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CEILING STRUCTURE

This invention relates generally to ceiling construction and installation and particularly to a
5 ceiling structure having a ceiling surface composed of ceiling material units which can be accurately installed in proper positions in bays formed between joint members assembled in grille or grid configuration. This invention is particularly applicable to
10 so-called false ceilings, which are generally decorative and constitute ceiling surfaces spaced apart from the rough bare ceiling of an architectural structure.

The method of forming a decorative ceiling
15 surface by installing ceiling material units in bays between joint members or furring members assembled in grid configuration is known and is being practiced in various forms. However, if the edges of the ceiling material units are not precisely aligned in
20 orthogonal horizontal directions, the ceiling will present an unsightly appearance. Heretofore, various modes of ceiling construction have been proposed, but those in which the precision of alignment has been considered to be of great importance
25 have been of complicated structural organization and have lacked practicability. Thus, in the present state of the art, no suitable forms of ceiling

construction have been reduced to practice.

This invention provides a ceiling structure of a construction by which edges of ceiling material units can be precisely aligned.

5 According to this invention, there is provided a ceiling structure comprising: a horizontal support structure of rigid grid form comprising first joint members and second joint members crossed orthogonally therewith to form and encompass open bays each
10 adapted to receive therein a ceiling material unit, the first joint members being suspendedly fixed in space; positioning members each of which has a mounting part, mutually perpendicular first and second positioning parts extending from the mounting part,
15 and a holding part, and four of which are secured at their mounting parts to first joint members at positions respectively near the four corners of each bay; a plurality of the ceiling material units each being thus received in a respective bay and accurately
20 positioned in specific alignment by the positioning members; and securing means fixed to each ceiling material unit and cooperatively functioning with the holding parts of the positioning members of the corresponding bay to secure the ceiling material unit
25 in the specific alignment.

A feature of this invention is that each positioning member has mutually perpendicular first and

and second positioning parts, and, when the positioning member is so mounted at its mounting part to its first joint member that one (e.g., the first) positioning part is aligned with the longitudinal direction of one (e.g., the first) joint member, the other (second) positioning part is aligned with the longitudinal direction of the other (second) joint members of the same bay. Accordingly, by using the two positioning parts as reference data, a rectangular ceiling material unit (i.e., panel) can be aligned in two orthogonal directions in the horizontal plane.

Another feature of this invention is that each ceiling material unit (panel) can be readily attached to and detached from its positioning members independently of the other ceiling material units, whereby maintenance and other work in the space above the ceiling is simplified. After a ceiling material unit has been detached, it can be readily attached in its former specific position.

Still another feature of this invention is that the holding part of each positioning member is provided in that member, which also has the mutually perpendicular positioning parts. Therefore the ceiling material unit can be attached to the holding parts and, at the same time, easily aligned accurately and easily in the orthogonal directions in the horizontal

plane.

The nature, utility, and further features of this invention will be more clearly apparent from the following detailed description when read in
5 conjunction with the accompanying drawings, briefly described below.

In the drawings: -

FIG. 1 is a fragmentary plan view, on a greatly reduced scale, showing a part of one example of a
10 ceiling structure according to this invention;

FIG. 2 is a relatively enlarged elevation showing the manner in which corner parts of two adjacent ceiling panels are precisely positioned by and secured to positioning members mounted on opposite
15 sides of a first joint member, shown in cross section;

FIG. 3 is a partial plan view, corresponding to FIG. 2 and further showing a joint between the first joint member and ends of two second joint members abuttingly joined thereto from opposite sides;

20 FIG. 4 is a partial elevation showing the manner in which a corner of a ceiling panel is secured in accurately positioned state to a corresponding positioning member mounted on a first joint member; and

25 FIGS. 5, 6, and 7 are respectively a plan view, an elevation and an elevation showing in detail the joint shown in FIG. 3 between the first joint member

and the ends of the two second joint members.

As shown in the drawings and mentioned in the description, orthogonal directions in the horizontal plane which are respectively parallel to first and
5 second joint members are designated by the symbols D1-D1 and D2-D2.

In one example of a false-ceiling construction according to this invention, as shown in FIG. 1, a plurality of ceiling panels 23 are supported and held
10 in true alignment by a horizontal frame structure of grille or grid form comprising, essentially, a plurality of first joint members 1 parallelly disposed apart at equal spacing intervals and directed in the first direction D1-D1 and a plurality of second joint
15 members 2 parallelly disposed apart at equal spacing intervals and directed in the second direction D2-D2. As shown in FIG. 2, this frame structure is suspended from the building ceiling structure by a plurality of adjustable hanger members 14 fixedly anchored at their
20 upper ends to the building bare ceiling structure and adjustably secured at their lower ends, as by a screw and nut attachment, to holding brackets 15 fixed to the upper parts of the first joint members 1. The first and second joint members 1 and 2 thus serve as
25 ceiling furring strips, which are very precise and of firm nature as will be seen from the following description.

The first joint members 1 in the D1-D1 direction are of long length extending from one side extremity of the ceiling to the opposite side extremity either as unitary members or spliced members. Each first joint member 1 is formed by a process such as extrusion and has a cross section as shown in FIGS. 2 and 6 with a flat bottom having along its lateral edge parts bent-up side walls 3 and with an upper structure 1a. Each side wall 3 has an outwardly bent, horizontal flange 3a.

The second joint members 2 in the D2-D2 direction are of uniform short length which is just sufficient for spanning between adjacent first joint members 1. Each second joint member 2 has a cross section with a flat bottom and a central flat part at its top as shown in FIG. 7 and has end parts 4 (FIGS. 5 and 6). In assembled state, the end parts 4 of each second joint member 2 are in abutting state against the outer faces of the side walls 3 respectively of the adjacent first joint members 1, the bottoms of these second and first joint members 2 and 1 lying flush in the same horizontal plane. At the same time, the above mentioned flange 3a is overlappingly disposed on the upper surface of the above mentioned central flat part of the end part of the second joint member 2. Each second joint member 2 thus abutting at its one end against a first joint

member 1 is in coaxial alignment with another second joint member 2 whose end part 4 is abutting that first joint member 1 on the opposite side thereof.

5 The end part 4 of each second joint member 2 is secured in the following manner to the flank of its corresponding first joint member 1. On the upper face of the end part 4, a connecting member 8 is held downward at its middle portion by a bolt 10 passed downward through a slot in the connecting
10 member 8 and the top part of the joint member 2 and screwed into a tapped hole in an attachment plate 6 disposed flush against the lower surface of the top part of the joint member 2. As viewed in the D1-D1 direction, this connecting member 8 has the shape of
15 the letter "zed" with a bent-down catch flange 9 at its end nearest the joint member 1 and a bent-up flange 12 at its other end. During assembly, the bent-down catch flange 9 is slipped over the aforementioned flange 3a fitted on the upper surface of
20 the extreme end of the second joint member 2. The flange 3a is thereby interposed between the connecting member 8 with its catch flange 9 and the upper part of the extreme end of the joint member 2.

 The connecting member 8 is connected to a connecting member 5 by a bolt 13 passed through a bent-up
25 flange 11 of the connecting member 5 and screwed into a tapped hole in the bent-up flange 12 of the

connecting member 8. The connecting member 5 is fixed to the upper part of the second joint member 2 by bolts 7 passed through the connecting member 5 and the upper part of the joint member 2 and screwed into tapped holes in the above mentioned attachment plate 6.

While the connecting member 5 is fixed to the second joint member 2, the connecting member 8 is free to move slightly in the D2-D2 direction relative to the second joint member 2 on which it is mounted. By tightening the bolt 13, the connecting member 8 is urged to move horizontally away from the adjoining first joint member 1, whereby its bent-down catch flange 9 is forced to tightly clamp the side wall 3 against the abutting end part 4.

A feature of this combination of these fixed and movable connecting members 5 and 8 is that their bent-up flanges 11 and 12, which are mutually parallel, are tilted somewhat to slope upward and toward the first joint member 1. Accordingly, when the bolt 13 is tightened as described above to draw the flange 12 toward the flange 11, an upward component of force is imparted to the flange 12. As a consequence, the connecting member 8 functions as a lever with the bolt 10 as a fulcrum and is subjected to a moment causing its end with the catch flange 9 to bear down firmly on the flange 3a of the first joint

member 1. Thus, the one end of the second joint member 2 is firmly secured to the flank of the first joint member 1 in a positively locked state against relative movement therebetween in the D2-D2 direction and the vertical direction.

The first and second joint members 1 and 2, when assembled in the above described manner, form a grille or grid frame with frame openings or bays 24 in which respective ceiling panels 23 are fixed and thus supported. Each ceiling panel 23 is thus fixed by positioning and fastening members in the manner described below.

Each first joint member 1, in its portion interposed between adjacent bays 24 on opposite sides thereof, has two pairs of positioning members 16, 16a and 16, 16a respectively at opposite ends of that portion as shown in FIG. 1. Each pair comprises a first positioning member 16 and a second positioning member 16a of symmetrically opposed shape and position with respect to the centerline of the joint member 1 as shown in FIG. 3. In other words, as shown in FIG. 1, each bay 24 is provided at its four corners with four positioning members, those at one pair of diagonally opposite corners being first positioning members 16 and those at the other pair of diagonally opposite corners being second positioning members 16a. Each positioning member is mounted on the upper part

1a of its first joint member 1 by screws 22 as shown in FIGS. 2 and 3.

Each of the first and second positioning members 16 (or 16a) is formed from plate material and has a planar mounting part 17 (or 17a) for mounting horizontally as described above, a vertical first positioning part 18 (or 18a) in the form of a plate bent down orthogonally to the mounting part 17 and parallelly to the first joint member 1 and a vertical second positioning part 19 (or 19a) in the form of a plate bent down perpendicularly to the first joint member 1 at one end (upper end as viewed in FIG. 3) of the first (or second) positioning member 16 (or 16a), this end being near the corresponding corner of the bay 24. A cutout 20 (or 20a) of the shape shown in FIG. 3 is provided at the other end of the positioning member 16 (or 16a).

Each ceiling panel 23 in plan view, in the illustrated example, is of square shape which is larger than the opening of the bay 24. As shown in FIG. 2, the outer peripheral edge part of the panel 23 is in the form of a vertical edge wall 25, inside of and spaced apart from which is a vertical inner wall 26. This inner wall 26 has along its upper part a contiguous inclined part 27 sloping upwardly and inwardly and along its lower part an outwardly projecting ledge 28. A louvre 29 is accommodated within the

ceiling panel 23 in the space encompassed by the inner wall 26. A packing 34 is supported on and along the upper edge of the edge wall 25 to be compressed and placed in intimate contact with the lower surfaces of the joint members 1 and 2 when the ceiling panel 23 is installed in place in its bay 24.

Each ceiling panel 23 is fastened in place in its corresponding bay 24 of the grid frame in the following manner. To an upper part of the inner wall 26 in vertical confrontation with each of the cutouts 20 of the four positioning members 16, 16a of that bay 24, the coiled base part 32 of a spring member 31 having two legs 30 is fixed by an anchoring member 33. In its free state, the legs 30 of each spring member 31 form therebetween an obtuse angle which is greater than that shown in FIG. 4.

The ceiling panel 23 is installed in place in the bay 24 by raising the panel 23 toward the bay 24, bringing the legs 30 of each spring member 31 together against the spring force thereof and inserting their outer ends into the corresponding cutout 20 (or 20a), and raising the panel 23 further, as its inner wall 26 in contact with the positioning parts 18, 19, 18a, and 19a is guided thereby, until the projecting ledge 28 contacts and is stopped by the lower edges of the positioning parts. The ceiling panel 23 is thereupon in properly installed state,

and the packing 34 is in firm contact with the lower surfaces of the joint members 1 and 2 of the bay 24.

From the foregoing disclosure, it will be
5 apparent that the false-ceiling construction according to this invention affords a number of advantageous features, the most important of which are as follows. Each ceiling panel can be easily installed in accurately positioned state in the horizontal
10 orthogonal directions (D1-D1 and D2-D2) of its edges because of the provision of the positioning parts of the first and second positioning members. As a result, all ceiling panels present a neat and aesthetic appearance. Furthermore, each ceiling
15 panel can be easily detached from its installed position independently of the other ceiling panels and can be reinstalled accurately and quickly in its former position in its bay. Accordingly, maintenance and other work in the space above the false ceiling
20 can be readily carried out.

While the ceiling structure of this invention has been described above with respect to an embodiment thereof with specific details, it will be apparent that several changes and modifications are
25 possible within the purview of the invention. For example, instead of spring members 31 and cutouts 20, positive locking devices and other mechanisms

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can be used. Furthermore, each ceiling material unit 23 can be of a construction to accommodate a louvre, a decorative panel, or the like, or it may be in the form of a metal panel.

CLAIMS

1. A ceiling structure comprising: a horizontal support structure of rigid grid form comprising first joint members and second joint members crossed orthogonally therewith to form and encompass open bays each adapted to receive therein a ceiling material unit, the first joint members being suspendably fixed in space; positioning members each of which has a mounting part, mutually perpendicular first and second positioning parts extending from said mounting part, and a holding part, and four of which are secured at their mounting parts to first joint members at positions respectively near the four corners of each bay; a plurality of said ceiling material units each being thus received in a respective bay and accurately positioned in specific alignment by the positioning members; and securing means fixed to each ceiling material unit and co-operatively functioning with said holding parts of the positioning members of the corresponding bay to secure said ceiling material unit in said specific alignment.

2. A ceiling structure according to Claim 1 which is a so-called false-ceiling structure suspended apart from a bare ceiling of an architectural structure, and in which the ceiling material units are ceiling panels.



3. A ceiling structure according to Claim 1 in which said holding part of each positioning member is an opening formed in the positioning member, and said securing means comprises spring locking means each secured to a respective one of the four corners of each ceiling material unit at positions for thus cooperatively functioning with said holding means.

4. A ceiling structure according to Claim 3 in which said spring locking means is a wire spring member comprising a coiled base part secured to each ceiling material unit, and two legs extending integrally from the coiled base part so as to form an obtuse angle therebetween, said legs being passed from below through, and being engaged resiliently in said opening.

5. A ceiling structure according to Claim 1 in which said mounting part and first and second positioning parts of each positioning member are each in the form of a plate, said positioning parts extending downwardly along the mutually crossed joint members, respectively.

6. A ceiling structure according to any one of Claims 1, 2 and 3 in which the first joint members are integrally continuous members, and the second



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joint members are of short length to span the distance between adjacent first joint members and are abuttingly fixed at their ends to said adjacent first joint members.

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7. A ceiling structure substantially as herein described and as illustrated in the accompanying drawings.



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