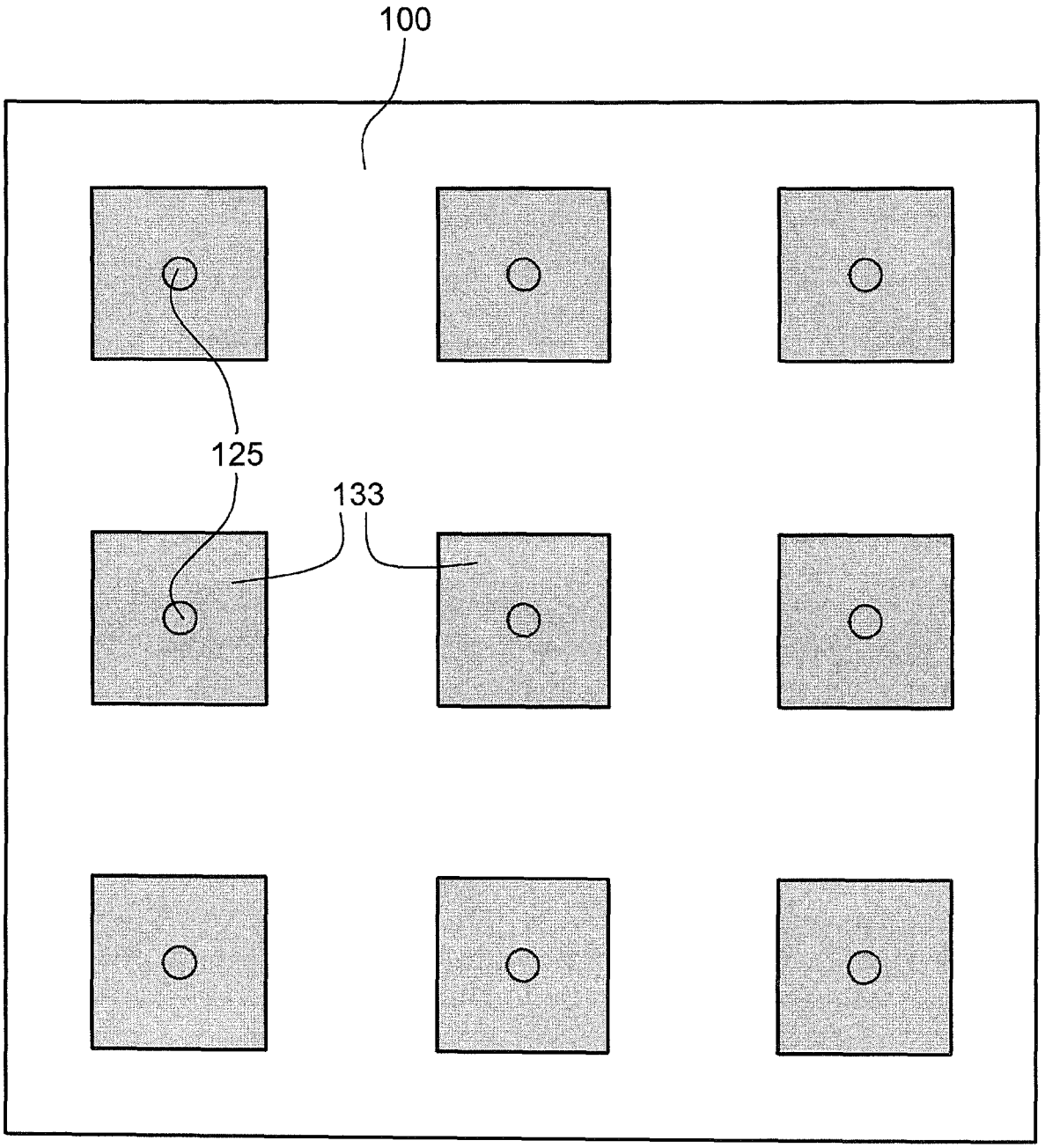

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 08 15 1457

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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	12 June 2008	Hamel, Pascal

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