May 16, 1961 E. LEHMANN 2,984,323

CEILING STRUCTURE

Filed May 28, 1956 4 Sheets-Sheet 1

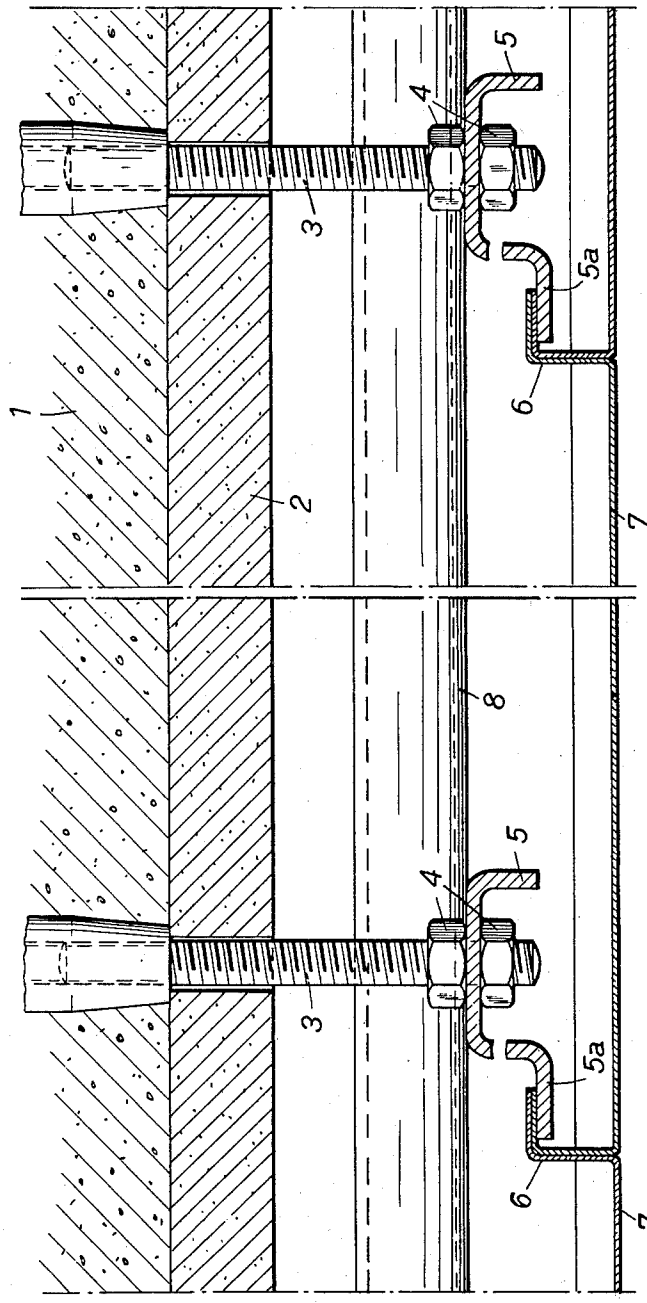

Fig. 1

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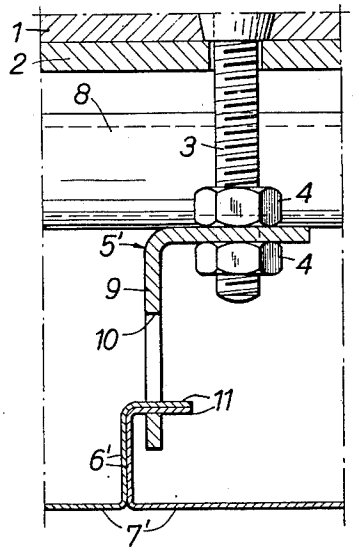

Fig. 2

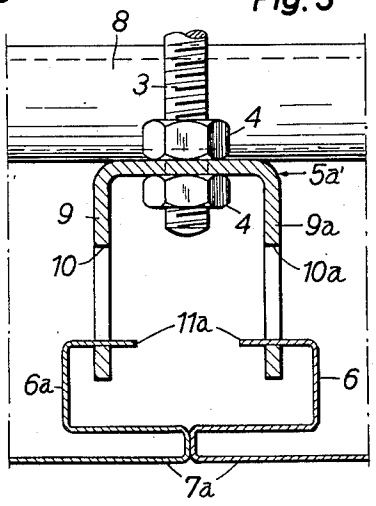

Fig. 3

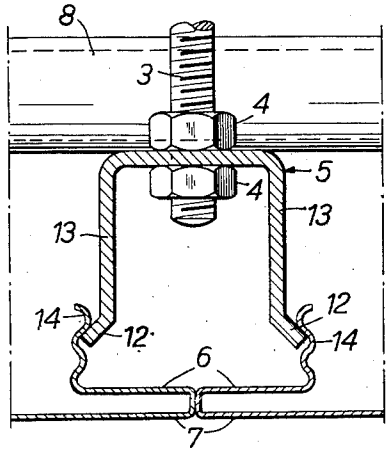

Fig. 4

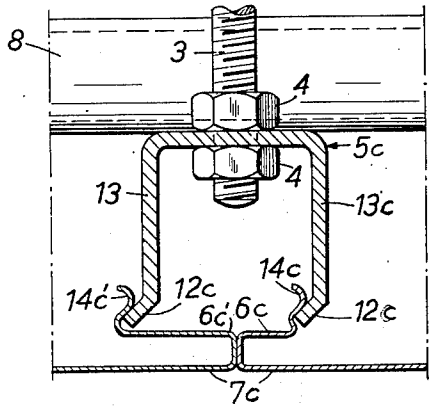

Fig. 5

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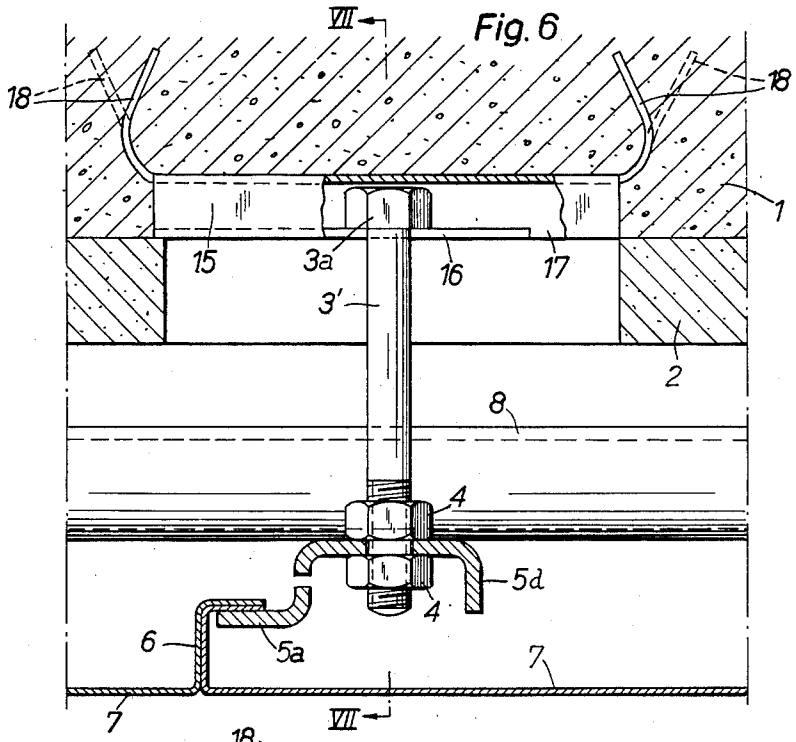
Fig. 6



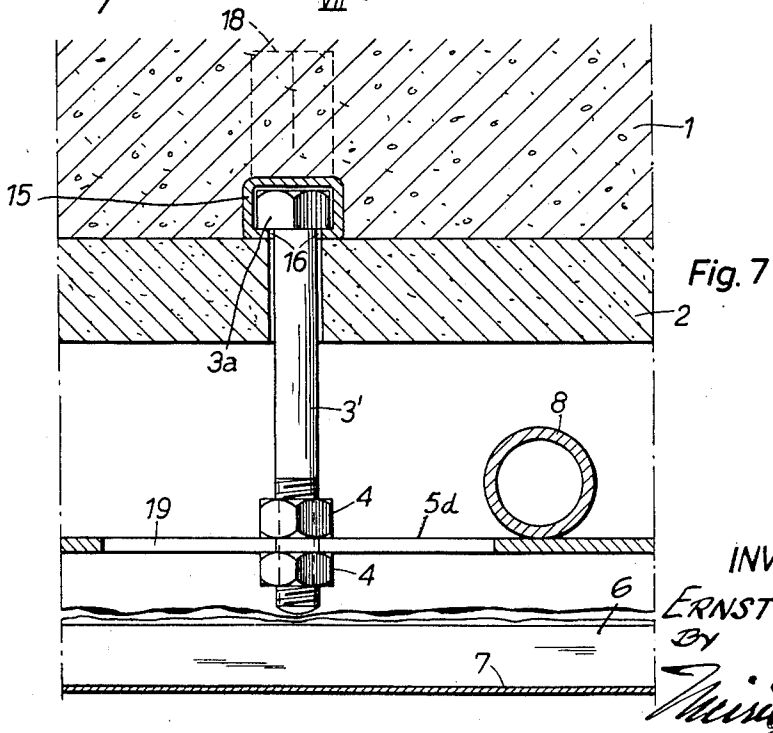


Fig. 7

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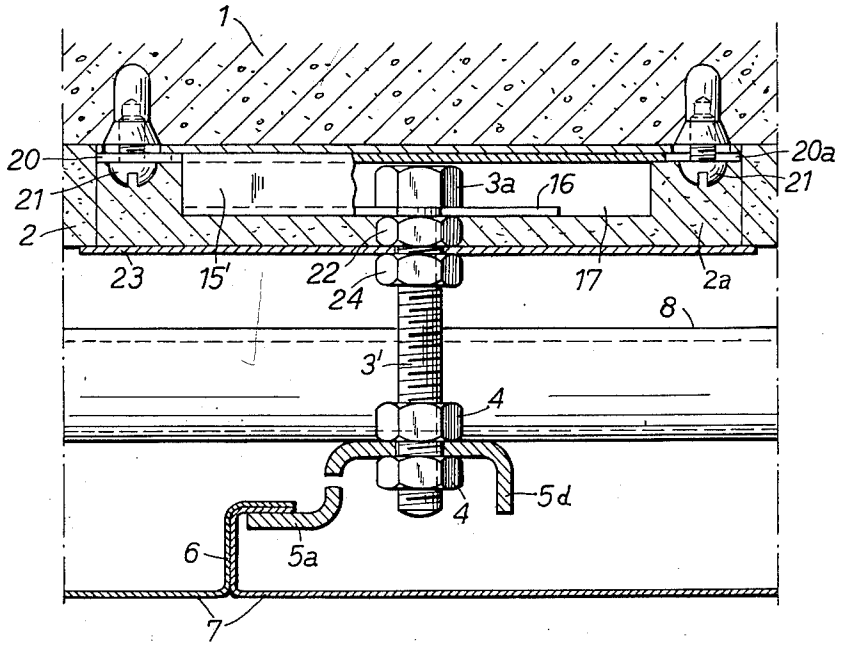
Fig. 8



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CEILING STRUCTURE

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5 Claims. (Cl. 189—86)

This invention relates to ceiling structures providing an interior or false ceiling formed of plates and suspended from a supporting ceiling. Such ceiling structures are generally known and are usually formed as radiant heating ceilings having heating pipes arranged in the interspace between the supporting ceiling and the interior ceiling, or as ventilation ceilings, having openings in the interior ceiling for the purpose of circulating air. Such a ceiling may also be built as sound absorbing ceiling.

According to the invention the ceiling structure comprises downwardly depending bolts anchored in the supporting ceiling, horizontal supporting beams secured to said bolts, and plates forming the interior ceiling, said plates having upturned marginal portions each provided with a lateral flange resting on one of said beams.

The pipes of a device for radiant ceiling heating may also be carried by the said beams.

The invention will now be more particularly described by way of example with reference to the accompanying drawings, in which:

Fig. 1 is a vertical section, taken across the supporting beams, of a first embodiment of the invention,

Fig. 2 is a vertical section of a second embodiment,

Fig. 3 shows a modification of Fig. 2,

Fig. 4 is a vertical section of a third embodiment,

Fig. 5 shows a modification of the structure shown in Fig. 4,

Fig. 6 is a vertical section of a fourth embodiment,

Fig. 7 shows a section on the line VII—VII in Fig. 6, and

Fig. 8 is a vertical section analogous to Fig. 1, through a fifth embodiment of the invention.

In Fig. 1 of the drawings, the numeral **1** designates a supporting ceiling, made e.g. of concrete, the underside of which is provided with a lining **2**. Threaded bolts **3** passing through the lining **2** and projecting downwardly are anchored in the supporting ceiling **1**. Threaded on the free end portion of each bolt **3** are two nuts **4**. The bolts **3** are arranged in parallel rows. The bolts **3** of each row of bolts project through openings provided in a channel-section supporting beam **5**, which is adjustably secured to the bolts **3** by means of the nuts **4**.

In the embodiment shown in Fig. 1, each of the channel-section beams **5** has a lateral flange **5***a*. Seated upon each longitudinal flange **5***a* are the horizontal legs of the upturned and mutually abutting edge portions **6** of two adjacent plates **7** of the interior ceiling. It is not necessary to fasten the legs of the edge portions **6** to the longitudinal flanges **5***a*. Instead of extending horizontally, the longitudinal flanges **5***a* of the beams **5** and the legs of the edge portions **6** of the plates **7** resting on the flanges can be slightly inclined. It is to be understood that the channel-section beams **5** can also be provided with lateral flanges **5***a* on both sides.

As may be easily seen, a very simple suspension device for the interior ceiling is provided by the parts **3**, **4**, **5** and **5***a*. This suspension device for the interior ceiling simultaneously serves as a support for the pipes **8**, placed

between the interior ceiling **7** and the supporting ceiling **1**, **2** and forming part of a system for radiant ceiling heating. The pipes **8** extend transversely of the channel-section beams **5** and rest upon the latter. A special fastening of the pipes **8** on the channel-section beams **5** is not required. Contrary to known radiant heating ceilings, the pipe system of the heating equipment thus has no independent suspension on the supporting ceiling.

In the described arrangement separate suspension members for the heating pipes are not required and moreover these pipes need not be aligned exactly in horizontal direction as is required in known constructions in which the plates or slabs of the interior ceiling are suspended from the pipes secured to the supporting ceiling in the described embodiment. The accurate horizontal positioning of the interior ceiling is obtained merely by corresponding adjustment of the channel-section beams **5** along the threaded bolts **3** by means of the nuts **4**. A further advantage of the ceiling structure according to the invention resides in the fact that the elements **3** to **7** are suitable both for ceilings with a radiant heating device and for ceilings without such a device.

The plates **7** of the interior ceilings may be perforated and/or be provided with a sound absorbing lining on their upper face.

In the embodiment according to Fig. 2 the supporting beam **5'** is L-shaped in section and is secured to the bolt **3** by its shorter horizontal leg. The longer leg **9** of the beam **5'** projecting downwardly in vertical direction, is provided with a plurality of equidistant slots **10**. The upturned marginal portions **6'** of the plates **7'** forming the interior ceiling are provided with a number of horizontal tongues **11** engaging within the slots **10** and the number of which correspond to that of the slots **10**. The height of the slots **10** and the height of the edge portions **6'** are so selected that, when for instance the plate **7'**, shown at the left in Fig. 2, is pressed upwardly to an extent causing its tongues **11** to abut the upper edge of the slots **10**, the adjacent plate **7'** can be moved to the left so far that its end tongues **11** can be disengaged from the slots **10**, whereby this latter plate can be removed. When inserting the plates **7'**, it is proceeded in an analogous manner.

The embodiment of the invention shown in Fig. 3 has beams **5***a'* of U-section. The beams **5***a'* in this case are secured by their webs to the bolts **3**, while the two depending legs **9***a* of the channel-section beam are provided with slots **10***a*. The plates **7***a* in this construction meet each other in a vertical plane extending through the respective row of bolts. The marginal portions **6***a* of the plates **7***a* are bent upwards symmetrically with respect to the said plane of separation and engage within the slots **10***a* of the associated leg **9***a*, each by a row of horizontal tongues **11***a*. In this case as well, the plates can be removed or inserted merely by pressing one plate upwardly and moving the other plate in transverse direction.

The embodiment shown in Fig. 4 has profiled beams **5***b* of U-shaped cross-section, the web of which is fastened to the bolts **3**. The edge portions **12** of the downwardly projecting legs **13** are outwardly bent at an angle. The marginal portions **6***b* of the sheet metal plates **7***b*, which meet in a plane extending vertically through the row of bolts are bent towards the beam **5***b* in a manner symmetrical to the said plane, and comprise upwardly extending resilient edge portions **14** corrugated in longitudinal direction. These resilient edge portions **14** of the plates are slipped over the outwardly bent edge portions **12** of the beam legs **13**, so that each plate **7***b* is releasably clamped between two adjacent beams **5***b* by means of its edge portions **14**. When for instance the plate **7***b* shown at the left in Fig. 4 is forced upwardly until the edge portion **12** of the beam leg engages the bottom groove of

the associated edge portion 14, of that plate, then the plate 7b situated at the right hand side, can be grasped by its left edge and can be released from its clamped position.

Also in the embodiment illustrated in Fig. 5, supporting beams 5c of U-shaped cross-section are provided in this case, however, the edge portions 12c of the legs 13c are bent at an angle in the same direction, that is, towards the left in the drawing. This arrangement requires an asymmetrical bending of the adjacent edge portions of the plates 7c, the edge portions 6c, 6c' respectively having resilient corrugated edge portions 14c, 14c', but in this case as well, the plates 7c are releasably clamped between two adjacent beams 5c by means of their resilient edge portions 14c, 14c' which are corrugated lengthwise.

In the embodiments according to Figs. 2 to 4, the suspension means for the interior ceiling also serves as a supporting means for the pipes 8, which are disposed between the plates 7 and the supporting ceiling 1 (Fig. 2) and form part of a system for radiant ceiling heating. The pipes 8 extend transversely of the beams 5 and rest on the latter; separate suspension members for the heating pipes 8 will thus be saved.

In the embodiment according to Figs. 6 and 7, a plurality of equidistantly spaced rows of horizontal guide rails 15 are embedded in the supporting ceiling 1. The rails 15 are of hollow rectangular cross-section and have a longitudinal slot 16 in their lower wall. At one end of the hollow section rail 15, its lower wall of the section is completely cut away in order to provide an entrance opening 17 (Fig. 6). By means of upwardly bent skirts 18 the hollow section rail 15 is tightly anchored in the supporting ceiling 1. Within each rail 15, the head 3a, of a threaded bolt 3' extending downwardly through the slot 16, is supported so as to be horizontally displaceable. The bolts 3' of each row of bolts project each through a longitudinal slot 19 (Fig. 7) in the supporting beam 5d extending at right angles to the guide rails 15 of each row, said beam being adjustably secured to the bolts 3' by means of two nuts 4. A lateral flange 5a (Fig. 6) of each beam 5d supports the horizontal leg of the upturned and mutually abutting marginal portions 6 of two adjacent plates 7 of the interior ceiling. It will be understood that the profile of the supporting beams 5d as well as the mode in which the plates 7 engage these beams could differ from the arrangement shown in the drawing.

The beams 5d of the ceiling structure shown in Figs. 6 and 7 also carry the pipes 8 of a system for radiant ceiling heating, said pipes being arranged between the interior ceiling 7 and the supporting ceiling 1, 2 in a direction transverse to that of the beams 5d.

As evident from the above description, the bolts 3' during assembly of the ceiling can be easily aligned in a row owing to their movable suspension in the rails 15, in order to bring the beams 5d into exactly parallel positions. On the other hand, the longitudinal slots 19 provided in the beams 5d allow for relatively large inaccuracies in the mutual spacing of the bolts 3' and guide rails 15, respectively, within each row.

In place of a head 3a forming an integral part of the bolt 3', a nut could be provided at the respective end of the bolt. Moreover, means could be provided for fixing the bolts 3' in their position on the guide rails. For this purpose the shanks of the bolts could be threaded their entire length and a further nut could be provided on each bolt 3' below the slotted lower wall of the guide rails 15 for tightening the head 3a on the latter. The opening left in the insulating layer 2 for mounting the rail 15 can be filled with insulating or sound absorbing material after the bolts 3' and the beams 5d have been mounted.

In the embodiment shown in Fig. 8, the guide rails 15' are not embedded in the concrete ceiling 1, but are screwed to the underside thereof. For that purpose, the guide rails are provided with end flanges 20 having slots 20a, through which fastening screws 21 extend. Alternatively the rails 15' could be secured to the bottom face of the concrete ceiling 1 by means of suitable elements other than these screws 21, e.g. by means of skirts embedded in the concrete. The bolt 3', the shank of which is threaded over its entire length, is fixed to the guide rail 15 by means of a nut 22. The recess provided in the insulating layer 2 for attaching the rail 15' to the ceiling 1 subsequently is filled up with insulating material 2a. A cover plate 23 held in place by a nut 24, closes the bottom of this recess. Otherwise the ceiling structure according to Fig. 8 is similar to the previously described one shown in Figs. 6 and 7. Instead of being inserted through the recess 17 in the lower wall of the rail 15', the bolt head 3a could also be passed through an open end thereof.

The arrangement of the guide rails 15' described with reference to Fig. 8 is particularly adapted to provide existing ceilings with an interior ceiling 7 and with a system for radiant heating.

I claim:

1. A ceiling structure comprising a support, a plurality of hangers depending from the support, a plurality of spaced beams adjustably supported by said hangers a sufficient distance below said support to carry pipes on the upper surfaces thereof and having longitudinally extending supporting portions spaced below said upper surfaces, and ceiling boards having upstanding vertical walls on two opposed sides, projecting hanger portions connected to the upper edges of said walls, said hanger portions being supported by said longitudinally extending supporting portions with adjoining walls of adjacent boards substantially in abutment, there being a substantial free and uninterrupted space below the hanger portions to permit pivoting of one end of the boards about the longitudinally extending portions near the other end of said boards, said supporting portions being spaced below said upper surfaces a distance at least equal to the height of said walls to permit one of said abutting walls to be moved vertically to enable relative lateral shifting between adjacent boards for removing and replacing a selected board without removing adjacent boards.

2. A ceiling structure comprising a support, a plurality of hangers depending from the support, a plurality of pipes, a plurality of spaced beams adjustably supported by said hangers a sufficient distance below said support to carry said pipes on the upper surfaces thereof and having longitudinally extending supporting portions spaced below said upper surfaces, and ceiling boards having upstanding vertical walls on two opposed sides, projecting hanger portions connected to the upper edges of said walls, said hanger portions being supported by said longitudinally extending supporting portions with adjoining walls of adjacent boards substantially in abutment, said beams being arranged to provide a free and uninterrupted path for the hanger portions above said supporting portions for a distance at least equal to the height of the walls, said supporting portions being spaced below said upper surfaces a distance at least equal to the height of said abutting walls, said hanger portions being flat with the hanger portions on both sides of said boards projecting in the same direction, said longitudinally extending portions projecting from said beams in a direction opposite to that of the hanger portions, there being a substantial free and uninterrupted space between the lower surfaces of the longitudinally extending portions and the upper surfaces of the ceiling boards to permit pivoting of one end of said boards about the longitudinally extending portions near the other end of said boards, the hanger portions of adjacent abutting walls being disposed one above the other so that when the board with the upper of the hanger portions is lifted a distance substantially equal to the height of the walls, the board with the lower hanger portions may be slid laterally to free its hanger portions from said supporting portions and be removed without removing adjacent boards.

3. A ceiling structure comprising a support, a plurality of spaced hangers depending from the support in a plu-

rality of aligned substantially parallel groups, a plurality of spaced beams, a plurality of pipes, means adjustably supporting said beams on said hangers in substantially parallel relation and spaced below said support and carrying said pipes on the upper surfaces thereof and between said hangers, said beams having longitudinally extending supporting portions spaced below said upper surfaces, and ceiling boards having upstanding vertical walls on two opposed sides, projecting hanger portions connected to the upper edges of said walls and projecting in the same direction, said hanger portions being supported by said longitudinally extending supporting portions with adjoining walls of adjacent boards substantially in abutment, there being a substantial free and uninterrupted space below the hanger portions to permit pivoting of one end of the boards about the longitudinally extending portions near the other end of the boards, said supporting portions being spaced below said upper surfaces a distance at least equal to the height of said walls to permit one of said abutting walls to be moved vertically to enable relative lateral shifting between adjacent boards for removing and replacing a selected board without removing adjacent boards.

4. The ceiling structure of claim 1, wherein said beams

each have at least one vertical leg extending downwardly from said upper surfaces, said legs having slots therein with the lower edges of said slots defining said supporting portions, said slots having a vertical dimension at least equal to that of the abutting portions of said walls.

5. The ceiling structure of claim 4, wherein said beams are of inverted U-shape in cross-section with the bight portion defining said upper surfaces and each leg having a slot therein, each wall above its abutting portion being recessed so as to be disposed over its corresponding board, the hanger portions of each board projecting in opposite directions.

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