PANEL FOR A SUSPENDED HEATING AND/OR COOLING CEILING

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A panel (10) for a suspended heating and/or cooling ceiling comprises a flat metal cassette having mutually spaced upper and lower metal sheets (11, 12) defining a sealed space (17) therebetween. The metal sheets are perforated by registering apertures (13, 14) which are sealed against the space along the circumference thereof. At least one of the metal sheets around each aperture forms an embossment (15) attached to the other metal sheet as a spacer between the metal sheets. An inlet (19) and an outlet (20) communicate with the space for circulating a fluid heat carrier through the space in heat exchanging relationship with the panel.
PANEL FOR A SUSPENDED HEATING AND/OR COOLING CEILING

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to a panel for a suspended heating and/or cooling ceiling.

[0003] In a room with a heating/cooling ceiling heat is transmitted by radiation from the ceiling to persons or objects in the room when the ceiling functions as a heater, and from the persons or objects to the ceiling when the panel functions as a cooler, the air in the room being heated or cooled, respectively, by convection. This gives a comfortable climate in the room, and in comparison with conventional air condition presents the following advantages:

[0004] the supply of external ventilation air to the room can be substantially reduced;
[0005] a fluid heat carrier, usually water, can be circulated through the panels in a low pressure system;
[0006] the heating/cooling system operates without generating noise;
[0007] the air humidity will not be influenced, dry air in the room being avoided;
[0008] no draft will be produced;
[0009] the system provides esthetical advantages;
[0010] the system is completely integrated in the ceiling, and the heating/cooling ceiling panels cannot be distinguished from ordinary ceiling panels when observed from below.

[0011] 2. Description of the Prior Art

[0012] According to EP-B1-0,662,547 a panel for a heating or cooling ceiling comprises a conduit for a heat carrier on the upper side of a plate. The conduit consists of a hose of flexible material, which is maintained on the plate by means of guides on the upper side of the plate. Since the hoses are not in contact with the plate over the total area thereof the panels of this prior art heating or cooling ceiling are not effectively heated or cooled, respectively, over the total area thereof, which reduces the efficiency.

[0013] GB-A-1,497,261 describes a cooling panel comprising corrugated plastic panels each containing a plurality of parallel channels through which a coolant such as water is circulated. The lower surface of the panel has a hydrophilic covering of a cellulose fibrous material which is wetted by water condensed from the atmosphere, but without the formation of droplets thereon.

[0014] Similar panels are described in GB-A-778,317 relating to a ceiling, floor or wall heating system comprising hollow panels of synthetic resin which may be used in a suspended ceiling and form passages for a circulating heat carrier such as water.

[0015] A cooling ceiling is described also in WO-A-9811390 which comprises a cooling tubular mat of plastics material located between building panels such as gypsum boards. The tubular mat can comprise tubes which are embedded into a material such as foamed plastics material or gypsum.

[0016] EP-B1-0,633,994 describes a hollow panel for suspended ceilings. This prior art panel is made of plastics material or plastics covered sheet metal and has such mechanical strength that the panel can support its own weight and a fluid heat carrier without distortion. The heat carrier is circulated through the hollow panel in contact with substantially all of the bottom wall of the panel for heat transfer between the room wherein the ceiling is mounted, and the heat carrier. The bottom surface of the hollow panel is provided with a textured paint finish to increase the surface area and avoid zones wherein condensation can occur.

BRIEF SUMMARY OF THE INVENTION

[0017] The primary object of the invention is to provide a panel for a suspended heating/cooling ceiling of the kind referred to above which is of a simple self-supporting construction and can be manufactured at low costs and which secures an effective heat transfer between the fluid heat carrier and the bottom wall of the panel at high efficiency in combination with excellent sound absorbing properties.

[0018] Said object is achieved by providing a panel for a suspended heating/cooling ceiling, defining a sealed space with an inlet and an outlet communicating with said space for circulating a fluid heat carrier through the space in heat exchanging relationship with the panel, which according to claim 1 is characterised in that the panel comprises a flat metal cassette having mutually spaced upper and lower metal sheets defining said space therebetween, and that the metal sheets are perforated by registering apertures which each are sealed against said space along the circumference thereof, at least one of the metal sheets around each aperture forming an embossment attached to the other metal sheet as a spacer between the metal sheets.

[0019] Preferred embodiments of the invention are defined in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The invention will be described in more detail with reference to the accompanying drawings showing illustrative embodiments of the invention, wherein

[0021] FIG. 1 is a plan view of a ceiling heating/cooling cassette according to one embodiment of the invention as seen from the bottom side of the cassette,

[0022] FIG. 2 is a fragmentary enlarged plan view of the cassette in FIG. 1,

[0023] FIG. 3 is a cross sectional view taken along line A-A in FIG. 2,

[0024] FIG. 4 is an enlarged fragment of the cross sectional view in FIG. 3,

[0025] FIG. 5 is a fragmentary cross sectional view similar to that in FIG. 4 of a second embodiment of the panel of the invention, and

[0026] FIG. 6 is a fragmentary cross sectional view similar to that in FIG. 4 of a third embodiment of the panel of the invention.
DETAILED DESCRIPTION OF THE INVENTION

[0027] Referring to FIGS. 1 to 4 the panel according to the invention comprises a rectangular (square) cassette 10 made of two metal sheets, preferably of aluminium or stainless steel, an upper one 11 and a lower one 12. The upper metal sheet 11 is perforated by identical circular apertures 13 uniformly distributed over the surface of the metal sheet. The lower metal sheet 12 has apertures 14 identical with apertures 13 and uniformly distributed over the surface of metal sheet 12 and having the same spacing as the apertures in metal sheet 11. As an example, in a square panel 600x600 mm with apertures having a diameter of 22 mm and a spacing between the centres of the apertures of 40,5 mm 199 apertures are provided making 21% of the surface area of the panel. At each aperture 14 metal sheet 12 forms an embossment 15 protruding against metal sheet 11 and shaped as a truncated cone terminating at the small end in a circular flange 16 surrounding the associated aperture 14. The flange 16 is plane parallel with metal sheet 12 and is attached to metal sheet 11 around a registering aperture therein. The attachment is effected by welding, preferably laser welding, flange 16 to metal sheet 11 along the periphery of the registering apertures 13 and 14 or by edge folding of the metal sheets along the periphery of the apertures, O-rings then being provided to seal between the metal sheets around the apertures. The embossments form spacers between the metal sheets 11 and 12 to define therebetween a space 17 which is sealed against the apertures in the metal sheets by the connection between the sheets along the periphery of the apertures. The embossments also strengthen and stiffen the panel.

[0028] The metal sheets are interconnected as by welding at the edges of the panel or by edge folding of the sheets with sealing strips located between the sheets, so that the panel forms a hermetically sealed cassette. The edge portions 18 can be configured in different manners known per se for mounting panels of the kind described in a number of rows in a metal grid system of conventional design suspended from a building structure.

[0029] The panel is provided with an inlet 19 and an outlet 20 for circulating a fluid heat carrier such as cooling or heating water through the space defined by the panel, in heat exchanging relationship with metal sheets 11 and 12. The inlet and the outlet, respectively, each comprise a spout 21 designed for attaching a tubing such as a flexible hose to the spout, which connects the panel with a heat carrier circulation system. This system can operate at standard pressures adopted for such systems and can be designed according to conventional design standards. Inlet 19 can be provided with a deflector in space 17 preferably welded to the panel, for distributing the incoming heat carrier over the top surface of the lower metal sheet. The embossments forming spacers between the upper and lower metal sheets disperse the heat carrier in space 17 defined by the panel.

[0030] When the panel is cooled by the circulating heat carrier the tendency for water condensed from a humid ambient atmosphere on the cold bottom surface of the panel, to form droplets on said surface can be reduced as is known in the art, by providing on the bottom surface of the panel an acoustically transparent covering that is wetted by the condensed water. A suitable covering can comprise a painted or non-painted glass fibre fabric or felt attached by an adhesive to the bottom surface of the panel, covering the entire area thereof, and provided with a textured finish which changes the topography of the surface. This change also increases the area of the heat radiating surface of the panel, which further improves the efficiency thereof. Additionally the covering imparts to the bottom surface of the panel a desired esthetical effect and also a certain sound absorbing quality. The covering also breaks the heat transmission between the metal of the panel and the metal of the suspending grid system where the panel is supported on the grid system at the edge portions 18 of the panel.

[0031] The through apertures in the panel allow sound to be transmitted to the top side of the panel and impart to the panel excellent sound absorbing properties. These properties can be further improved by attaching to the top surface of the panel by an adhesive a sound absorbing glass fibre quilt of sufficient thickness, preferably about 50 mm, and by filling the apertures with metal wool which also increases the heat transfer. The top surface of the panel can be treated with a texture paint to increase the surface area in order to prevent to some extent condensation on the top surface.

[0032] It is possible to provide also the upper metal sheet 11 with embossments 15 as disclosed in FIG. 5, the metal sheets being interconnected at flanges 16 on the upper and lower metal sheets, respectively.

[0033] The preferred shape of the embossments is the shape of a truncated cone because this provides a larger exposed area of the bottom surface of the panel than cylindrical embossments as shown in FIG. 6 although such embossments are within the scope of the invention.

1. A panel (10) for a suspended heating and/or cooling ceiling, defining a sealed space (17) with an inlet (19) and an outlet (20) communicating with said space for circulating a fluid heat carrier through the space in heat exchanging relationship with the panel (10), wherein the panel comprises a flat metal cassette having mutually spaced upper and lower metal sheets (11, 12) defining said space therebetween, and that the metal sheets are perforated by registering apertures (13, 14) which are sealed against said space along the circumference thereof, at least one (12) of the metal sheets around each aperture forming an embossment (15) attached to the other metal sheet (11) as a spacer between the metal sheets.

2. The panel of claim 1 wherein the metal sheets (11, 12) consist of aluminium or stainless steel.

3. The panel of claim 1 wherein the metal sheets (11, 12) are interconnected by welding or edge folding of the metal sheets.

4. The panel of claim 1 wherein the metal sheets (11, 12) are interconnected at the periphery (18) of the panel to form a hermetically sealed cassette.

5. The panel of claim 1 wherein each embossment (15) is shaped as a truncated cone.

6. The panel of claim 5 wherein each embossment (15) forms a circular flange (16) around the associated aperture (13, 14) said flange being plane parallel with the metal sheet (12) forming the embossment.

7. The panel of claim 6 wherein said flange (16) is attached to the other metal sheet (11) which is planar.
8. The panel of claim 5 wherein both metal sheets (11, 12) form an embossment 15, 15' around registering apertures (13, 14) and wherein opposite embossments on one and the other plate, respectively, being interconnected at said flanges (16).

9. The panel of claim 1 wherein the bottom side of the lower metal sheet (12) including the apertures (13, 14) therein is topographically modified.

10. The panel of claim 9 wherein the bottom side of the lower metal sheet (12) is covered by fabric or felt attached by adhesive to the bottom side, the bottom side of said fabric or felt being topographically modified.

11. The panel of claim 1 wherein the apertures are filled with a metal wool.

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