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(54) Arrangement for the suspension of suspended ceiling elements.

(57) The invention concerns an arrangement for the suspension of suspended ceiling elements at a ceiling structure, wherein the suspended ceiling element (1) comprises suspended ceiling beams (3), a system of battens (4) and a flat plate (5), the lower surface of which constitutes a suspended ceiling support, and wherein the ceiling structure (2) comprises ceiling structure beams (6), where one or several of the ceiling structure beams is or are provided with suspension means (7). In order to achieve simple mounting of a suspended ceiling at a ceiling structure, the suspended ceiling element (1) comprises a suspended ceiling girder (8) that extends between two suspended ceiling beams (3), and the suspended ceiling girder (8) is surrounded by at least one of the said suspension means (7).

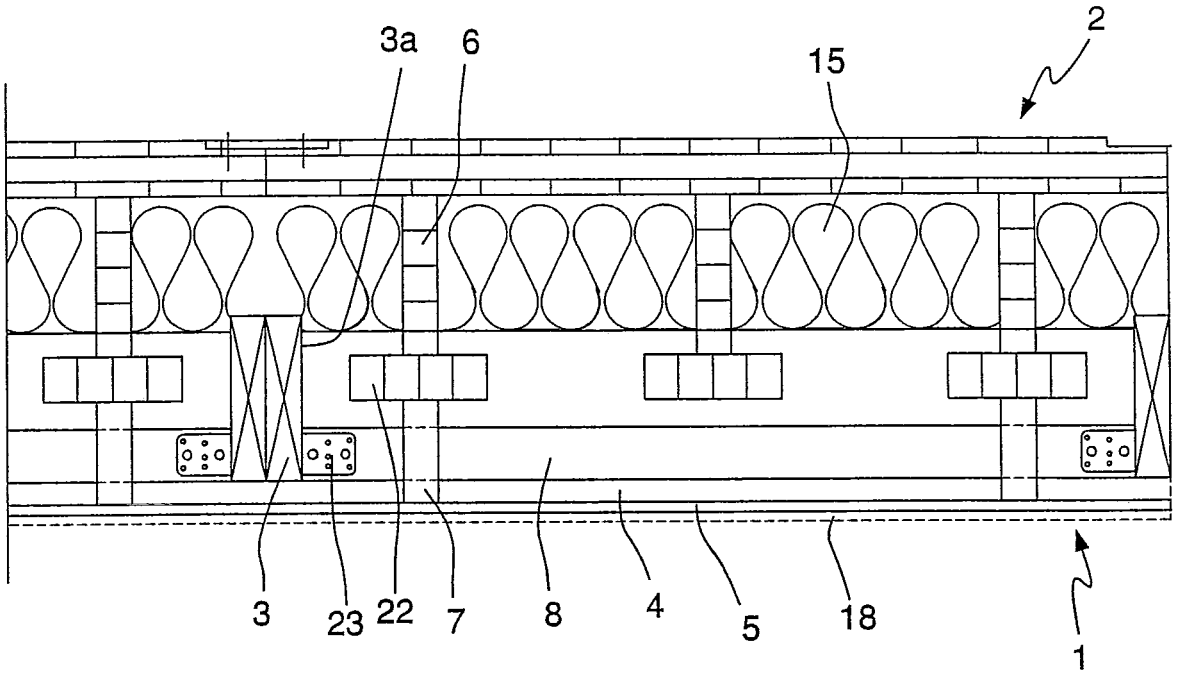

FIG.1

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Description

[0001] The present invention concerns an arrangement for the suspension of suspended ceiling elements in a ceiling structure construction according to the introduction to claim 1 and a prefabricated ceiling structure cassette according to claim 14 comprising such an arrangement.

[0002] When raising multistorey buildings constructed from lightweight materials, principally wood, many different methods have previously been used for the mounting of suspended ceilings.

[0003] One method has been to mount the suspended ceiling solely along its outer edges such that it is resting on the vertical load-bearing walls. This works well in spaces where there is less than 4 metres between the load-bearing walls, but the above-described building method is unsuitable in multistorey buildings with greater distances between the load-bearing walls since a freely hanging suspended ceiling risks being drawn down by its own weight and becoming skewed. Another construction solution for the suspension of suspended ceilings in such spaces must therefore be sought.

[0004] One method to avoid the problem is to anchor the suspended ceiling to a ceiling structure that is mounted above the suspended ceiling when it is in place. This requires complicated and detailed suspension assemblies and it requires time-consuming and labour-intensive operations when mounting the ceiling during the construction of the building.

[0005] One purpose of this invention, therefore, is to offer an arrangement with few component parts that makes it possible to mount a suspended ceiling on a ceiling structure in a simple, easy and rapid manner. This purpose is achieved with an arrangement that has the characteristics described in the characterising part of patent claim 1. Further advantageous embodiments of the invention are specified in claims 2-5.

[0006] When constructing multistorey buildings, the building must satisfy requirements posed by the construction client and by authorities with respect to soundproofing between the storeys. In particular, multistorey buildings constructed principally of lightweight materials such as wood have demonstrated problems of undesired transfer and distribution of vibration, structure-borne sound and the sound of footsteps that are produced on one storey through the common wooden frame construction to another storey, something that can be experienced as disturbing. It is therefore important to achieve effective insulation of vibration and sound. In particular, the dimensional requirements are often set by the sound of footsteps. An integral vibration insulation and insulation against the sound of footsteps is to insulate against this excitation of vibratory sound and the sound of footsteps, while at the same time remaining dynamic for a long period without demonstrating any significant creep. In building constructions of the type previously mentioned, namely ones in which the suspended ceiling is anchored at a ceiling structure located above the suspended ceiling, the problems associated with undesired transfer of vibratory sound and the sound of footsteps must be carefully dealt with.

[0007] This is particularly the case with respect to avoiding that the various building elements, the ceiling structure, suspended ceiling elements and the construction fittings that are their components, are in contact with each other; instead seeking a solution in which the problem described above concerning the anchoring of the suspended ceiling and the problem of the transfer of vibratory sound and the sound of footsteps are solved.

[0008] A further purpose of this invention, therefore, is to offer an arrangement for the suspension of a suspended ceiling at a ceiling structure in a multistorey building in a manner that insulates sound and vibration. This purpose is achieved with the embodiments of the invention having the characteristics that are specified in claims 6-13.

[0009] In order to facilitate the construction of multistorey buildings principally constructed from wood, many prefabricated building elements are manufactured and assembled in factories. These must then be transported to the site at which the building is being constructed. Final assembly at the site may be very labour-intensive and time-consuming, so methods are sought to make the work more efficient by building the prefabricated elements to be as complete as possible.

[0010] A further purpose of this invention, therefore, is to offer a prefabricated ceiling structure cassette that is secure under transport and simple to use when constructing large continuous floor areas and suspended ceilings of large area. This purpose is achieved with a prefabricated ceiling structure cassette that has the characteristics described in the characterising part of claim 13.

[0011] The invention will be described below based on several embodiments and with reference to the drawings. Further advantages and positive effects of the invention will be described in more detail after this.

Figure 1 shows a cross-section through a ceiling structure cassette with an arrangement according to the invention.

Figure 2 shows a cross-section of two joined ceiling structure cassettes, each one of which has an arrangement according to the invention.

Figure 3 shows schematically a perspective view of a first embodiment of the suspension means according to the invention.

Figure 4 shows a cross-section through a second embodiment of the arrangement with damping elements according to the invention.

Figure 5 shows schematically a perspective view of the second embodiment of the arrangement with damping elements according to invention, according to Figure 4.

Figures 6 and 7 show detailed views of various fixture arrangements for the attachment of the suspended

ceiling girder to the suspended ceiling beam.

[0012] With reference to Figure 1, there is shown there a ceiling structure cassette that comprises an arrangement for the suspension of a suspended ceiling element at a ceiling structure.

[0013] The arrangement for the suspension comprises a suspended ceiling element 1, principally of wood, that has parallel and solid suspended ceiling beams 3 of wood at two opposing outer edges, and a system 4 of wooden battens that extend between the suspended ceiling beams 3 and that are fixed orthogonally to the lower surfaces of the suspended ceiling beams. The system of battens 4 constitutes the support for a first flat sheet formed plate 5, normally a flat building board of plaster or a similar material. The flat sheet formed plate is attached to the lower surface of the system of battens, which faces away from the suspended ceiling beams. The lower surface of the first flat sheet formed plate 5, which faces away from the suspended ceiling beams, constitutes the support for a second flat sheet formed plate 18 that is mounted on site, attached by screws, after the ceiling structure cassette has been installed at the intended location in the building.

[0014] A suspended ceiling girder 8 extends orthogonally between the two parallel suspended ceiling beams 3, each end of which girder is attached to the relevant suspended ceiling beam by a fixture arrangement 23. The suspended ceiling girder is normally approximately 4 metres long, but it can be longer.

[0015] The fixture arrangement 23 is arranged at the vertical side 3a of the suspended ceiling beam, as shown in Figure 1. The fixture arrangement 23 is shown in this figure comprising an attachment means 25, for example an angle bracket, and an assembly means 24, such as a screw or nail connection. It is possible to attach the angle bracket by the assembly means 24 onto the side of the suspended ceiling girder as shown in Figure 1, and it is also possible to attach it to the upper surface or lower surface of the suspended ceiling girder as is shown in Figure 6. A second simpler embodiment of the fixture arrangement 23 comprises solely a screw connection 24 that is screwed through the suspended ceiling beam directly into the end of the suspended ceiling girder, see Figure 7.

[0016] The ceiling structure cassette in Figures 1 and 2 comprises also a ceiling structure 2 that comprises solid ceiling structure beams 6, normally of wood, of standard dimensions. Each ceiling structure beam 6 comprises a ceiling structure beam flange 22 of wood that is arranged orthogonally at the end of the ceiling structure beam that lies closest to the suspended ceiling element.

[0017] The ceiling structure beams rest on load-bearing wall constructions in multistorey buildings and constitute the support for the floor covering. They constitute also a framework for insulation 15, for example mineral wool that has been introduced into the compartments between the ceiling structure beams. The ceiling structure beams are placed at regular intervals within the ceiling structure cassette and the dimensions of the beams and their separation have been adapted such that the ceiling structure satisfies currently valid building standards. A common distance between the beams is 40 cm.

[0018] With reference to Figure 1, the arrangement according to the invention comprises suspension means 7 that is attached by attachment means 14 to the lower surface of the ceiling structure beam flange 22. The suspension means 7 surrounds the suspended ceiling girder 8. The suspended ceiling girder rests in, which means it is supported by, the suspension means and the suspended ceiling element is in this way supported by the suspension means. It is normal that two suspension means 7, one each attached at the relevant ceiling structure beam flange 22, are arranged to surround one suspended ceiling girder 8, as is shown in, for example, Figure 1. The weight of the suspended ceiling element is in this way distributed over several ceiling structure beams.

[0019] The suspension means 7 demonstrates such a cross-sectional form that the suspended ceiling girder 8 is surrounded by and locked in its form by the suspension means. The suspension means in this way prevents rotation of the suspended ceiling girder around its longitudinal axis. The suspended ceiling girder and the suspension means have cross-sections that are essentially complementary to each other. A suspended ceiling girder with a rectangular or square cross-section is surrounded by a suspension means with an essentially complementary cross-section, such as rectangular, square, U-shaped or having parts of such cross-sections, such that the above-mentioned locking effect is achieved.

A first embodiment of the arrangement according to the invention is shown in Figure 3, which embodiment comprises suspension means 7 that are intended to surround a suspended ceiling girder 8.

A second embodiment of the arrangement according to the invention is shown in Figures 4 and 5, which embodiment comprises suspension means 7 that surround a suspended ceiling girder 8 and a damping element 9, 10 that has been introduced into the gap between the suspended ceiling girder and the inner surface of the suspension means. The damping element will be described in more detail below.

[0020] In the embodiments of the arrangement according to the invention that are shown in Figures 3, 4 and 5, the suspension means 7 is shown, which suspension means comprises a yoke or loop, with an essentially U-shaped cross-section that demonstrates two essentially parallel sides 11 and a bottom part 12 that unites the sides at one end, with the bottom part arranged in a plane that is essentially orthogonal to the sides, where each side 11 has at its free end a flange 13 that is directed orthogonally outwards from the side. The flange 13 may alternatively also be directed inwards towards the opposing side 11 (not shown in the drawings). The flanges 13 are designed to make contact with and be attached to the ceiling structure beam flange 22 by an attachment

means 14, preferably a screw or similar. The suspension means 7 comprises an inner surface that faces the suspended ceiling girder. The inner surface has a first inner surface wall 19a, a second inner surface wall 19b and a lower inner surface bottom 20, see Figure 3. It is normal that the suspension means is manufactured from thin sheet metal, preferably perforated thin sheet metal, that is worked, bent, to give the form that is described above.

[0021] In order to prevent the transfer of vibration, structure-borne sound and the sound of footsteps between the floor structure and the suspended ceiling elements as far as possible, at least one of vibration-damping and sound-damping elements of either an elastomeric material or a viscoelastic material, or a material that is both elastomeric and viscoelastic, has been arranged between them. Among the large number of elastomeric materials with damping properties available on the market, the damping material that is marketed under the tradename SYLOMER®, an elastic rubber material, has proved to be particularly suitable for building purposes, not least due to its high resistance to aging, its suspension properties and its ability to dampen vibration. The viscoelastic material for insulating the sound of footsteps that is marketed under the tradename STEPISOL®, a flexible urethane cellular plastic (polyethene foam plastic), has also demonstrated very advantageous sound-damping properties in building applications. The material withstands high loads without becoming significantly deformed.

[0022] With reference to Figures 4 and 5, the second embodiment of the arrangement according to the invention comprises a damping element 9, 10. The damping element comprises one or several flat sheets that are incorporated into different positions between the floor structure and the suspended ceiling element in order to achieve the intended effect of damping either vibration or sound, or both.

[0023] In accordance with the embodiment shown in Figure 4, the damping element 9, 10 is located between the suspended ceiling girder 8 and the suspension means 7. In another embodiment (not shown in the drawings) the damping element 9, 10 is located between the suspended ceiling girder 8 and the ceiling structure beam flange 22.

[0024] In a further embodiment (not shown in the drawings) the damping element 9, 10 is located between the flanges 13 of the suspension means and the ceiling structure beam flange 22. Various combinations of these embodiments may be envisaged in order to obtain an effect in damping vibrations or sound, or both. In order to facilitate the mounting, the damping element may be attached at one of the surfaces with which the element is to make contact by a glued joint, using, for example, hot-melt adhesive or similar.

[0025] The second embodiment of the arrangement according to the invention that is shown in Figure 4 has a damping element 9, 10 that comprises several different components with vibration or sound-damping properties. The inner surface walls 19a, 19b of the suspension means are fully or partially covered with a flat damping element 9, preferably with sound-damping properties, such as STEPISOL®, while the inner surface of the bottom 20 of the suspension means is fully or partially covered with a flat damping element 10, preferably with vibration-damping properties, such as SYLOMER®. The suspended ceiling girder in the suspended ceiling element thus is not in immediate contact with the suspension means, which is attached at the ceiling structure beam flange: the suspended ceiling girder rests in a resilient manner on the damping element in the suspension means.

[0026] The ceiling structure cassette is shown in Figure 2 with transport protection in the form of spacer blocks 21. A spacer block 21 is attached to the system of battens 4 in the suspended ceiling element 1 and located in a position that corresponds to a ceiling structure beam flange 22 in the ceiling structure in the final ceiling structure cassette. Before transport of the completed ceiling structure cassette from the factory to the end-user site, a screw connection is arranged through the suspended ceiling element, the spacer block and the ceiling structure beam flange that is located directly above the spacer block. The screw connection thus applies a cohesive force on the suspended ceiling element and the ceiling structure, whereby the ceiling structure cassette can be transported safely and without problems to the end-user site. When final mounting of the ceiling structure cassette in the multistorey building is carried out, the screw connection that fixed the suspended ceiling element to the ceiling structure beams is removed and the suspended ceiling element is lowered under its own weight in order subsequently to be supported by the suspension arrangement. It is normal that the suspended ceiling element is displaced approximately 1-2 cm in the vertical direction downwards. In a ceiling structure cassette provided with the suspension arrangement according to the invention comprising damping elements as described above, this displacement results in the suspended ceiling element no longer being in immediate contact with the ceiling structure beam flanges, resting instead in a resilient manner on the suspension means. Thus vibration and sound are not transferred.

[0027] The present invention is not to be considered to be limited to that which has been described above and shown in the drawings: it can be changed and modified in several different ways within the scope of the innovative concept defined by the attached patent claims.

Claims

1. An arrangement for the suspension of suspended ceiling elements at a ceiling structure,
   wherein the suspended ceiling element (1) comprises suspended ceiling beams (3), a system of battens

(4) and a sheet formed plate (5), the lower surface of which constitutes the support for the suspended ceiling, and wherein the ceiling structure (2) comprises ceiling structure beams (6), where one or several of the ceiling structure beams is or are provided with suspension means (7), **characterised in that** the suspended ceiling element (1) comprises a suspended ceiling girder (8) that extends between two suspended ceiling beams (3), and **in that** the suspended ceiling girder (8) is surrounded by at least one of the said suspension means (7).

2. An arrangement according to claim 1, wherein the suspension means (7) demonstrates such a cross-sectional form that the suspended ceiling girder (8) is surrounded by and locked in its form by the suspension means.

3. An arrangement according to either claim 1 or 2, wherein the suspended ceiling beams (3) are parallel with the ceiling structure beams (6), the suspended ceiling girder (8) is arranged to be orthogonal to the suspended ceiling beams, and the suspended ceiling girder is surrounded by at least two suspension means (7), each one of which is attached at the relevant ceiling structure beam.

4. An arrangement according to any one of claims 1-3, wherein the suspended ceiling girder (8) is attached at each end at the relevant suspended ceiling beam (3), where the suspended ceiling girder is attached either with only a single assembly means (24) or with an attachment means (25) and an assembly means (24).

5. An arrangement according to any one of claims 1-4, wherein the ceiling structure beams (6) comprise a relevant ceiling structure beam flange (22), and wherein the suspension means (7) is attached at the ceiling structure beam flange.

6. An arrangement according to any one of claims 1-5, wherein the suspension means (7) comprises a damping element (9, 10) that has vibration-absorbing and sound-absorbing properties, or a damping element (9, 10) with vibration-absorbing properties, or a damping element (9, 10) with sound-absorbing properties.

7. An arrangement according to claim 6, wherein the damping element (9, 10) is located between the suspended ceiling girder (8) and the suspension means (7).

8. An arrangement according to either claim 6 or 7, wherein the damping element (9, 10) is located between the suspended ceiling girder (8) and the ceiling structure beam flange (22).

9. An arrangement according to any one of claims 6-8, wherein the damping element (9, 10) is located between the suspension means (7) and the ceiling structure beam flange (22).

10. An arrangement according to any one of claims 6-9, in which different regions of the surface of the suspension means (7) that are facing the suspended ceiling girder (8) are provided with damping elements (9, 10) that have the same damping properties.

11. An arrangement according to any one of claims 6-9, in which different regions of the surface of the suspension means (7) that are facing the suspended ceiling girder (8) are provided with damping elements (9, 10) that have different damping properties.

12. An arrangement according to any one of claims 1-11, wherein the suspension means (7) comprises a yoke with an essentially U-shaped cross-section that demonstrates two essentially parallel sides (11) and a bottom part (12) that unites the sides at one end, wherein the bottom part is arranged in a plane that is essentially orthogonal to the sides, and wherein each side (11) has at its free end a flange (13) that is directed orthogonally outwards from the side.

13. An arrangement according to any one of claims 1-12, wherein the suspension means (7) is attached at a ceiling structure beam flange (22) by attachment means (14), preferably in the form of a screw.

14. A prefabricated ceiling structure cassette comprising an arrangement according to any one of the preceding claims 1-13.

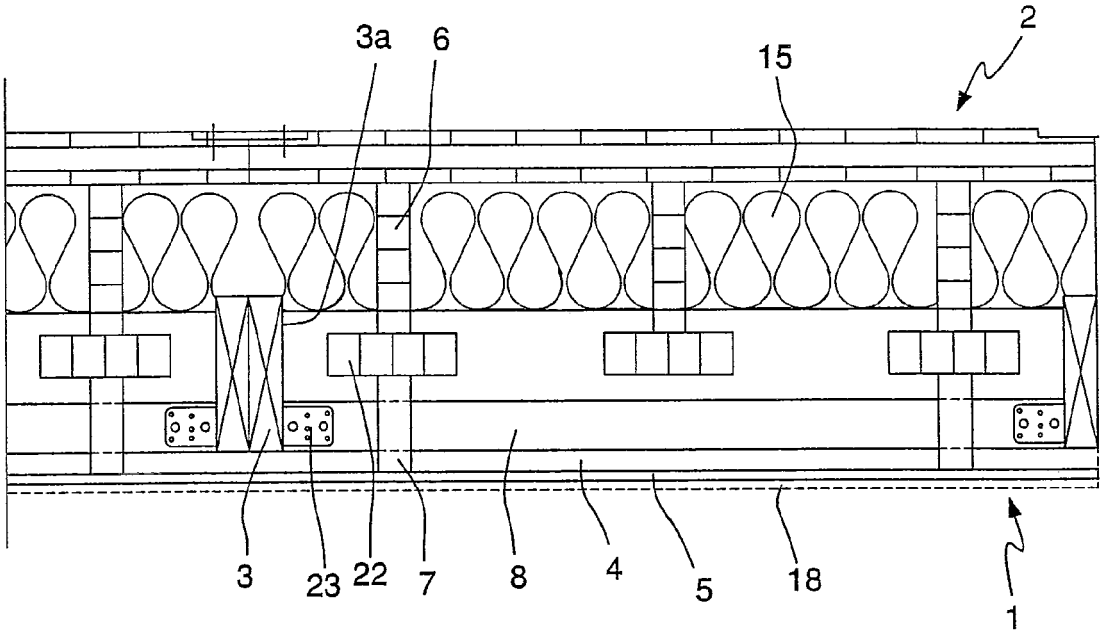

FIG.1

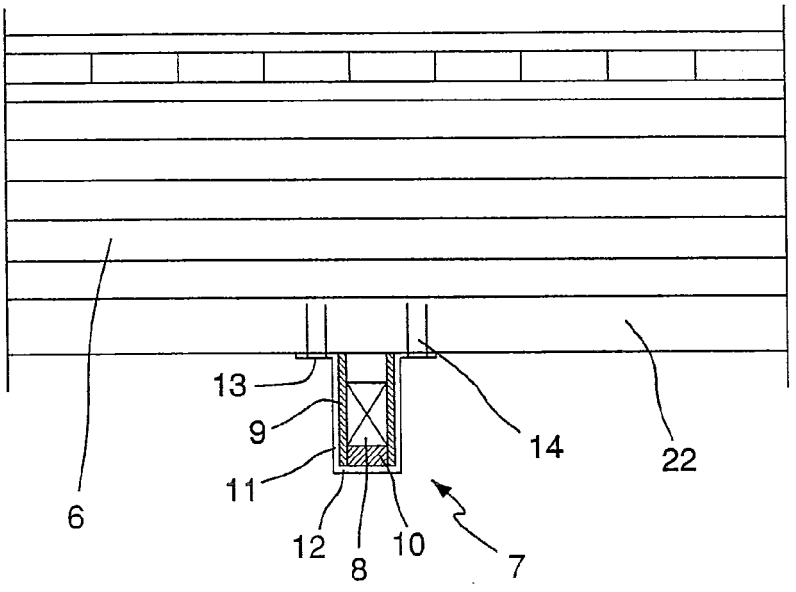

FIG.4

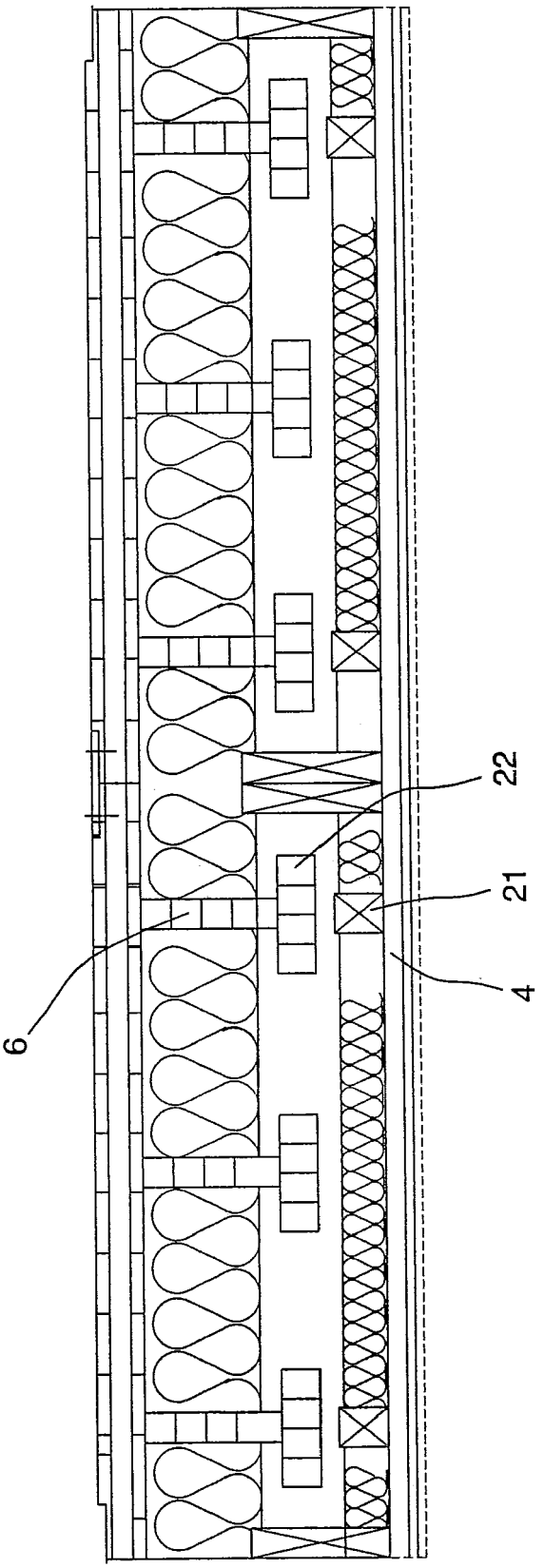

FIG.2

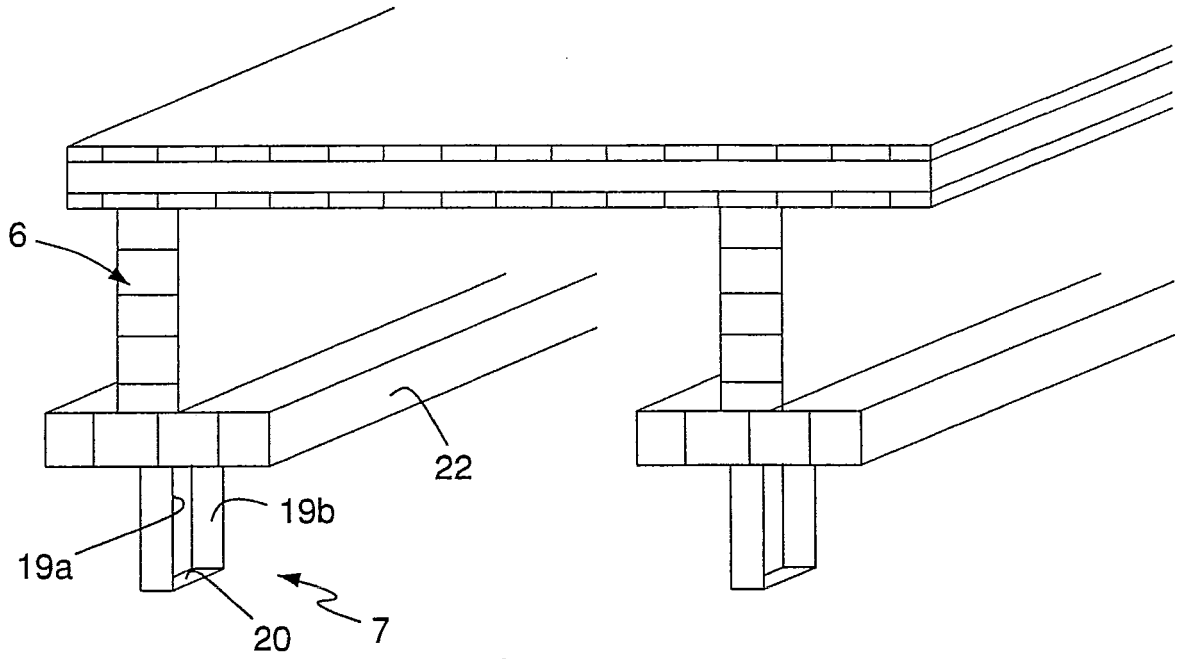

FIG.3

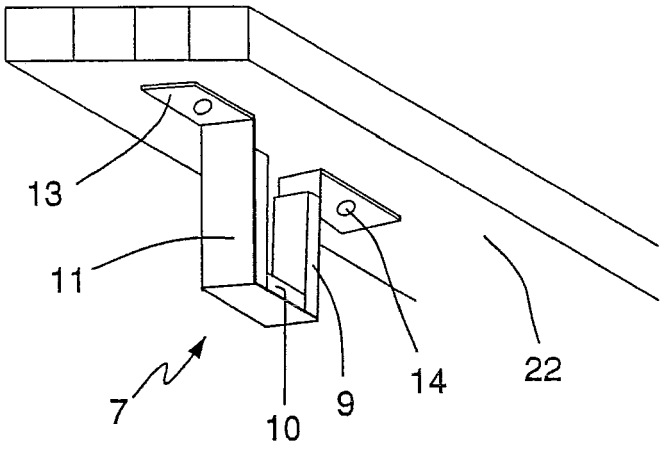

FIG.5

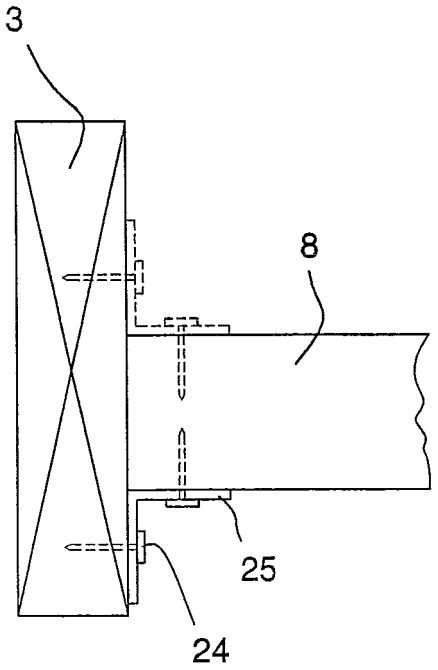

FIG.6

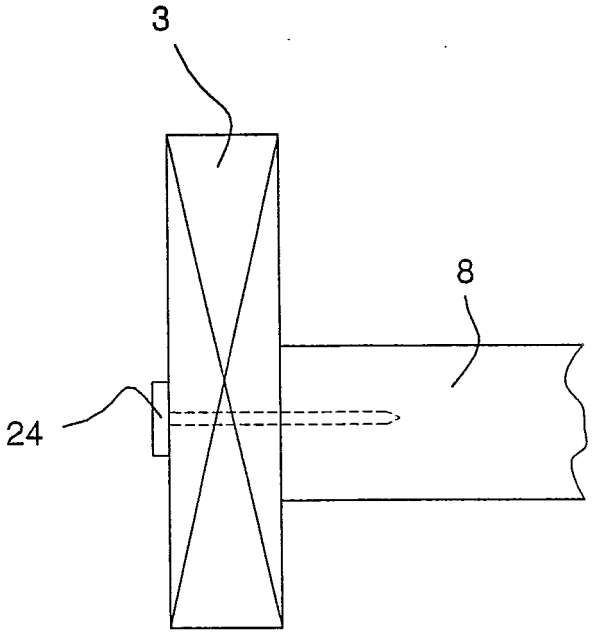

FIG.7