

CEILING OR WALL ELEMENT WITH A HEATING OR COOLING
REGISTER

The invention relates to a ceiling or wall element according to the preamble of claim 1 and a ceiling or wall element according to the preamble of claim 14 as well as the use of a composite material consisting of a non-woven fabric and a graphite film as a ceiling or wall element. The invention further relates to a thermally activatable concrete wall or concrete ceiling to which such ceiling or wall elements are fixed.

Ceiling or wall elements which have a frame with a base plate which can be fixed to the ceiling or the wall and a heating or cooling register arranged in the frame are already known from the prior art. Known from DE 20 2007 010 215 U1 for example is a wall or ceiling cladding with a heating or cooling register in the form of pipes which are fixed to heat conducting profiles. The heat conducting profiles rest on a rear side of a cladding surface formed by cladding panels. The cladding panels are fixed to supporting rails having a U-shaped cross-section. The supporting rails and the cladding panels fastened thereon thus form a frame which can be fixed to a ceiling or wall with a base formed by the cladding panels. The heat conducting profiles are arranged in the interior of this frame and abut against the cladding panels. The heat conducting profiles and the pipes fixed thereon form the heating or cooling register. In order to produce good heating conducting contact between the pipes and the cladding surface, binders are provided transversely to the elongate heat conducting profiles which hold at least two adjacent heat conducting profiles on the cladding panel under spring tension.

The heat conducting profiles have an approximately semicircular shoulder on their rear side in which the pipes are arranged. The pipes have heating or cooling medium such as hot or cold water, for example, flowing through them depending on the intended application as a heating or cooling line. The heat conducting profiles are usually made of metal, for example, made of aluminium. The cladding panels can, for example, comprise plasterboard panels.

In such wall or ceiling claddings the efficiency of the heat or cold transmission from the wall or ceiling claddings to the room is very low. This is on the one hand due to the intermediate spaced between the adjacent heat conducting profiles. These intermediate spaces act like an insulating layer and prevent a uniform dissipation of the heat flow over the surface of the wall or ceiling claddings facing the room. On the other hand, the heat or cold transmission from the heating or cooling lines to the cladding panels is very inefficient because the cladding panels comprise poor heat conductors.

Starting from this, it is the object of the invention to further develop a generic ceiling or wall element so that efficient heat transmission can be ensured between the heating or cooling register and the room to be heated or cooled. Furthermore, the ceiling or wall element should have good sound absorption.

This object is solved by a ceiling or wall element having the features of claim 1. The object is further solved in the presence of a thermal activatable concrete wall or concrete ceiling having a ceiling or wall element with the features of claim 2. Preferred embodiments of these ceiling or wall elements can be deduced from claims 3 to 18.

In a ceiling or wall element which has a frame with a base which can be fixed to a ceiling or a wall, in which a heating or cooling register is disposed, the object forming the basis of the invention is solved in that a non-woven fabric and a perforated graphite film are disposed between the base of the frame and the heating or cooling register. The non-woven fabric preferably comprises a carbon fibre non-woven. However, it can also comprise a glass fibre non-woven. The carbon fibre non-woven has a higher thermal conductivity than a glass fibre non-woven but is more expensive. The non-woven brings about good sound absorption of the ceiling or wall element. The graphite film preferably comprises a film of expanded graphite which is provided with a perforation. The perforated graphite film ensures good thermal contact between the heating or cooling register and the base plate of the ceiling or wall element. The base of the ceiling or wall element is preferably made of a thermally conductive material, in particular of a metal sheet or a graphite-modified panel such as a graphite-modified plasterboard panel. The frame is preferably formed as a cassette, where at least the base is made of a punched metal sheet or metal sheet provided with a perforation. The punching or the perforation in the base combined with the non-woven fabric resting on the base in the interior of the frame ensures good sound absorption.

The non-woven fabric and the perforated graphite film disposed thereon preferably comprises a composite which can be produced by calendering. Such a composite can particularly expediently be made from a carbon fibre non-woven and a graphite film made of expanded graphite. The production of expanded graphite (so-called expanded graphite) is known inter alia from US 3,404,061-A. In order to produce expanded graphite, graphite intercalation compounds or graphite salts such

as, for example, graphite hydrogen sulphate or graphite nitrate are heated in a shock manner. The volume of the graphite particles is thereby increased by a factor of about 200 - 400 and at the same time the bulk density decreases to values of 2 - 20 g/l. The expanded graphite thus obtained consists of worm- or concertina-shaped aggregates. If completely expanded graphite is compacted under the directional action of pressure, the layer planes of the graphite are preferably arranged perpendicular to the direction of action of the pressure, where the individual aggregates become entangled. In this way, self-supporting surface structures such as, for example, webs, plates or moulded bodies can be produced from expanded graphite. Thin films (having thicknesses in the range of 50 μm to 3 mm) can be produced by pressing or rolling webs of expanded graphite. When calendering a film of expanded graphite thus produced with a carbon fibre non-woven, the carbon fibres of the non-woven surface and the surface of the graphite film become entangled so that a firm and non-detachable composite is formed between the carbon fibre non-woven and the graphite film.

Perforation of the graphite film increases its flexibility and thereby facilitates the handling of the film. Since graphite is a brittle material, there is a risk that the film will tear or break when handling thin films of expanded graphite. This risk can be reduced significantly by the perforation of the graphite film.

The heating or cooling register can comprises heating or cooling lines fixed to heat conducting profiles. In order to ensure good thermal contact between the heating or cooling register and the base of the frame, the base is in thermal contact with the heat conducting

profiles via the composite comprising the non-woven fabric and the perforated graphite film.

The heating or cooling register can also comprise a lightweight panel of expanded graphite in which heating or cooling lines are embedded. In this exemplary embodiment the surface of the graphite lightweight panel is preferably in thermal contact with the perforated graphite film over its entire principal area. Good thermal contact between the heating or cooling lines and the base of the frame is made in this way via the good heat-conducting composite comprising the perforated graphite film and the non-woven fabric. The heat (or cold) carried in the heating or cooling lines can be distributed very efficiently and uniformly over the entire surface of the ceiling or wall element in the room in which the ceiling or wall element is located. The surface of the graphite lightweight panel opposite the graphite film is preferably in thermal contact over its entire principal surface with the surface of the wall or the ceiling to which the ceiling or wall element is fixed. As a result of this thermal contact, the heat coming from the heating or cooling lines can be released partially via the graphite lightweight panel to the wall or ceiling so that the mass of the wall or ceiling can be used as a thermal accumulator for a delayed release of heat.

So-called concrete core activation systems are known from the prior art for the air conditioning of rooms having concrete ceilings or concrete walls. In these systems pipes carrying heating or cooling media are mounted in, below or on the concrete ceiling or the concrete wall. By storing the heating or cooling energy in the concrete mass of the ceiling or the walls and a time-delayed delivery of the stored heating or cooling energy, an energy-efficient air conditioning of the

rooms can be achieved. Thus, for example, at night a cooling fluid (for example, water) is cooled and passed through the pipes in a concrete core activated ceiling or wall, whereby the ceiling or the wall is slowly cooled. The cooling energy stored in the concrete ceiling or wall can then be released into the room during the day in particular in the warm summer months, to slowly lower the room temperature in the room.

For the cladding of such thermally activatable concrete ceilings or walls, the invention provides a ceiling or wall element comprising a frame with a base which can be fixed to the wall or the ceiling, where a non-woven fabric and a perforated graphite film are provided between the base of the frame and the wall or the ceiling. In this exemplary embodiment a lightweight panel of expanded graphite is preferably additionally provided between the graphite film and the wall.

In this exemplary embodiment of the invention the non-woven ensures good sound absorption of the ceiling or wall element. Good thermal contact between the thermally activatable wall or ceiling and the base of the frame is ensured by means of the perforated graphite film and graphite lightweight panel provided between the graphite film and the wall or ceiling surface. This provides efficient heat transmission between the thermally activatable wall or ceiling and the room.

The invention is explained in detail hereinafter by means of exemplary embodiments with reference to the accompanying drawings. In the drawings:

Figure 1: shows a schematic view of a first embodiment of a ceiling or wall element according to the

invention with a frame in which a heating or cooling register is arranged;

Figure 2: shows a schematic view of an alternative embodiment of a ceiling or wall element according to the invention with a frame and a heating or cooling register arranged therein;

Figure 3: shows a schematic view of a ceiling or wall element arranged on a thermally activatable ceiling or wall.

In the exemplary embodiments of the invention described hereinafter, the use of ceiling or wall elements according to the invention for fixing to a ceiling 5 extending in the horizontal plane is shown. We therefore talk of ceiling elements in each case. The ceiling or wall elements according to the invention can however also be used in a corresponding manner for fixing to a vertical wall. In the exemplary embodiments shown in the drawings the same or corresponding parts are provided with the same reference numbers.

Insofar as thermally activatable concrete ceilings or walls are mentioned, this is understood as concrete ceilings or walls in which pipes are laid for the passage of a heating or cooling medium. These pipes are used for the thermal activation of the ceiling or the wall.

Figure 1 shows a first exemplary embodiment of a ceiling element 10 according to the invention for fixing to a ceiling, where the ceiling element 10 has a frame 2 which can be fixed to a ceiling 5.

The frame 2 comprises a base formed by a base plate 2a and side walls 2b disposed thereon or formed integrally with the base plate 2a. A fixing flange 2c is formed on the upper edge of the side walls 2b by which means the

frame 2 can be fixed to the ceiling, in particular can be screwed thereon. The frame 2 is preferably formed in a cassette shape with four side walls 2b arranged circumferentially around the base plate 2a. The frame 2 is preferably made of metal, in particular from a metal sheet. The base plate 2a is provided with a perforation. The holes of the perforation in the base plate 2a ensure that sound waves can penetrate into the frame 2 and can be damped there.

A heating or cooling register 9 is arranged in the cassette-shaped frame 2. In the exemplary embodiment shown in Figure 1, the heating or cooling register 9 comprises a plurality of fixing profiles 11 arranged next to one another and parallel to one another, which are formed in a strip shape and fabricated from a heat-conductive material, in particular a metal. The fixing profiles 11 preferably comprise aluminium profiles. Heating or cooling lines 12 (hereinafter designated as pipes) are fixed to the fixing profiles 11. The pipes 12 can, for example, be engaged positively or non-positively in semicircular receiving tabs on the upper side of the fixing profiles 11. Other possibilities for fastening are, however, also feasible such as, for example, a fixing by means of pipe clips or similar.

The fixing profiles 11 are disposed on a perforated graphite film in thermal contact with the graphite film 1. Expediently, the underside of each fixing profile 11 is adhesively bonded to the graphite film 1 by means of a thermally conducting adhesive. A non-woven fabric 3 is disposed between the perforated graphite film 1 and the inner surface of the base plate 2a. The non-woven fabric 3 can comprises a glass fibre non-woven or preferably a carbon fibre non-woven. The non-woven 3 is adhesively bonded to the inner surface of the base plate 2a by means of a thermally conducting adhesive.

The non-woven fabric 3 and the perforated graphite film 1 expediently comprise a composite material. A composite produced by calendering from a carbon fibre non-woven 3 and the perforated graphite film 1 is particularly suitable.

The graphite film 1 expediently comprises a thin film of expanded graphite with a perforation. A hole fraction of 2% to 10% ensures good handling of the perforated graphite film 1 and prevents breaking or tearing of the graphite film.

Figure 2 shows another exemplary embodiment of a ceiling or wall element according to the invention which has a heating or cooling register 9 arranged in the frame 2. Unlike in the exemplary embodiment shown in Figure 1, the heating or cooling register 9 is here formed by a lightweight panel 13 of expanded graphite in which heating and cooling lines 12 are embedded. The underside of the lightweight plate 13 is in thermal contact with the surface of the perforated graphite film 1. A non-woven fabric, in particular a glass fibre or a carbon fibre non-woven is again arranged between the perforated graphite film 1 and the base plate 2a of the frame 2. As in the exemplary embodiment of Figure 1, the non-woven fabric 3 and the perforated graphite film 1 expediently comprises a non-detachable composite of a carbon fibre non-woven and a film of expanded graphite provided with a perforation. In order to ensure the best possible thermal contact between the upper side 15 of the graphite lightweight panel 13 and the surface 14 of the ceiling 5, the upper side 15 of the graphite lightweight plate 13 is adhesively bonded to the ceiling surface 14 with a thermal adhesive 4.

In both exemplary embodiments the non-woven expediently has a thickness of 50 μm to 3 mm and the thickness of

the perforated graphite film is preferably between 200 μm and 3 mm.

Figure 3 shows a ceiling element 10 fixed to a thermally activatable concrete ceiling 5. Pipes 7 through which a heating or cooling medium can be passed for thermal activation of the ceiling 5 run in the concrete ceiling. The ceiling element 10 has a frame 2 which, as in the two previous exemplary embodiments, comprises a base plate 2a and at least two side walls 2b. As in the two previous exemplary embodiments, the frame 2 is expediently cassette-shaped with a base plate 2a and four peripheral side walls 2b. The frame 2 is made of a metal sheet and the base plate 2a has a perforation which ensures that sound waves can enter into the frame interior and be absorbed there.

A non-woven fabric 3 lying on the base plate 2a and preferably glued thereon and a perforated graphite film 1 located thereon is again disposed in the interior of the cassette-shaped frame 2. The non-woven fabric 3 and the perforated graphite film 1 expediently again comprise a carbon fibre non-woven and a film of expanded graphite. A lightweight panel 13 of expanded graphite is disposed on the graphite film 1 in flat and thermal contact therewith.

For fixing the ceiling element 10 on the thermally activatable concrete ceiling 5, the frame 2 is fixed in a known manner to the surface 14 of the ceiling 5, for example, by screwing. In order to ensure the best possible thermal contact between the upper side 15 of the graphite lightweight panel 13 and the surface 14 of the ceiling 5, the upper side 15 of the graphite lightweight panel 13 is glued to the ceiling surface 14 with a thermally conducting adhesive 4. However, the use of an adhesive can also be omitted. In particular,

the use of an adhesive can be omitted if the surface 15 of the graphite lightweight panel 13 projects over the upper edge of the side walls 2b of the frame 2 when not yet mounted. Then, when screwing the frame 2 to the ceiling surface 14, the lightweight panel 13 made of compressible graphite is slightly compressed. This ensures good thermal contact between the upper side 15 of the graphite lightweight panel 13 and the ceiling surface 14 over the entire area, where slight unevennesses in the ceiling surface 14 can be compensated by compressing.

The material composite used in the exemplary embodiments of Figures 1 to 3 consisting of a non-woven fabric 3 and a graphite film 1 joined to the non-woven fabric 3 can be fixed directly to a ceiling 5 or a wall without a supporting frame as ceiling or wall element 10. In this case, the material composite is adhesively bonded to the ceiling 5 or the wall by means of a thermally conducting adhesive, where the thermally good conducting graphite film 1 is preferably adhesively bonded to the surface of the ceiling 5 or the wall over the entire area in order to make a good heat-conducting coupling over the entire surface of the ceiling or wall. This arrangement ensures on the one hand a rapid heat exchange between the room and the ceiling or wall whereby the mass of the ceiling or wall (which is formed for example as a concrete ceiling or wall) can be used as a thermal accumulator from which the stored heat can be released in a time-delayed manner again into the room. On the other hand, the non-woven fabric 3 of the material composite ensures good sound absorption so that the ceiling or wall element 10 formed from the material composite can serve as a sound-absorbing acoustic element.

Like the material composite used in Figures 1 to 3, consisting of the non-woven fabric 3 and a graphite film 1 connected to the non-woven fabric 3, the graphite film 1 is preferably perforated and expediently has a perforation with a hole fraction of more than 5% per unit area. The non-woven fabric (3) preferably comprises a carbon fibre non-woven which has been joined to the graphite film (1) by calendering.

PATENT CLAIMS

1. A ceiling or wall element (10) for fixing to a ceiling (5) or a wall wherein the ceiling or wall element (10) has a frame (2) with a base plate (2a) which can be fixed to the ceiling (5) or the wall, in which a heating or cooling register (9) is disposed, characterised in that a non-woven fabric (3) and a perforated graphite film (1) are disposed between the base plate (2a) of the frame (2) and the heating or cooling register (9).
2. A ceiling or wall element (10) for fixing to a ceiling (5) or a wall wherein the ceiling or wall element (10) has a frame (2) with a base (2a) which can be fixed to the ceiling (5) or the wall, characterised in that a non-woven fabric (3) and a graphite film (1) are disposed on the base (2a) of the frame (2).
3. The ceiling or wall element (10) according to claim 1 or 2, characterised in that the graphite film (1) is perforated.
4. The ceiling or wall element according to claim 1 or 2, characterised in that the graphite film (1) comprises a film made of expanded graphite having a perforation.
5. The ceiling or wall element according to claim 3 or 4, characterised in that the perforated graphite film (1) has a hole fraction of more than 205% per unit area.
6. The ceiling or wall element according to any one of the preceding claims, characterised in that the

frame is made of a thermally conductive material, in particular of a metal sheet or a graphite-modified composite element such as a plasterboard.

7. The ceiling or wall element according to any one of the preceding claims, characterised in that the frame is configured as a cassette (2) which is open on one side.
8. The ceiling or wall element according to any one of the preceding claims, characterised in that the perforated graphite film (1) is firmly connected to the non-woven fabric (3).
9. The ceiling or wall element according to any one of the preceding claims, characterised in that the non-woven fabric (3) comprises a glass fibre non-woven or a carbon fibre non-woven.
10. The ceiling or wall element according to claim 87, characterised in that the non-woven fabric (3) comprises a carbon fibre non-woven which is connected to the perforated graphite film (1) by calendering.
11. The ceiling or wall element according to claim 1, any one of the preceding claims, characterised in that the heating or cooling register (9) comprises a fixing profile (11) and heating or cooling pipes (12) fixed thereto.
12. The ceiling or wall element according to claim 119, characterised in that the fixing profile (11) is made of a heat-conductive material, in particular a metal.
13. The ceiling or wall element according to claim 120, characterised in that the perforated graphite

film (1) is in thermal contact with the fixing profile (11).

14. The ceiling or wall element according to any one of claims 1 or 11 to 138, characterised in that the heating or cooling register (9) comprises a lightweight panel (13) of expanded graphite in which heating or cooling pipes (12) are embedded.
15. The ceiling or wall element according to any one of the preceding claims, characterised in that the base plate (2a) of the frame (2) is perforated.
16. A ceiling or wall element (10) for fixing to a thermally activatable concrete wall or concrete ceiling (5) wherein the ceiling or wall element (10) has a frame (2) with a base plate (2a) which can be fixed to the ceiling (5) or the wall, characterised in that a non-woven fabric (3) and a perforated graphite film (1) as well as a lightweight panel (13) of expanded graphite is disposed between the base plate (2a) of the frame (2) and the wall or ceiling (5) (9).
17. The ceiling or wall element (10) according to claim 2, characterised in that a lightweight panel (13) of expanded graphite is disposed on the graphite film (1).
18. Thermally activatable concrete wall or concrete ceiling (5) in which pipelines (7) run for the passage of a heating or cooling fluid, characterised in that ceiling or wall elements (10) according to any one of claims 1 to 164 arranged adjacent to one another are fixed on the surface (14) thereof.

19. Thermally activatable concrete wall or concrete ceiling (5) according to claim 175, wherein the ceiling or wall elements (10) contain a lightweight panel (13) made of expanded graphite, characterised in that a thermal coupling between the surface (14) of the wall or ceiling (5) and the wall or ceiling element (10) is formed extensively over the entire principal surface (15) of the or each graphite lightweight panel (13).
20. Use of a composite material consisting of a non-woven material (3) and a graphite film (1) connected to the non-woven material (3) as or in a ceiling or wall element (10) for fixing to a ceiling (5) or a wall.
21. The use according to claim 19, characterised in that the graphite film (1) is perforated.
22. The use according to claim 19 or 20, characterised in that the graphite film (1) comprises a film of expanded graphite with a perforation.
23. The use according to claim 19 or 20, characterised in that the perforated graphite film (1) has a hole fraction of more than 20% per unit area.
24. The use according to any one of claims 19 to 22, characterised in that the non-woven fabric (3) comprises a glass fibre non-woven or a carbon fibre non-woven.
25. The use according to any one of claims 19 to 23, characterised in that the non-woven fabric (3) comprises a carbon fibre non-woven which is connected to the graphite film (1) by calendering.