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(19) **United States**(12) **Patent Application Publication**
Yonash et al.(10) **Pub. No.: US 2008/0148665 A1**(43) **Pub. Date: Jun. 26, 2008**(54) **CEILING TILES MADE OF RIGID PVC****Publication Classification**(76) Inventors: **Richard F. Yonash**, Sebastopol, CA
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CA (US)(51) **Int. Cl.**
E04B 9/04 (2006.01)
E04F 13/08 (2006.01)
(52) **U.S. Cl.** **52/384; 52/506.06**
(57) **ABSTRACT**

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6550 ROCK SPRING DRIVE, SUITE 240
BETHESDA, MD 20817(21) Appl. No.: **11/954,329**(22) Filed: **Dec. 12, 2007****Related U.S. Application Data**(60) Provisional application No. 60/871,274, filed on Dec.
21, 2006.

A ceiling tile and back panel combination is comprised of PVC plastic preferably made from UV Stabilized 0.013 thick vinyl plastic and formed into the desired shapes. The ceiling tiles and back panel provide all the functionality of conventional drop ceiling tiles and ceiling panels, but at a fraction of the weight. A thin wall construction uses fewer raw materials, and makes the tiles more efficient to ship than conventional mineral fiber ceiling tiles. Additionally, the tiles of the invention do not negatively impact indoor air quality or encourage microbial growth. Also, the tiles are 100% recyclable. Acoustical performance is enhanced by formed surface features, and both thermal and acoustical performance is greatly improved when tiles are used in combination with back panels and intermediate panels, creating isolated air baffles. When installed under fire suppression sprinkler heads, tiles drop out of the way in the event of a fire so sprinklers can do their job. No special tools are required for installation.

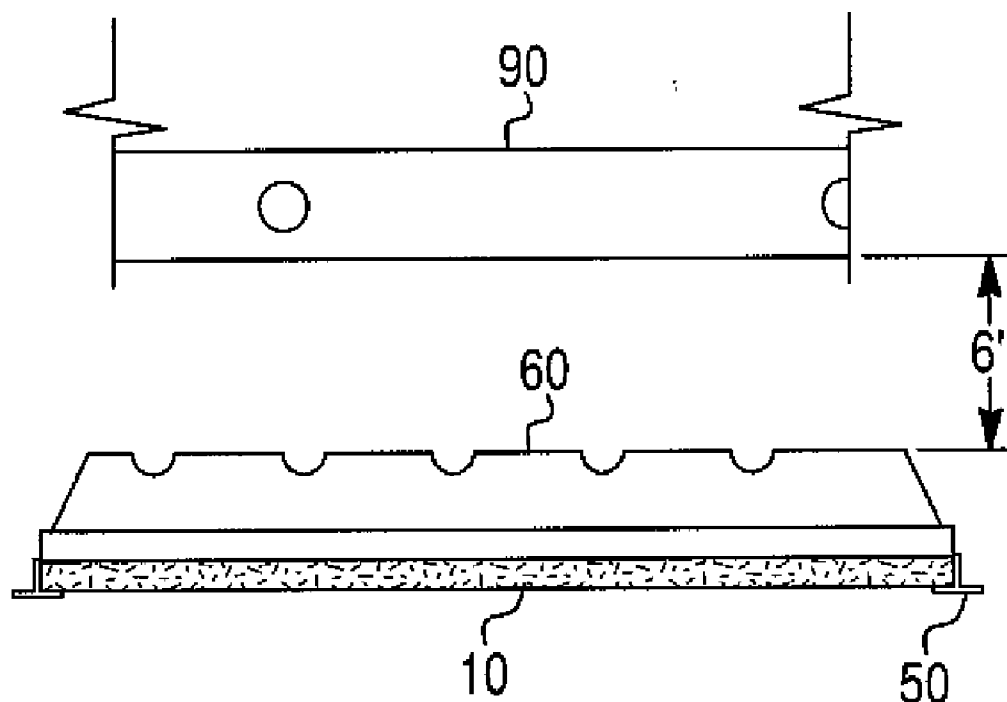


Fig. 1

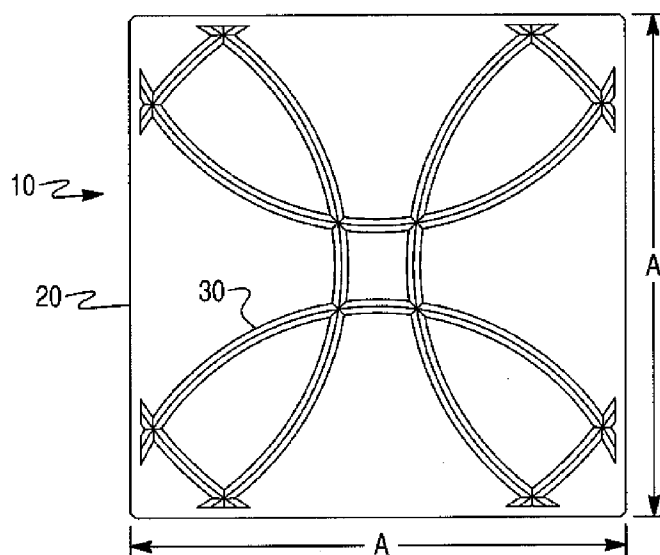


Fig. 2

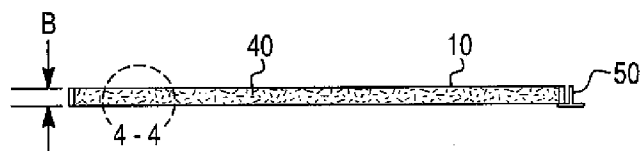


Fig. 3

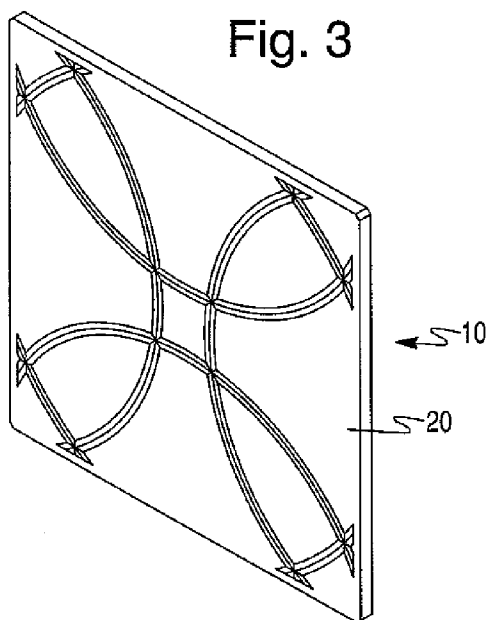


Fig. 4

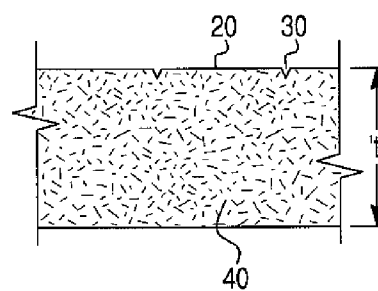


Fig. 5

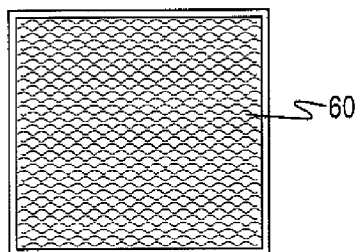


Fig. 6

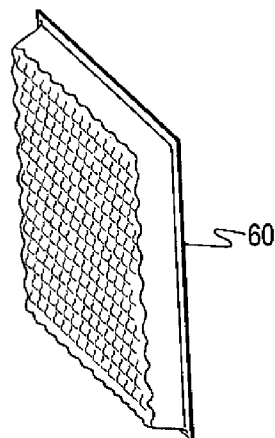


Fig. 7

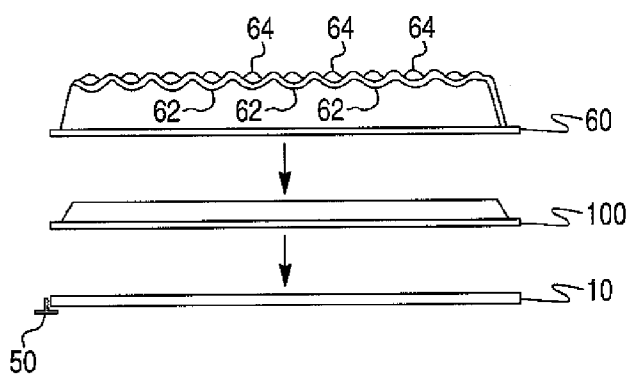


Fig. 8

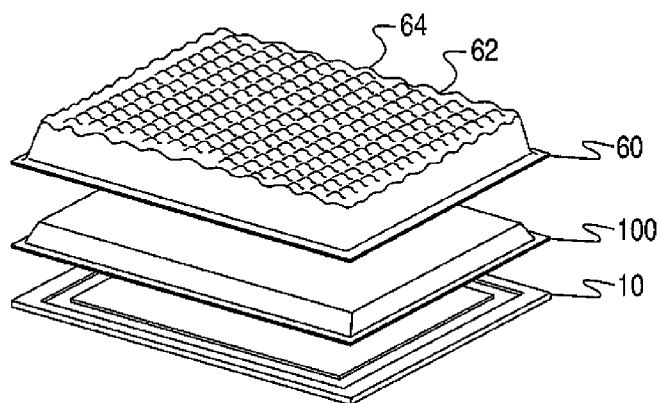


Fig. 9

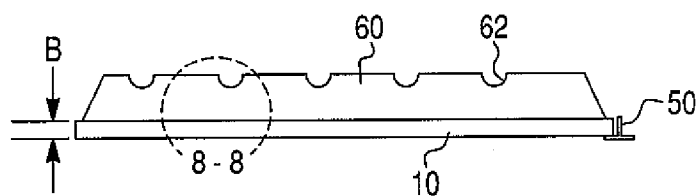


Fig. 10

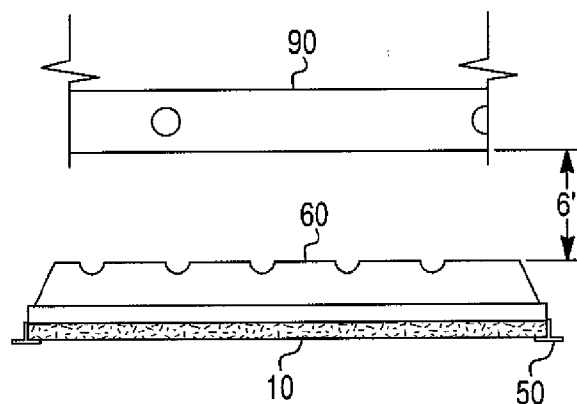


Fig. 11

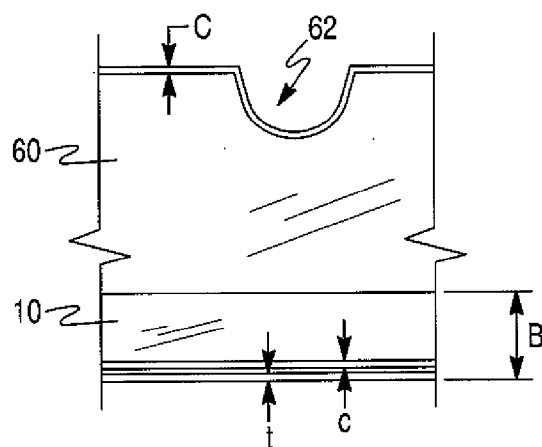


Fig. 12

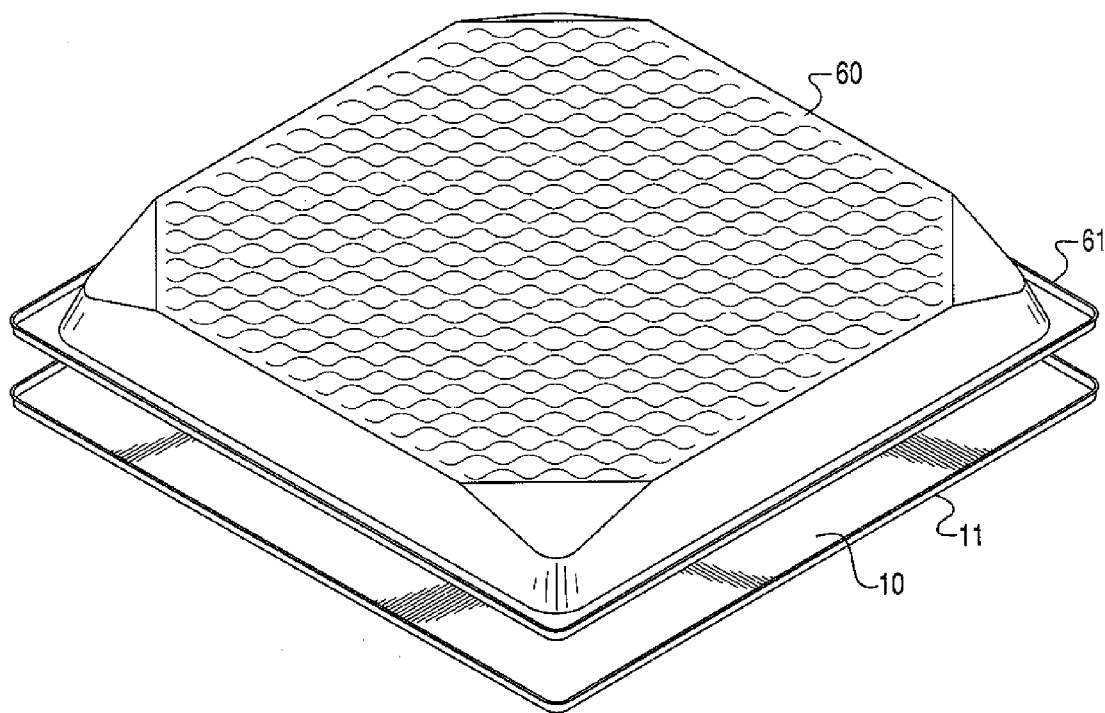


Fig. 13

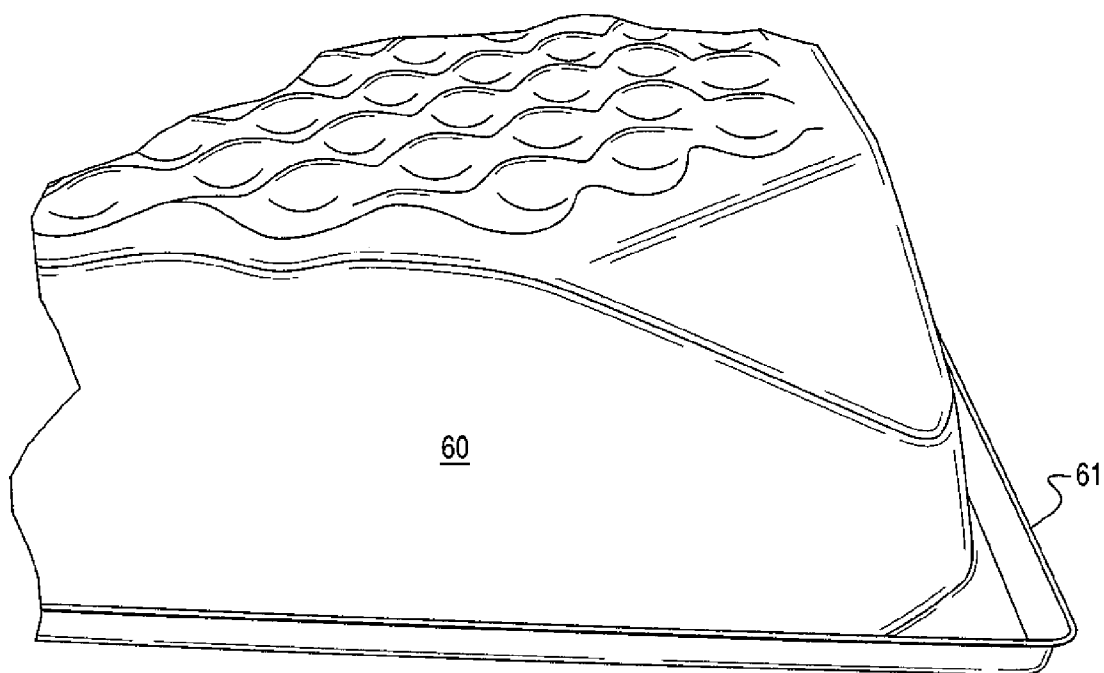


Fig. 14

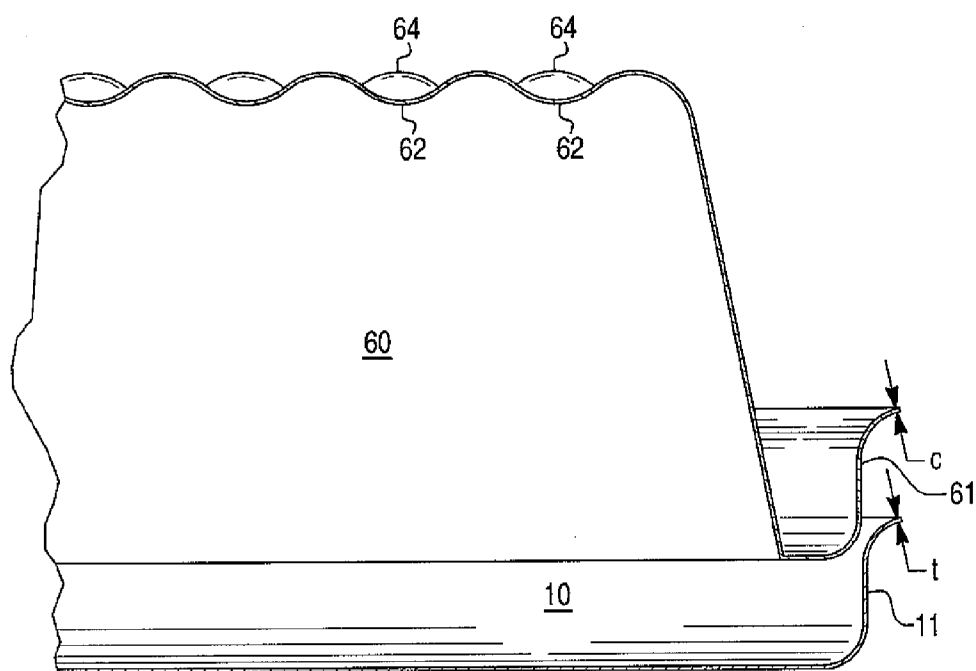
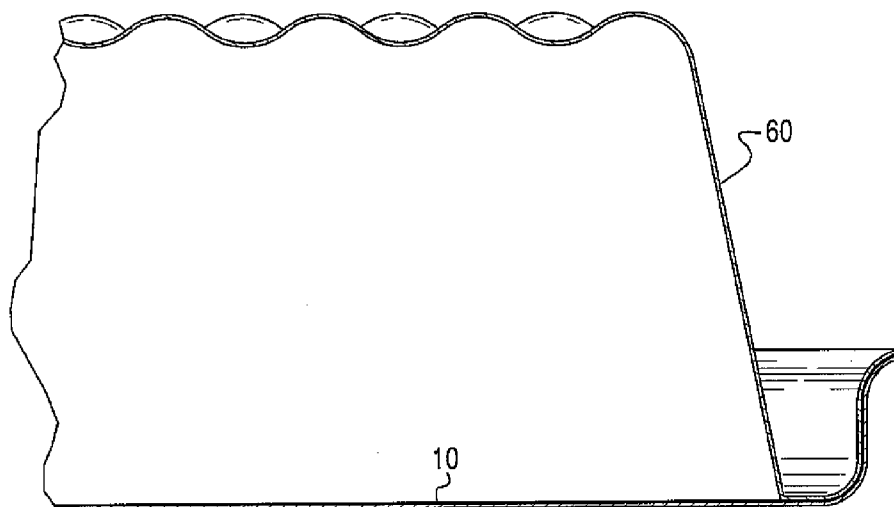


Fig. 15



CEILING TILES MADE OF RIGID PVC

CROSS-REFERENCE TO RELATED APPLICATION AND CLAIM FOR PRIORITY

[0001] This application is a U.S. Utility patent application based on U.S. Provisional Patent Application No. 60/871,274 filed on Dec. 21, 2006. The disclosure of the prior application is hereby incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to ceiling tiles, which are made of rigid polyvinyl chloride (PVC). More specifically, the present invention provides a PVC ceiling tile structure with improved acoustic and environmental benefits.

[0004] 2. Description of Related Art

[0005] Ceiling grid systems for supporting tile panels, such as acoustical ceiling tiles, are used extensively in both new and remodeled building and room structures. Grid systems typically consist of main-runners and cross-tees, having lateral supporting shoulders that are arranged perpendicular to each other to form a rectangular pattern. After the grid is installed, the tile panels are placed onto the supporting shoulders of the runners and cross-tees. Such a grid system offers many advantages such as increasing a room's energy efficiency, improving a room's acoustics, enhancing the aesthetic value of a room, lowering a ceiling, and allowing for the installation of electrical fixtures, pipes, sprinklers and duct work.

[0006] Ceiling grid systems are relatively inexpensive to install as compared to a plaster ceiling. As a consequence, there is a continuing need to improve on the design and integrity of grid systems, particularly in light of the fact that many such systems are installed in commercial buildings requiring years of service, or installed by the do-it-yourself home owner.

[0007] However, conventional ceiling tile systems are difficult to manufacture, difficult to transport and fail to provide desired environmental benefits. The need therefore exists for an environmentally friendly ceiling tile that is aesthetic, easy to manufacture and install. Further, the need exists for a ceiling tile that is fire rated and approved for use under ceiling fire suppression sprinkler systems.

SUMMARY OF THE INVENTION

[0008] A ceiling tile assembly, comprising a main body portion formed of rigid PVC defining a planar surface with ridges and troughs to define ornamental features on the planar surface, an edge portion around the periphery of said main body portion, and a back panel formed to seat onto the main body portion by nesting within a depression defined by the edge portion.

[0009] In the preferred embodiment, the main body portion and the edge portion have a thickness of about 0.13 inches. The back panel is preferably cup-shaped to define an air pocket between the back panel and the main body portion to improve acoustic and insulation properties of the ceiling tile assembly.

[0010] The assembly is designed to drop out of the ceiling support grid during a fire because the materials will deform and shrink to fall out of the ceiling grid, so as not to hamper operation of a fire suppression system.

[0011] The present invention provides improved lighting, enhanced acoustic and air pocket insulation. Additionally, the invention provides favorable indoor air quality, natural resource, and environmental benefit achieved with rigid PVC without phthalates.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a plan view of a first embodiment of the ceiling tile of this invention.

[0013] FIG. 2 is an edge view of the first embodiment ceiling tile of FIG. 1.

[0014] FIG. 3 is a perspective view of the ceiling tile of FIG. 1.

[0015] FIG. 4 is an enlarged side elevation view of the ceiling tile of FIG. 2 taken generally along section line 4-4 of FIG. 2.

[0016] FIG. 5 is a plan view of a ceiling tile back panel made of rigid PVC.

[0017] FIG. 6 is a perspective view of the ceiling tile back panel of the invention.

[0018] FIG. 7 is an edge view of ceiling tile, a ceiling tile back panel, and a ceiling tile intermediate panel and combination made of rigid PVC.

[0019] FIG. 8 is a perspective of the ceiling tile, the ceiling tile back panel, and the ceiling tile intermediate panel and combination made of rigid PVC.

[0020] FIG. 9 is an edge sectioned view of the combination ceiling tile and back panel arrangement illustrated in FIG. 5.

[0021] FIG. 10 is an edge view of an application of the ceiling tile of the invention in combination with the ceiling tile back panel, further in use with an illumination fixture situated above the tile.

[0022] FIG. 11 is an enlarged sectioned view of the tile of FIG. 9 taken generally along lines 8-8 of FIG. 9 showing the back panel nested within the tile and further illustrating a PVC wall thicknesses of each optimized for structural characteristics.

[0023] FIG. 12 is an exploded perspective view of the back panel and ceiling tile shown in combination with the back panel placed convex side up to nest within the concave tile.

[0024] FIG. 13 is a partial perspective view of the back panel showing the peripheral raised edge of the back panel.

[0025] FIG. 14 is a partial sectional view of the back panel being nested with the recessed tile with the back panel placed convex side up.

[0026] FIG. 15 is a partial sectional view of the back panel fully nested within the recessed tile.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

[0027] It is an advantage of the present invention to provide improved lighting, enhanced acoustic and air pocket insulation. Specifically, when used in combination with translucent lighting panels, the present invention provides better light diffusion, and eliminates the shadows and dark spots frequently caused by dust and insect accumulation on conventional, single-wall lighting panels. Furthermore, the present invention can increase the NRC (Noise Reduction Coefficient) rating of ceiling tiles by 20% to 25%. Still further, the present invention insulating air impedes thermal transfer and moderates temperature fluctuation.

[0028] With reference to FIG. 1, the present invention is illustrated in plan view to show a first preferred embodiment

of the ceiling tile **10**, which is preferably made of rigid PVC. This view shows that the tile has length and width, respectively indicated by L and W, which is preferably but not necessarily 23.75 inches for a 2x2 tile. This particular tile illustrated in FIGS. **1** and **2** has a depth B of about 0.25 inches and a material thickness of about 0.13 inches. Also shown is a molded decorative pattern **30** on the surface **20** of the tile **10**, together with the molded surface characteristic. The molded surface characteristic of surface **20** is that area of the molded tile between the decorative patterns **30**. The molded decorative patterns **30** can be any design and are not intended to be limited to the particular design shown. The particular design shown is merely for illustrative purposes.

[0029] Thermoforming is the preferred method of manufacture for the tile(s) **10** of the present invention. Thermoforming uses heat, vacuum, and pressure to form plastic sheet material into a shape that is determined by a mold. Sheet stock is heated to a temperature at which the plastic softens, but that is below its melting point. Using vacuum and/or pressure, the plastic is then stretched to cover and duplicate the contours of a mold. Then, the plastic is cooled so it retains its shape, thereby providing the molded surface characteristic(s) on the surface **20**. Finally it is removed from the mold and trimmed as required to create a finished part. Indeed, the tiles of this invention may be cut using scissors or other common cutting tools to achieve the exact shape desired for a particular application.

[0030] Generally, thermoforming can accommodate a wide range of sheet thicknesses and part sizes, from thin-gauge sheet used to form small packaging containers to heavy-gauge sheet used to make items as large as pallets, boat hulls and recreational vehicle tops. Thermoforming is known by those of skill in the art for low tooling costs, short tooling lead times, and great versatility.

[0031] According to the present invention, ceiling tiles are preferably made from UV-stabilized, 0.013" thick vinyl plastic formed with a peripheral edge portion defining a depression or recessed configuration as will be described in more detail with respect to FIGS. **12-15** below. These ceiling tiles provide all the functionality of conventional mineral fiber or gypsum drop ceiling tiles and ceiling panels, but at a fraction of the weight. Available in many sizes, including but not limited to both 24"x24" and 24"x48" sizes, the feather-light construction creates a ceiling that is durable and aesthetic yet easy to install. The ease of manufacture and versatility of style provides economic and aesthetic benefits not found in the prior art.

[0032] The ceiling tiles and drop ceiling panels come in any color, including UL-approved white opaque and black opaque vinyl for a traditional ceiling tile look, and UL-approved translucent white vinyl for use under lighting fixtures.

[0033] The tiles formed by the method of the present invention also provide reduced maintenance requirements. As the tiles don't crumble or crack like conventional mineral fiber tiles, they don't create dust—and they can be easily removed and replaced from the grid without cracking if access to the space above the grid is required, which it frequently is. Moving conventional tiles in and out of the grid can break them down pretty quickly. And because our tiles do not absorb moisture, they don't take on permanent stains and odors like conventional tiles. The net result is that ongoing maintenance requirements (cleaning, replacement) are greatly reduced.

[0034] Further, in the event of an earthquake, because these tiles are so light weight they do not create the potential "fall-

ing hazard" of conventional mineral fiber tiles. Because they are so flexible it is probable that they will just ride out a quake instead of cracking, crumbling, and falling. If they do fall, they won't hurt anything or anyone that they might fall on, because they are so light.

[0035] Another unique feature of the present invention is the favorable indoor air quality, natural resource, and environmental benefit achieved with rigid PVC, a material not generally associated with those characteristics. The environmental benefits and air quality aspects of the tiles are achieved by use of rigid PVC without phthalates. Phthalates, or phthalate esters, are a group of chemical compounds that are mainly used as plasticizers (substances added to plastics to increase their flexibility). They are chiefly used to turn polyvinyl chloride from a hard plastic into a flexible plastic. However, there is a debate raging about the health effects of and risks caused by phthalates. The present invention eliminates those risks by eliminating phthalates from the rigid PVC.

[0036] FIG. **2** is an edge view of the first preferred embodiment ceiling tile made of invention. FIG. **2** shows that the tile has depth of about 0.25 inches, indicated by B, and a material thickness 't' which is preferably but not necessarily about 0.13 inches. See FIG. **4**. This figure also shows the tile **10** in relationship to a conventional T-bar suspension grid **50** in cross section. FIG. **3** is a perspective view of the first preferred ceiling tile shown in FIGS. **1** and **2**.

[0037] The vinyl ceiling tiles and drop ceiling panels of the present invention are specifically rated, listed and approved for installation under fire suppression sprinkler systems that activate at 165° F., but they may be designed for installation under fire suppression sprinkler systems with other activation temperatures. Opaque vinyl ceiling tiles, translucent vinyl lighting tiles and clear vinyl back panels install in all standard 1" T-Bar ceiling systems (but can be made to install into custom systems) and are engineered to drop harmlessly out of the way in the event of a fire, allowing the sprinklers to do their job. Specifically, the tile(s) **10** are designed to deform and shrink when subjected to the heat-rating of the sprinkler system employed in the ceiling grid; therefore, the tiles **10** may be mounted below the sprinklers without the need to cut holes in the tiles for sprinkler exposure. Because the sprinklers are not visible from the ground, the tiles further enhance the aesthetic properties of the ceiling without sacrificing fire safety.

[0038] When used under current fire sprinkler systems, transparent and opaque vinyl ceiling tiles and panels, intermediate panels, and clear back covers should not be fastened directly to metal T-bar members. They should be set in place only. No clips, fasteners or impediments of any kind should be used to limit the ceiling panels' ability to drop from the suspension system without restraint in the event of a fire. In areas where there is exposure to drafts and air currents, hold down clips can be used to limit the ceiling panels' upward movement only—clips should not prevent ceiling panels from dropping out in the event of a fire. Of course, the specific support structure and fastening members will be determined by the specific ceiling tile and support structure employed for each application. The important provision of fire safety remains the ability for the novel tiles to shrink and deform so they may drop out of the ceiling so the sprinkler system will work to its optimal performance.

[0039] Ceiling tiles and drop ceiling panels may be suspended by means of an approved ceiling suspension system using standard 1" face T-bar manufacturer's instructions for

suspension system installation, but other suspension systems are certainly possible and within the scope of the present invention. Installation is performed by laying the ceiling tiles and ceiling panels in place in the suspension system desired as will be understood by those of skill in the art.

[0040] FIG. 4 is an enlarged side elevation view of the ceiling tile taken generally along section line 4-4 of FIG. 2 illustrating a molded surface characteristic 20 and molded decorative patterns 30. The present invention requires no special cleaning agents. A soft, damp rag is usually sufficient. User should not to apply too much pressure because some tiles may have a tendency to become dented or bent. The tiles of this invention are impervious to water damage during cleaning, and there is no need for scheduled professional cleaning and resurfacing to prevent environmental and aesthetic problems. Small, stubborn spots can be handled with household cleaners, such as Fantastik® or Windex®. Cleaners containing organic solvents or other aggressive ingredients should not ordinarily be used because they may affect the surface appearance of the tile. Examples of such cleaners that may affect the surface appearance include chlorine bleach, liquid grease remover, strong soaps and detergents containing organic solvents, nail polish remover and furniture polish/cleaners. The present invention may also be painted and mounted on walls.

[0041] With reference to FIGS. 5-8, the multi-layer embodiment of the invention will now be described. FIG. 5 is a plan view of a ceiling tile back panel 60 made of rigid PVC with diffusion depressions and projections 62, 64 formed on the top surface. FIG. 6 is a perspective view of the ceiling tile back panel 60 of the invention. One embodiment employs isolated air baffles or air gaps created by using the ceiling tiles, back panels, and intermediate panels in combination. The air baffles or air gaps are provided by gaps between the back panel 60, optional intermediate panel 100 and/or the tile 10. FIG. 7 is an edge view of ceiling tile 10, a ceiling tile back panel 60, and a ceiling tile intermediate panel 100 and combination made of rigid PVC. FIG. 8 is a perspective of the ceiling tile 10, the ceiling tile back panel 60, and the ceiling tile intermediate panel 100 and combination made of rigid PVC.

[0042] FIG. 9 is an edge sectioned view of the ceiling tile back panel 60 illustrated in FIG. 5 nested within the concave tile 10. The diffusion depressions 62 are also illustrated in FIG. 9. FIG. 10 is an edge view of an application of the ceiling tile of the invention in combination with the ceiling tile back panel 60, further in use with an illumination fixture 90 above.

[0043] For best lighting results and lengthened life of the ceiling tiles and drop ceiling panels, diffusers or back panel 60 used in lighting applications should be positioned 6" from the lamps. It is also preferable that translucent lighting ceiling tiles and drop ceiling panels be used with the separate clear back panels 60, which nest above the exposed panels. These ceiling tile back panels 60 provide better diffusion of light, hide dust and insect accumulation and increase sound absorption and insulation properties. When installing clear back panels 60 above the ceiling tiles and panels 10, one simply sets the panels 10 into the 1" T-bar suspension system 50 in pairs: one clear back panel 60, convex side up, in combination with the exposed ceiling panel 10.

[0044] FIG. 11 is an enlarged sectioned view of the tile of FIG. 9 taken generally along lines 8-8 of FIG. 9 with the back panel 60 nested within the concave tile 10, and further illustrating the PVC wall thickness 't' of the tile 10 and PVC wall

thickness 'C' of the back panel 60 optimized for structural characteristics. In the preferred embodiment, both thicknesses 't' and 'C' are about 0.13 inches.

[0045] FIGS. 12-15 illustrate the preferred design and embodiment of the present invention whereby the back panel 60 is nested, convex side up, within the concave tile member 10. These Figures further illustrate the peripheral edge 61 of the back panel 60 as well as the projections and recesses 62, 64 providing the diffuser function of the back panel 60. Both the back panel 60 and the recessed tile 10 are formed with peripheral edges 61, 11; respectively, to provide a necessary rigidity to the back panel 60 and tile 10 and to enhance the nesting capability of these elements. Indeed, the peripheral edges 61, 11 add to the rigidity of the back panel and tile when placed in the T-bar suspension system 50.

[0046] From the foregoing description, it is clear that the present invention provides improved lighting, enhanced acoustic and air pocket insulation. Specifically, when used in combination with translucent lighting panels, the present invention provides better light diffusion, and eliminates the shadows and dark spots frequently caused by dust and insect accumulation on conventional, single-wall lighting panels. Furthermore, the present invention can increase the NRC (Noise Reduction Coefficient) rating of ceiling tiles by 20% to 25%. Still further, the present invention insulating air impedes thermal transfer and moderates temperature fluctuation.

[0047] Additionally, the present invention provides favorable indoor air quality, natural resource, and environmental benefit achieved with rigid PVC, a material not generally associated with those characteristics. The environmental benefits and air quality aspects of the tiles are achieved by use of rigid PVC without phthalates. Phthalates, or phthalate esters, are a group of chemical compounds that are mainly used as plasticizers (substances added to plastics to increase their flexibility). They are chiefly used to turn polyvinyl chloride from a hard plastic into a flexible plastic. However, there is a debate raging about the health effects of and risks caused by phthalates. The present invention eliminates those risks by eliminating phthalates from the rigid PVC.

[0048] While the present invention has been described in terms of specific embodiments, it is to be understood that the invention is not limited to these disclosed embodiments. This invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided by way of illustration only and so that this disclosure will be thorough, complete and will fully convey the full scope of the invention to those skilled in the art. Indeed, many modifications and other embodiments of the invention will come to mind of those skilled in the art to which this invention pertains, and which are intended to be and are covered by both this disclosure, the drawings and the claims.

What I claim is:

1. A ceiling tile assembly, comprising:

a main body portion formed of rigid PVC defining a planar surface with ridges and troughs to define ornamental features on said planar surface;

an edge portion around the periphery of said main body portion, said edge portion being angled at about 90 degrees with respect to said planar surface to add stability and rigidity to said main body portion; and

a back panel formed to seat onto said main body portion, said back panel being nested within a depression defined by said edge portion.

2. The ceiling tile assembly according to claim 1, wherein main body portion and said edge portion have a thickness of about 0.13 inches.

3. The ceiling tile assembly according to claim 1, wherein said ridges and troughs are disposed in a symmetric pattern on said planar surface.

4. The ceiling tile assembly according to claim 1, wherein said back panel is formed with a peripheral edge around the periphery of said back panel, said peripheral edge being angled at about 90 degrees with respect to said planar surface to add stability and rigidity to said back panel and to nest within the edge portion of said main body portion.

5. The ceiling tile assembly according to claim 1, wherein said back panel is cup-shaped to define an air pocket between the back panel and said main body portion to improve acoustic and insulation properties of said ceiling tile assembly.

6. The ceiling tile assembly according to claim 1, wherein said back panel is formed of rigid PVC having a thickness of about 0.13 inches.

7. The ceiling tile assembly according to claim 1, further comprising an intermediate panel disposed between said main body portion and said back panel to further enhance acoustic and insulation properties of said ceiling tile assembly.

8. The ceiling tile assembly according to claim 1, wherein said ceiling tile assembly is formed and sized to deform and shrink when heated to about 165 degrees Fahrenheit to thereby fall out of a ceiling grid support system to enable a fire suppression sprinkler system to distribute water from above said ceiling tile assembly to an area below said ceiling grid support system.

9. The ceiling tile assembly according to claim 1, wherein said main body portion is formed of rigid PVC without phthalates.

10. A ceiling tile assembly, comprising:

a main tile body formed of rigid PVC defining a planar surface with ridges and troughs to define ornamental features on said planar surface and an edge portion around the periphery of said planar surface;

a back panel formed to seat onto said main body portion, said back panel being coextensive with said main tile body,

wherein said back panel is cup-shaped to define an air pocket between the back panel and said main body portion to improve acoustic and insulation properties of said ceiling tile assembly.

11. The ceiling tile assembly according to claim 10, wherein said main tile body and said back panel is formed and sized to deform and shrink when heated to about 165 degrees Fahrenheit to thereby fall out of a ceiling grid support system to enable a fire suppression sprinkler system to distribute water from above said ceiling tile assembly to an area below said ceiling grid support system.

12. The ceiling tile assembly according to claim 10, further comprising an intermediate panel disposed between said main body portion and said back panel to further enhance acoustic and insulation properties of said ceiling tile assembly.

13. The ceiling tile assembly according to claim 10, wherein said main body portion and said back panel is formed of rigid PVC without phthalates.

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