FIRE-RATED CEILING GRID SYSTEM

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ABSTRACT OF THE DISCLOSURE

This invention comprises a ceiling grid system in which the cross T-members are formed with end tabs which extend through slots in the main T-members and wherein the members normally are locked together by fingers struck and bent laterally from the tabs at opposite sides of the main T-members. The fingers extend laterally and rearwardly from the tabs so that the fingers on the far sides of the main T-members but endwise against the main T-members to positively prevent the tabs from pulling back out of the slots. The fingers on the near sides of the main T-members are effective under normal conditions to prevent the tabs from pulling farther into the slot but under thermal expansion conditions the fingers flex inwardly permitting the tabs to penetrate farther into the slots so as to prevent buckling of the members and to maintain the integrity of the ceiling in case of fire.

This invention relates generally to acoustical ceilings, and particularly to an improved grid system for an acoustical ceiling that maintains its integrity during relatively high ambient temperature conditions.

The grid system of this invention is an improvement over that disclosed in U.S. Patent No. 3,119,475, granted Jan. 28, 1964 and owned by the assignee of this application.

Acoustical ceilings of the type to which the present invention relates are generally suspended from a conventional ceiling or overhead structure to provide both an aesthetically pleasing and acoustically superior ceiling for a room or other enclosure. These acoustical ceilings are made up of a plurality of acoustical panels supported by a rigid grid system which includes a plurality of interlocking grid members arranged generally normal to each other.

One of the problems arising in these acoustical ceilings is that the grid members elon gate and buckle or cause other grid members to buckle when subjected to heat such as occurs, for example, in the case of a fire. Buckling of the grid members lifts and sometimes dislodges the acoustical panels and the resulting gaps or openings in the ceiling exposes the overhead structure and permits the fire to spread more rapidly than otherwise would be the case.

For this reason, fire and other regulations and specifications dictate that acoustical ceilings maintain their integrity for a time despite relatively high ambient temperature conditions such as are caused by fire. In this fashion, the fire can be contained for a time to the one enclosure and is prevented from spreading immediately to the overhead structure and other parts of the building. Furthermore, acoustical ceilings desirably should be capable of easy and accurate assembly and should be pleasing in appearance.

Accordingly, main objects of the present invention are to provide an acoustical ceiling construction which provides an effective fire barrier between the floor and ceiling of an enclosure and which is readily and accurately assembled.

Further objects include a construction of the above character which is versatile, attractive in appearance, relatively inexpensive to manufacture and rugged in construction.

Further objects and advantages of the present invention will become more apparent from a consideration of the following detailed description taken in conjunction with the drawings in which:

FIGURE 1 is a fragmentary perspective view illustrating a grid system for the support of acoustical panels in an acoustical ceiling and embodying the present invention;

FIG. 2 is an enlarged sectional view of FIG. 1 taken along the line 2—2 thereof;

FIG. 3 is an enlarged sectional view of FIG. 1 taken along the line 3—3 thereof;

FIG. 4 is a sectional view of FIG. 3 taken along the line 4—4 thereof;

FIG. 5 is an enlarged sectional view of FIG. 4 taken along the line 5—5 thereof;

FIG. 6 is a fragmentary perspective view of one of the grid members embodying the present invention; and

FIG. 7 is an enlarged sectional view of FIG. 2 taken along the line 7—7 thereof.

Broadly described, the present invention includes interlocking normally arranged grid members wherein one of said members has a narrow aperture and the other of said members has a tab projecting from the end thereof and positionable within said aperture, at least two longitudinally spaced fingers struck out of said tab and angled rearwardly thereof, whereby said grid members are interlocked when said tab is positioned through said aperture with one of said fingers beyond said aperture and whereby expansion of said member causes said tab to pass further through said aperture, the other of said fingers to pass through and beyond said aperture.

Referring now more particularly to the drawings, and especially FIG. 1, a grid system for an acoustical ceiling is indicated generally at 11 and is seen to include a plurality of parallel spaced first or main grid members 13, each of generally inverted T-shaped vertical cross section defined by a vertical flange 15 and horizontal flanges 17, 19. A plurality of second or cross grid members 21 each also of generally inverted T-shaped vertical cross section defined by a vertical flange 23 and horizontal flanges 25, 27 extend transversely between one of the main grid members 13. In addition, cross grid members 21 may extend transversely between inner ones of the cross grid members 21 between and parallel to the main grid members 13 as shown to form an aesthetically pleasing lattice having rectangular spaces for accepting rectangular acoustical panels 29. These panels 29 are conveniently supported upon the horizontal flanges 17, 19 of the main grid members 13 and upon the horizontal flanges 25, 27 of the cross grid members 21 and are restrained against excessive lateral movement by the vertical flanges 15, 23 thereof, respectively.

The grid system 11 may be suspended from a conventional ceiling or overhead structure by a plurality of hangers 31, the lower ends of which are secured to the vertical flanges 15 of the main grid members 13 through openings 33.

Turning now to FIGS. 2 and 3, it is seen that each cross grid member 21 is provided at opposite ends thereof with projecting tabs 35 and 37 which are substantially extensions of but offset laterally in opposite directions from the vertical flange 23. The vertical flanges 15 of the main grid members 13 on the other hand have a plurality of pairs of spaced vertical apertures 39, 41 throughout their length to accept the tabs 35, 37 as shown in FIG. 3. Since the tabs 35, 37 are offset to opposite sides of the vertical flanges 23, adjacent cross grid members 21 in alignment when assembled with the main grid members 13 as shown and the grid system 11 is geometrically accurate. Also, the vertical flanges 23 of the cross grid
members 21 may have similar spaced vertical apertures 39, 41 to accept the tabs 35, 37 of other cross grid members interconnected therewith as shown in FIG. 1.

According to the present invention, the tabs 35, 37 are constructed to permit relatively easy assembly of the cross grid members 21 to the main grid members 13 and to other cross grid members 21 to permit the first-mentioned cross grid members 21 to expand longitudinally without themselves buckling or without causing other grid members to buckle, such as when a fire exists in the enclosure. In this connection, attention is directed particularly to FIGS. 4 and 6 which show the form and construction of the tab 35 and it will be understood that the tab 37 is similarly formed and constructed. As shown, the tab 35 is slotted longitudinally at 43 substantially dividing the tab 35 into upper and lower tab portions 45 and 47. The upper tab portion 45 has a first finger 49 which is bent and bent to one side thereof and a second finger 51 which is bent and bent to the other side thereof and spaced rearwardly from the first finger 49. Both of the fingers 49 and 51 extend rearwardly of the tab 35 and the first finger 49 preferably is adjacent and opens into the slot 43 while the second finger 51 is intermediate the slot 43 and the top edge 50 of the tab 35 so as to be surrounded by a field of metal. The lower tab portion 47 has first and second rearwardly projecting fingers 53 and 55 aligned vertically with the fingers 49 and 51, respectively, but extending to the opposite side of the tab 35 from their corresponding vertically aligned fingers. As shown, the finger 53 preferably is adjacent and opens through the bottom edge 56 of the tab 35 while the finger 55 is intermediate the bottom edge 56 and the slot 43 so as to be entirely surrounded by a field of metal. Thus, the fingers 51 and 55 which are entirely surrounded by metal extend in opposite directions from the tab 35 as do the two fingers 49 and 53 which extend through open sides of the tab.

The aperture 39 in the vertical flange 15 of the main grid member 13 is slightly wider than the width of the tab 35 to freely accept the same but encounters interference from the fingers 49, 51, 53, 55. Since the forwardmost fingers 49, 53 are adjacent and open through the slot 43 and the tab bottom edge 56, respectively, these fingers bend inwardly relatively easier than the fingers 51 and 55 which are entirely surrounded by metal when the tab 35 is inserted into the aperture 39 with manual force, as seen in full lines in FIG. 5. However, since the fingers 51, 55 are intermediate the slot 43 and the tab edges 50, 56 respectively, they are stiffer and present a somewhat greater resistance to bending so that when the tab 35 is inserted into the aperture 39 with manual force, these fingers prevent the tab 35 from being inadvertently projected fully into the aperture 39. In addition, the tab lower portion 47 has a tapered abutting surface 57 at its lower edge 56 (FIG. 4) substantially intermediate the fingers 53, 55 which engages the vertical flange 15 below the aperture 39 to prevent full projection of the tab 35 through the aperture 39 during assembly. The upper tab surface 50 rides close to the upper surface of the aperture 39 to insure that the abutting surface 57 engages the vertical flange 15 during assembly. This, then defines the normal assembled position of the cross grid member 21 and the main grid member 13 and is shown best in FIGS. 3 and 4 and in dot-dash lines in FIG. 5.

It is not desirable under certain circumstances to make the tab 35 or 37 from fast and resilient steel or to make the ends tabs 35 and 37 of a high quality steel which must be riveted or otherwise fastened to the main body portion of the grid member. Rather, it is desirable that the tabs 35 and 37 be made in one piece with the main body of the grid member so that the entire part can be to be entirely formed in one operation 38 and then operated with operations. However, this creates the problem of getting the front fingers 49 and 53 of the tab 35, for example, through the relatively narrower slot 39 without flexing and stressing the metal in the fingers beyond its elastic limit and thus causing a permanent set or deformation which would adversely affect the interlocking function and holding power of the fingers after assembly. This problem is solved in the particular embodiment of the invention here shown by way of illustration by providing in the upper and lower tab portions 45 and 47 and by positioning the front fingers 49 and 53 in the forward or terminal ends of the tab portions. By reason of this unique combination and correlation of parts, the upper and lower portions of the tabs flex bodily or "wigwag" in opposite directions as the fingers are forced through the slot of the connecting grid member. This action of the tab portions occurring simultaneously with the inward flexure of the fingers permits the latter to pass readily through the slot without permanent set or deformation even though the grid member is made of a cold rolled relatively soft steel according to conventional practice and which is necessary as a practical matter in order to permit the grid member to be fashioned readily by conventional roll and die forming operations.

In a typical construction developed and used in actual practice the grid member is formed from cold rolled steel .020" thick. Since a double thickness of metal is provided at the tabs 35 and 37, the overall thickness dimension of the tabs is .040". The slot is made .070" wide in order to accommodate the tab of the connecting grid member and to compensate for variations in the thickness dimension of the tab due to manufacturing tolerances, metal springback and the like. In order to assure proper interlocking engagement of the fingers 49 and 53 with the connecting grid member under the conditions, the fingers are struck and bent laterally so that they project at least .035" beyond the adjacent or near surface of the tab. This means that the overall dimension between the projecting ends of the fingers 49 and 53 is .110" and it also means that .110" of metal must be pushed through a slot only .070" wide at assembly without significantly over stressing the fingers. This is accomplished according to the present invention as suggested above by the combined flexure of the upper and lower tab portions 45 and 47 and the fingers 49 and 53. It is desirable, in this connection, that the slot 43 extend at least to the inner ends of the rear fingers 51 and 55 as this assures adequate flexure of the tab portions 45 and 47. Also, the location of the front fingers 49 and 53 at the edges of the tab portions 45 and 47 assist in obtaining the snap-through action desired for the front fingers as they can flex more easily than if they were entirely surrounded by metal as in the case of the rear fingers 51 and 55.

That part of the problem having to do with proper engagement of the front fingers 49 and 53 with the connecting grid member is accomplished in part, as suggested above, by specifically designing the tab end so that the front fingers can be pushed through the slot 39 without overstressing the metal. However, other factors present in the construction also contribute to this result. For one thing, the fact that the locking fingers are formed from a double thickness of metal makes them stiffer and less likely to be deformed permanently at assembly than if they were made of a single thickness of metal and this fact compensates to a degree for the relatively nonresilient nature of the metal if the grid member is made of cold rolled steel according to conventional practice. In addition, the spacing between the front fingers 49 and 53 and the rear fingers 51 and 55 longitudinally of the tab 35 is a significant factor as the spacing is such that the rear fingers begin to bear on the connecting grid member at opposite sides of the slot 39 at about the time the front fingers snap through the slot, as perhaps best shown in FIGURE 7. Thus, the rear flared rear fingers 51 and 55 tend to hold the cross grid member centered in the slot 39, as also shown in FIG. 7, and thus maintain the front fingers 51 and 53 properly in engagement with the
connecting grid member. This is significant, particularly during assembly of the ceiling grid system, as the previously assembled grid members sometimes are racked back and forth during assembly. By this it is meant that the connecting grid is racked not always at right angles to the connecting grid members as shown in the drawings, particularly during the assembly operation. All of the assembled grid members are usually kept in the same horizontal plane, but the cross grid members are sometimes inclined to one side or the other with respect to the connecting grid members. Very often in practice the entire grid assembly is racked when not used during the actual assembly of the parts, and it may be racked back and forth repeatedly before the assembly is completed. Usually, all the parts are simply put together in a rough assembly pattern and then, after all of the parts are assembled, the workers rearrange the grid so that all of the members are precisely at right angles to each other. If the interlocking engagement between tabs of the cross members and the connecting grid members is not effective and secure, they may come loose when the assembly is racked, and the construction specifically referred to and described above makes the instant assembly particularly effective under these conditions.

The tab 37 on the other end of each cross grid member 21 is similarly formed and has a longitudinal slot 59 defining upper and lower tab portions 61, 63 along with a first and second finger 65, 67 on the upper portion 61 and a first and second finger 69, 71 on the lower portion 63. As was the case with the tab 35, the fingers 65, 69 are formed adjacent one edge of the tab portions 61, 63 are in general vertical alignment and extend to opposite sides of the tab 37 while the fingers 67, 71 are formed intermediate the edges of the tab portions 61, 63, respectively, in general vertical alignment and also extend to opposite sides of the tab 37. In addition, the tab 37 also may have a tapered butting shoulder (not shown) on its lower edge and intermediate the fingers 69, 71 to engage the vertical flange 15 below the aperture 41. The normal assembled position of these parts is shown also in FIGS. 3, 4, and 7.

In assembly, the cross grid members 21 are secured to the main grid members 13 simply by manually inserting the tabs 35, 37 through the apertures 39, 41 and together, the main and cross grid members form a rigid grid system such as that shown in FIG. 1. For appearance, the cross grid member horizontal flanges 25, 27 have raised ends, 75 which slide on the main grid member horizontal flanges 17, 19 respectively, when the grid members are assembled (FIG. 4).

When a fire occurs in the enclosure, the cross grid members 21 become heated and tend to expand longitudinally against the main grid members 13 or other cross grid members 21 as may be the case. The upper edge 50 of the tabs 35, 37 is tapered in reverse fashion at 72 to the abutting surface 57 illustrated on the bottom edge 56 of the tab 35 (FIG. 4) so that when the cross grid members 21 expand and push against the main grid members 13, the cross grid members 21 are cammed upwardly toward the other member 21. The tab 35, 37 project further through the apertures 39, 41. Continued expansion of the cross grid members 21 during heating causes the tabs 35, 37 to gradually project further through the apertures 39, 41 whereupon the rearwardmost fingers 51, 55 and 65, 71 are bent back toward their tabs 35, 37, respectively, and allow the cross grid members 21 to completely fit through the apertures 39, 41. The fingers 51, 55 and 65, 71 are constructed to flex and permit full projection of the tabs 35, 37 without imposing such strain on these cross grid members 21 or on the interconnected main grid members 13 or other cross grid members 21 as may be the case which might cause buckling thereof and lift or tilt one or more of the panels 29. When allowed, cross grid members 21 extend from both sides of the main grid member 13 as shown in FIG. 3, the expansion forces of the cross grid member 21 oppose one another and while the tendency is not so great to buckle the main grid member 13, the forces on the cross grid members 21 are substantially doubled. However, where the cross grid member 21 interconnect with one of the outermost main grid members 13 and where a cross grid member 21 interconnects with a cross grid member 21 or with a main grid member 13 and does not have another cross grid member 21 aligned therewith on the other side of the interconnected member, the expansion forces imposed by the expanding cross grid member 21 would, in the absence of the tab construction illustrated, cause buckling of the interconnected member.

The tabs 35, 37 preferably are constructed as shown having a slot 43, 59 respectively, and a pair of longitudinally spaced fingers on each tab portion defined by the slots 43, 59. However, in some installations, it may be desirable to eliminate these slots 43, 59 and/or utilize only one pair of longitudinally spaced fingers on each tab 35, 37. It will be understood that in such cases, it is preferable that the forwardmost finger or fingers on each tab 35, 37 be weaker in resisting bending, such as is the case when this finger or fingers are formed adjacent one edge of the tab, while the rearwardmost finger or fingers on each tab 35, 37 are desirably stronger resisting bending, such as is achieved by forming these fingers intermediate the tab edges.

The main grid members 13 can, as shown in FIG. 1, be of integral construction when their ends are not confined and simply rest upon a ceiling support so that expansion thereof during heating effects a substantially uniform expansion thereof and does not materially affect the grid system integrity. Also, the vertical flanges 23 of the cross grid members 21 can be slotted as at 77, 79 to permit the tabs 35, 37 to flex laterally when the main grid members 13 expand so that the integrity of the system is maintained. However, when the main grid members 13 are confined at their ends, they can be constructed from individual grid members interconnected at their ends by expansion spacers of the type illustrated and described in U.S. Patent No. 3,119,475, granted Jan. 28, 1964 and owned by the assignee of the present application, or they can be constructed so as to isolate and control expansion thereof as illustrated and described in my copending application Serial No. 537,100, filed March 24, 1966; now Patent No. 3,350,125.

From the foregoing, it will be apparent that the grid system of the present invention is such as to fulfill the forementioned objects and advantages and while a preferred embodiment of the present invention has been illustrated and described above in detail, various additions, substitutions, modifications and eliminations may be made thereto without departing from the spirit of the invention as encompassed by the appended claims.

What is claimed is:

1. In a grid system for an acoustical ceiling, interlocking normally arranged grid members, one of said members having a narrow aperture, another of said members having a tab projecting from the end thereof and positionable within said aperture, at least two longitudinally spaced fingers struck out of said tab and angled rearwardly thereof whereby said grid members are interlocked when said tab is positioned through said aperture with one of said fingers beyond said aperture and whereby expansion of said one member causes the other of said fingers to pass through and beyond said aperture.

2. A construction as claimed in claim 1 wherein said tab is formed with a slot defining an upper and a lower tab portion, each having one pair of said longitudinally spaced fingers struck out laterally therefrom and angled rearwardly thereof.

3. A construction as claimed in claim 1 wherein said one finger is formed adjacent one edge of said tab and is relatively flexible in use and said other finger is formed...
intermediate the edges of said tab and is relatively stiff in use.

4. A construction as claimed in claim 1 wherein said tab is formed with a longitudinal slot extending from the free end thereof and defining an upper and a lower tab portion, each tab portion having one pair of said longitudinally spaced fingers struck out laterally therefrom and angled rearwardly thereof, the forwardmost one of said fingers of each said pair being formed adjacent one edge of said tab and being relatively flexible in use and the rearwardmost one of said fingers of each of said pair being formed intermediate the tab edges and being relatively stiff in use.

5. A construction as claimed in claim 1 wherein the forwardmost portion of said tab has a transverse dimension slightly less than the long dimension of said aperture for easy passage therethrough and wherein the rearwardmost portion of said tab is offset downwardly from said forwardmost portion.

6. A construction as claimed in claim 1 wherein the width of the forwardmost portion of said tab is slightly less than the length of said aperture for easy passage therethrough, the forwardmost portion of said tab being upwardly offset from said rearwardmost portion thereof connected in the plane of the tab and said portions being connected by a rearwardly tapering surface at each longitudinal tab edge.

7. A construction as claimed in claim 6 wherein said one finger is positioned forwardly of said tapered surfaces and said other finger is positioned rearwardly thereof.

8. A construction as claimed in claim 1 wherein said longitudinally spaced fingers extend to opposite sides of said tab.

9. A construction as claimed in claim 2 wherein said longitudinally spaced fingers of each said pair extend to opposite sides of said tab.

10. A construction as claimed in claim 2 wherein the forwardmost fingers of each said pair are substantially vertically aligned and wherein the rearwardmost fingers of each said pair are substantially vertically aligned.

11. A construction as claimed in claim 1 which includes a further grid member aligned with said another grid member and on the opposite side of said one grid member therefrom, said one grid member having another narrow aperture spaced and separate from and generally parallel to said first-mentioned aperture, said further grid member having a tab projecting from the end thereof substantially identical to said first-mentioned tab and positionable within said another aperture, said tabs being offset laterally in opposite directions from said further and other grid members a distance substantially equal to the spacing between said apertures to position said further and other grid members substantially in alignment with each other.

12. A construction as claimed in claim 1 wherein said tab is constructed integrally with said other member and the forwardmost one of said fingers has a double thickness metal construction.

13. A construction as claimed in claim 2 wherein the rearwardmost fingers of each of said pair engage said one grid member on opposite sides of said aperture to hold said tab centered in said aperture and the forwardmost fingers of each said pair in a locked position.

14. In a grid system for an acoustical ceiling, interlocking normally arranged grid members, one of said grid members having a narrow elongate aperture and the other of said grid members having an end tab in said aperture, the width of said tab being slightly less than the length of said aperture for easy insertion of said tab into said aperture, the terminal portion of said tab being offset from the root portion thereof in the plane of the tab and said offset portions being connected by rearwardly and downwardly sloping surfaces at each longitudinal tab edge, said tab being formed with a longitudinal slot defining upper and lower tab portions, and each tab portion having a pair of longitudinally spaced forward and rearward fingers struck out laterally therefrom, extending to opposite sides of the tab and angled rearwardly thereof, said forward fingers being formed adjacent the edges of said tabs and the rearward fingers being formed intermediate the tab edges, whereby said grid members are interlocked when said tab is positioned through said aperture with said forward and rearward fingers at opposite sides of said one grid member and whereby longitudinal expansion of said other grid member is accommodated by said rearward fingers passing through and beyond said aperture.

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