A PANEL

TECHNICAL FIELD

The present invention relates generally to panels that can be used to cover interior surfaces in buildings, for instance in auditoriums, open-plan offices etc. and more specifically to such panels for use in buildings with thermally activated building systems (TABS) in which balancing acoustics and thermal comfort is a well-recognised challenge.

BACKGROUND OF THE INVENTION

In such fields as architecture and interior design there is often a need for panels for covering of boundaries of a room, such as the ceiling, the walls or partitions placed within the room. Such panels can serve purely aesthetic purposes but can also be used to actively alter a room's characteristics, for instance relating to acoustic and thermal properties of the room.

Panels used to determine the acoustic properties of a room often comprise a frame structure supporting a plate of a sound-absorbing material such as mineral wool, gypsum or a thin wood membrane. Although such panels can offer quite excellent solutions relating to acoustic regulation of rooms, the thermal properties of such panels, such as their thermal transparency, are seldom optimal and may in fact be very far from optimal. It is a problem with known panels simultaneously to optimise acoustic properties and thermal properties and hence to use the panels in an attempt to optimise overall comfort of a room.

Especially in buildings with thermally activated building systems (TABS), balancing acoustics and thermal comfort is a well-recognised challenge.

SUMMARY OF THE INVENTION

According to an aspect of the present invention, there is provided a panel comprising one or more sound-absorbing elements and sub-regions that connect the front of the panel with the rear of the panel, and in which sub-regions sound-absorbing elements are not present, the sub-regions forming channels through the panel that provide thermal transmission between the front of the panel and the rear of the panel, whereby said sub-regions ensure thermal transmission through the panel, characterized in that the panel comprises brackets that together with frame portions provide receptacles for said sound-absorbing elements, and wherein said brackets comprise a central portion provided with apertures for providing access of a sound field to side faces of the sound-absorbing elements.

On the above background, embodiments~~it is an object~~ of the present invention seek to provide panels which to a high degree optimise both the thermal properties and the acoustical properties of the panels. The panels according to embodiments of the present invention preferably combine a sustainable design with a unique aesthetic and an excellent functional performance, thereby offering a high degree of control of acoustics and thermal comfort. Panels according to embodiments of the invention features

innovative "Thermal Transparency" technology, and can advantageously be used in combination with thermally activated building systems (TABS), while still ensuring strong acoustic performance.

The panels according to embodiments of the invention offer flexible solutions to diverse interior requirements. They may beare quick to install, they can easily be taken down, reassembled and reupholstered to meet changing requirements. The panels according to embodiments of the invention can be provided with a fabric covering the front face of the panel, and according to an embodiment of the invention this fabric can easily be changed, as often as needed, to reflect updated usage or design needs.

According to a preferred embodiment of the invention, the panels comprise a frame, for instance made of aluminium, with a concealed tensioning mechanism which keeps the surface of the fabric perfectly stretched. As a result, the panels according to this preferred embodiments mayare not be affected by changes in humidity or temperature and remain looking good for many years.

The panels according to embodiments of the invention can be used at least to regulate the following key environmental aspects of a room:

Acoustics:

The panels according to embodiments of the invention can be tailored to meet the full spectrum of acoustic challenges, whatever the size and function of the room in question. As a result, the panels according to embodiments of the invention are particularly relevant to today's architecture, which often features open-plan rooms that are critical with respect to acoustic noise problems.

Thermal comfort:

In buildings with thermally activated building systems (TABS), balancing acoustics and thermal comfort is a well-recognised challenge. The panels according to embodiments of the invention have been designed to assist in controlling the interior temperature of such premises.

The panels according to embodiments of the invention allow for the transmission of thermal radiation without any significant reduction of acoustic performance. As a result, the panels according to embodiments of the invention can optimise comfort and significantly contribute to reducing a building's energy consumption.

According to embodiments of the invention, the above and other advantageous effects are obtained with a panel comprising one or more sound-absorbing elements and sub-regions that connect the front of the panel with the rear of the panel, and in which sub-regions, sound-absorbing elements are not present. These sub-regions maythereby ensure a high degree of thermal transmission through the panel.

The panel according to embodiments of the invention thus comprises one or more sound-absorbing elements and sub-regions that connect the front of the panel with the rear of the panel, and in which sub-regions sound-absorbing elements are not present, where the sub-regions form channels through the panel that connect the front of the panel with the rear of the panel, whereby the sub-regions may ensure thermal transmission through the panel.

The sub-regions that ensure the required thermal transmission through the panel can according to a first class of embodiments of the invention be entirely open, i.e. providing fluid connection between front and rear surfaces of the panel or they can be filled with a material that has a high thermal conductivity, thereby blocking fluid connection through the sub-regions between front and rear surfaces of the panel, but still ensuring a required thermal transmission through the sub-regions.

According to an embodiment of the panel according to the invention, the panel comprises a substantially rigid frame defining a region comprising said sound-absorbing elements, where said region is provided with one or more sound-absorbing elements comprising a front face, a rear face and a plurality of side faces, arranged in said frame in such a manner that at least some of said side faces are exposed to a sound field in surroundings, in which said panel is placed. The sound-absorbing elements can be substantially box-shaped, but other shapes could also be used without departing from the scope of the invention.

According to preferred embodiments of the invention, sound absorption is not only provided by the sound field coming in contact with the front surface of the sound-absorbing elements but also with side surfaces of these elements, this may increasethereby increasing the effective absorption area of the individual sound-absorbing elements and compensatethereby compensating for the reduced front area of the sound-absorbing elements compared with a panel, wherein the entire front surface consists of a sound-absorbing material. The overall sound absorption of a panel according to embodiments of the invention is thus affected not only by the front area of the panel (or both the front and rear area of the panel if it is exposed to a sound field on both front and rear side of the panel) but also by the total side area of the sound-absorbing elements and hence by the thickness of the panel.

~~According to an embodiment of t~~The panel according to embodiments of the invention, the dimensions of said sound-absorbing elements are chosen according to the lowest frequency at which substantial sound absorption shall take place.

~~According to an embodiment of t~~The panel according to embodiments of the invention, the frame is furthermore provided with a sheet of flexible material, for instance a fabric, suspended over the front of the region defined by the frame. The frame is preferably provided with means for releasable attachment of the flexible material to the frame and preferably these attachment means are formed for tensioning the flexible material over the region defined by the frame, such that the flexible material may always remains tensioned regardless of for instance changes in temperature and humidity of the surroundings and of aging effects of the flexible material itself.

According to a further embodiment of the invention, the panel ~~according to the invention~~ is provided with a sheet of flexible material, for instance fabric, suspended over both the front and the rear of the region defined by the frame.

~~According to a further embodiment of t~~The panel according to embodiments of the invention, the sub-regions are provided through said sound-absorbing elements. This embodiment of the invention comprises a substantially rigid frame defining a region within the frame, where the region is provided with one or more sound-absorbing elements comprising a front face and a rear face, where the one or more sound-absorbing elements extend(s) over the entire region defined by the frame and where said sub-regions are provided through said sound-absorbing elements, such that the sub-regions connect said front face and rear face of the one or more sound-absorbing elements.

The sub-regions may provide fluid connection between said front face and rear of the one or more sound-absorbing elements.

Embodiments of t~~T~~he present invention furthermore relates to a method for optimising both the thermal properties and the acoustical properties of panels for offering flexible solutions to diverse interior requirements, such as in connection with thermally activated building systems (TABS), while still ensuring a required sound-absorption function of the panels, the method comprising:

(i) the provision of one or more panels comprising one or more sound-absorbing elements and sub-regions that connect a front face (11) of the panel with a rear face of the panel, and in which sub-regions sound-absorbing elements are not present, the sub-regions forming

CLAIMS

1. A panel comprising one or more sound-absorbing elements and sub-regions ~~(8, 22)~~ that connect the front ~~(11)~~ of the panel with the rear ~~(12)~~ of the panel, and in which sub-regions ~~(8, 22)~~ sound-absorbing elements are not present, the sub-regions ~~(8, 22)~~ forming channels through the panel that provide thermal transmission between the front ~~(11)~~ of the panel and the rear ~~(12)~~ of the panel, whereby said sub-regions ~~(8, 22)~~ ensure thermal transmission through the panel, **characterized in that** the panel comprises brackets ~~(3)~~ that together with frame portions provide receptacles for said sound-absorbing elements, and wherein said brackets ~~(3)~~ comprise a central portion ~~(6)~~ provided with apertures ~~(14)~~ for providing access of a sound field to side faces of the sound-absorbing elements.

2. A panel according to claim 1, wherein said sub-regions ~~(8, 22)~~ provide fluid connection between said front ~~(11)~~ and rear ~~(12)~~ of the panel.

3. A panel according to claim 1, wherein said sub-regions are blocking fluid connection between said front ~~(11)~~ and rear ~~(12)~~ of the panel, but wherein the sub-regions are provided with a material with high thermal conductivity.

4. A panel according to claim 1, wherein the panel comprises a substantially rigid frame ~~(1, 17)~~ defining a region within the frame, where the region is provided with one or more sound-absorbing elements comprising a front face, a rear face and a plurality of side faces, arranged in said frame in such a manner that at least some of said side faces are exposed to a sound field in the surroundings, in which said panel is placed.

5. A panel according to claim 1 or 4, wherein said sound-absorbing elements are substantially box-shaped.

6. A panel according to claim 1, wherein the dimensions of said sound-absorbing elements are chosen according to the lowest frequency at which substantial sound absorption shall take place.

7. A panel according to any of the preceding claims, wherein said frame is furthermore provided with a sheet of flexible material ~~(10, 19)~~ suspended over the front ~~(11)~~ of the region defined by the frame ~~(1)~~.

8. A panel according to claim 1, wherein said central portions ~~(6)~~ are made of a material providing acoustic access of a sound field to side faces ~~(6)~~ of the sound-absorbing elements.

9. A panel according to claim 8, wherein said material is a mesh or a fabric.

10. A panel according to claim 1, wherein said sub-regions ~~(22)~~ are provided through said sound-absorbing elements.

11. A panel according to claim 1, wherein the panel comprises a substantially rigid frame ~~(1)~~ defining a region within the frame, where the region is provided with one or more sound-absorbing elements comprising a front face and a rear face, where the one or more sound-absorbing elements extend(s) over the entire region defined by the frame ~~(1)~~ and where said sub-regions ~~(22)~~ are provided through said sound-absorbing elements, such that the sub-regions ~~(22)~~ connect said front face and rear face of the one or more sound-absorbing elements.

12. A panel according to claim 10 or 11, wherein said sub-regions ~~(22)~~ provide fluid connection between said front face and rear of the one or more sound-absorbing elements.

13. A panel according to claim 10 or 11, wherein said sub-regions ~~(22)~~ are blocking fluid connection between said front face and rear face of the one or more sound-absorbing elements, but wherein the sub-regions ~~(22)~~ are provided with a material with high thermal conductivity.

14. A panel according to any of the preceding claims 10 to 13, wherein said frame ~~(1)~~ on the edge portions that face the interior region defined by the frame is provided with recessed attachment portions ~~(23)~~ for attachment of said one or more sound-absorbing elements ~~(21)~~ to the frame ~~(17)~~.