

P6 – Infringement and Validity of United Kingdom Patents

Tuesday 30 September 2014
10.00 a.m. – 3.00 p.m.

Time allowed – FIVE hours

INSTRUCTIONS TO CANDIDATES

1. You should undertake the assessment task outlined on page 2.
2. Start each part of the question on a fresh sheet of paper.
3. Enter the question paper reference number (P6) and your candidate number in the appropriate boxes at the top of each sheet of paper.
4. The scripts are photocopied for marking purposes.
 - a. Use **black ink**.
 - b. Write on one side of the paper only.
 - c. Write within the printed margins.
 - d. Do not use highlighter pens on your answer script.
5. Do not state your name anywhere in the answer.
6. Write clearly: examiners cannot award marks to scripts that cannot be read.
7. Marks are awarded for the reasoning displayed and the points selected for discussion rather than the conclusions reached.

INFORMATION FOR CANDIDATES

1. The total number of marks for this paper is 100.
2. At the end of the examination the invigilator will instruct you to:
 - a. count the number of pages you have used;
 - b. use the boxes on each page of the answer script to number pages in the format “1 of 25, 2 of 25 etc”;
 - c. place your answer sheets in order in the white envelope, seal the envelope and leave the envelope on the desk.
3.
 - a. Do not staple the pages, or use sellotape or treasury tags.
 - b. You may take the examination paper with you.
4. This question paper consists of 20 pages in total, including this page, and comprises:

Assessment Task Outline	(01 page)
Client's letter	(01 page)
Document A (Technical Description)	(04 pages)
Document B (EP1234567)	(06 pages)
Document C (Excerpt from Journal)	(02 pages)
Document D (US6123456)	(05 pages)

5

Assessment Task Outline

Your task is to read the Client's letter and the accompanying documents and then to prepare a memorandum in advance of the meeting suggested in the client's letter.

10

Your memorandum should include notes on infringement and validity **in the UK only** and further notes on possible steps to be taken to help your client.

5 **Client's Letter**

Dear Attorney,

10 You might recall our last meeting about seven years ago when I presented my initial concept to you. Despite your clear advice we decided to completely shelve the concept and instead focussed on other opportunities.

15 Anyway, in January of this year we took on a new Chief Technical Officer. She spent her first few months with us looking through our old files. She was very excited when she came across the record of our initial concept and she has convinced me that the time is right for us now to take the concept to market. She has made a prototype and conducted some trials – despite my reservations the results have been very positive.

20 As you will no doubt remember, the original concept was for a ceiling tile incorporating a phase change material (PCM) which is able to help regulate the temperature within a room. When the room is hot, for example during the day, the PCM will melt and absorb heat energy from the room, when the room is cold, for example during the night, the PCM will solidify and give the heat energy back to the room. I think we were the first to propose such a concept. I attach a copy of the write up (Document A) that you and I worked on seven years ago. The
25 technical details have not changed in the interim.

Because of the positive results we would like a patent application filed before we start selling ceiling tiles in December of this year (the tiles we shall sell are detailed in Table 1 of Document A). We have started production and are currently stockpiling tiles ready for
30 December.

To help with completion of the patent application I asked our team to conduct some searches, they found three further documents which are attached. Whilst I don't really understand the detail, one of the documents (Document B) seems to disclose a concept
35 similar to ours. However, I recall you saying that the most important thing for a patent is who thought up the idea first and because Document B is pretty recent it is probably irrelevant to us. Document C is from the 'go-to' textbook in the field - everyone studies it from cover-to-cover. Document D was filed by a now-defunct US business.

40 As it has been a while since we last met, I shall pop over for a coffee next week to talk through all of this.

Kind Regards,

45 Celia Ling

You have undertaken further searches and have confirmed that EP1234567 (Document B) is granted and in force in the UK, and that Document D does not have any equivalents.
50

Technical Description for preparation of a patent specification

Our invention relates to ceiling tiles and wall tiles.

10 Ceiling tiles typically form part of a suspended ceiling, which comprises a grid of metal supports with the ceiling tiles being provided in the gaps in the grid. The metal supports are hung or suspended from a bracket attached to a ceiling by a hanger. The metal supports take the form of an inverted T and the periphery of each tile is usually supported on a foot of a metal support – see **Fig. 1** and **Fig. 2**, where **Fig. 1** is a view from below a part of a
15 suspended ceiling and **Fig. 2** is a view along a portion of the suspended ceiling.

In contrast, wall tiles are typically secured to wooden or metal batons which are themselves secured to a vertical wall.

20 Our invention seeks to provide a tile (i.e. a ceiling or wall tile) which can help to regulate the temperature in a room.

Our invention seeks to use phase change materials within a ceiling or wall tile. Phase change materials work by absorbing energy (heat) when they melt (i.e. change phase from solid to liquid) and by releasing energy when they solidify (i.e. change phase from liquid to solid).
25

We originally investigated incorporating a single slab of phase change material into a tile but found there were problems in use. Firstly because a large solid slab is used there may be issues of containment of the molten or liquid material. Also use of large solid slabs can lead to the formation of air pockets when the phase change material melts, for example if the
30 cavity within the tile is not exactly matched to the size of a slab. Whilst we found this is less of a problem for ceiling tiles (which remain horizontal in use) it may be more problematic for wall tiles (which are vertical in use) because any air bubbles or pockets which form will tend to migrate to the vertically uppermost portion of the cavity. Also we found that large slabs
35 are less effective at managing energy input from a hot spot, for example if next to a radiator or in the direct line of sight for sunlight through a window.

Our invention seeks to address one or more of these problems.

Referring to **Fig. 3** there is shown a cross sectional view of our proposed ceiling tile CT. The ceiling tile CT comprises a body B provided with an internal cavity V for holding phase change material. **Fig. 3A** shows the two-part body B of the ceiling tile CT absent of any inserted parts. The key feature of the ceiling tile CT is the metal divider M, which is shown in perspective view in **Fig. 4**.
40

45 The divider M comprises a sheet part S with first and second major surfaces S_1 , S_2 . Provided on each of the first and second major surfaces S_1 , S_2 is a centrally-disposed, cruciform-shaped first and second wall part W_1 , W_2 respectively.

The divider M is made from steel. The sheet part S is 1mm thick and the wall parts W_1 , W_2
50 are preferably 2 mm thick.

The first major surface S_1 , is coated with a thermally insulating plastic layer P, the purpose of which will be explained below.

10 The divider M separates the cavity V of a ceiling tile T into four upper and four lower fluid-tight compartments, each of which may be filled with phase change material PCM, such as wax or other known materials.

15 The body B of the ceiling tile CT is formed from a mineral, such as gypsum, or other materials known in the art, and is usually formed in two parts which are joined together once the components of the tile CT have been assembled.

As can be seen, the free edge of the first wall part W_1 , is located in a cruciform-shaped trench T provided in the lowermost surface of the cavity V of the tile CT.

20 In use, as the room heats up the phase change material PCM will heat and eventually melt, thereby absorbing energy from the room. The first wall part W_1 , is metal and so is more thermally conductive than the first phase change material PCM1 located in each of the four lower compartments. As such, heat energy is preferentially conducted along wall part W_1 , and along sheet part S and wall part W_2 and is conducted into the four uppermost compartments where it can be absorbed by the phase change materials PCM2 located there.

25 The wall part W_2 is also effective in conducting heat energy away from the phase change materials PCM2 in the uppermost compartments when the outside environment is cold.

30 The presence of the thermal insulating layer P inhibits heat energy from the sheet part S from being conducted into the PCM in the lowermost compartments (i.e. PCM1).

This construction is beneficial because smaller slabs of phase change material can be used and it allows for different grades or types of phase change material to be used in different parts of the cavity V. For example, when one face of the tile CT faces the room the furthestmost cavity or cavities can be filled with one type of phase change material (PCM2)

35 and the nearer cavity or cavities can be filled with another phase change material (PCM1). We prefer a lower melting point phase change material to be furthest from the room facing side so as to maximise the flow of heat energy away from the room.

40 Also the divider M splits the cavity V into smaller sealed portions. This means that the issue with complete filling is mitigated.

Obviously more or fewer compartments can be formed by adding further walls or removing walls W, on the divider M.

45 When used as a wall tile, the divider M helps to retain the wax phase change material in place.

The ceiling tile CT with which we are going into production, uses wax as the PCM material, and is made in accordance with the above description. It has the following features:

10	External size	30 x 30 x 5 cm
	Body B Material	Gypsum, in two parts sealed at the facing parts.
	Cavity V size	22 x 22 x 3 cm
	Compartments	8 (4 upper and 4 lower)
	Compartment Volume	10 x 10 x 1cm
15	Melting Point of PCM1	23°C
	Melting Point of PCM2	18°C

Table 1: Characteristics of Production Ceiling Tile

Fig.1

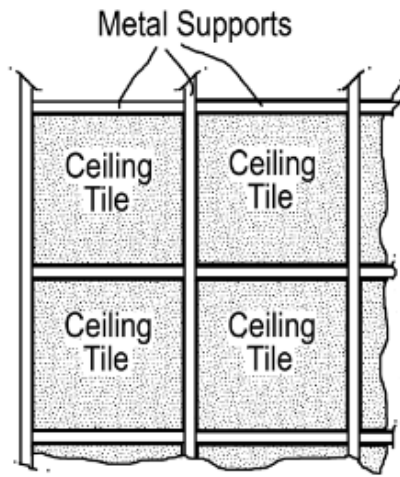


Fig.2

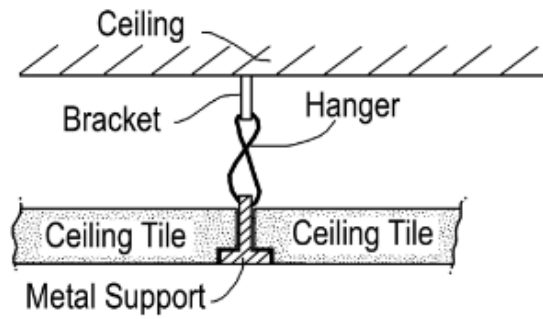


Fig.3

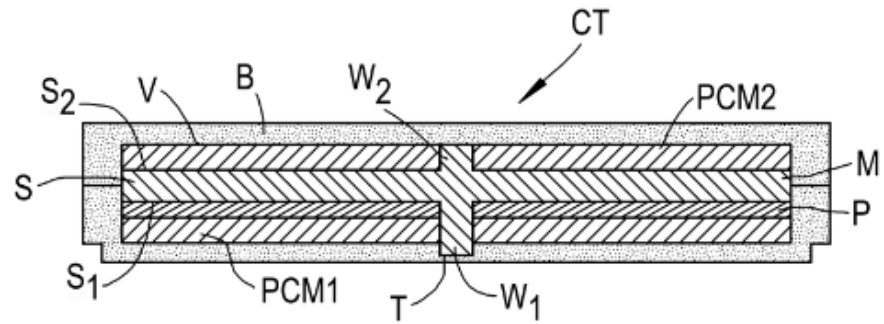


Fig.3A

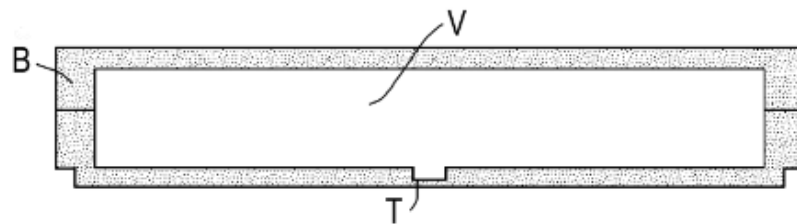
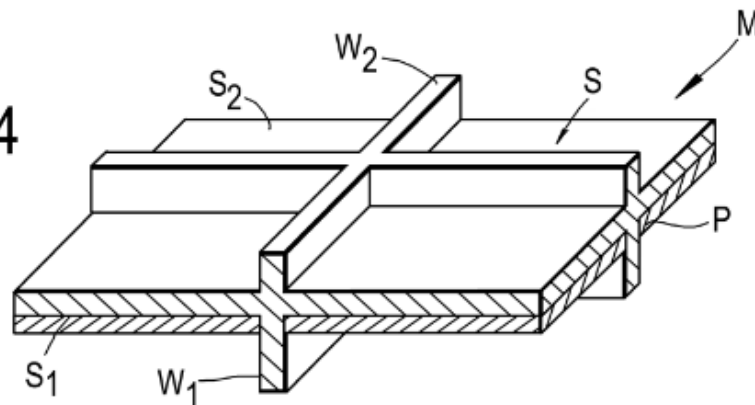


Fig.4



**Heat Absorbing Panel
EP1234567**

(Filed January 2010, granted 10 February 2014)

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This invention relates to a heat-absorbing panel, for example to a heat-absorbing wall, floor or ceiling tile.

15

There is a well-known need to reduce energy use, especially energy derived from fossil fuel sources. This may be achieved by conserving energy and/or utilising more of the naturally occurring 'renewable' sources, such as wind, tide, geothermal and solar.

20

It is an object of this invention to provide a heat absorbing panel which can be used to clad the walls, ceilings, floors etc. of a building to help reduce energy use.

A first aspect of the invention is provided in accordance with Claim 1.

25

The panel of the invention allows for more efficient absorption of heat energy and the return of that heat energy to the room when needed.

Various subsidiary features are to be found in the dependent Claims.

30

Most advantageously, the heat conducting material may comprise a flat sheet with plural protuberances or elongate extensions. The extensions extend into, and may extend beyond, the phase change material. This construction makes for highly efficient heat exchange between the external environment and the phase change material.

35

The invention is described by way of a non-limiting embodiment, with reference to the following drawings:

Fig. 1 is an elevation of a tile or panel according to the invention;

Fig. 2 is a sectional view along line A-A of Figure 1;

Fig. 3 is a perspective view of a part of the tile or panel of Figure 1; and

40

Fig. 4 is a perspective view of another part of the tile or panel of Figure 1.

Referring to **Fig. 1**, there is shown a tile T for use in a room. The tile T has a room-presenting face 1 and a non-room-presenting face 2. The room-presenting face 1 will typically be provided with a surface finish appropriate for the use to which the tile T is to be put.

The tile T is formed in two parts, a first part 10, comprising the room-presenting face 1 and a second part 20 comprising the non-room-presenting face 2. Both the first part 10 and the second part 20 are moulded from a ceramic material such as gypsum held in a resin matrix, as is well known in the art.

Taking the second part 20 first (as shown best in **Fig. 3**), this part 20 comprises a flat base portion 21 with a wall portion 22 provided at the periphery of the base portion 21 to define a cavity 23 and to provide the second part with a tray-shape. The non-room-presenting face 2 is on the opposite side of the base 21 to the cavity 23.

Similarly, the first part 10 (as shown in **Fig. 4**) comprises a flat base portion 11 with a wall portion 12 provided at the periphery of the base portion 11 to define a cavity 13 and to provide the first part 10 with a tray-shape. Plural cavities 14 extend from the cavity 13 into the base portion 11. The room-presenting face 1 is on the opposite side of the base portion 11 to the cavity 13.

Referring now to **Fig. 2**, the tile T has a cavity C formed between the first part 10 and second part 20. The cavity C (formed by a combination of cavity 13 and cavity 23) is filled with a phase change body P which comprises, in sequence from the first part 10 to the second part 20, a first phase change material 31, a heat conducting layer 32 and a second phase change material 33.

The first phase change material 31 is a wax with a melting point of between 5 and 40°C. The wax is typically between 5 to 15 mm thick. In our most preferred embodiment the wax has a melting point of 18°C and is 10mm thick.

The heat conducting layer 32 is a sheet of metal, which is typically steel and may be from 0.5 to 1 mm thick. Provided on one surface of the heat conducting layer 32 are

5 a series of protuberances 35 which extend through the first phase change material 31 and into the cavities 14 in the base section 11 of the first part 10. The protuberances 35 do not extend to the room-presenting surface 1. The position of the protuberances 35 can be seen in **Fig. 1**.

10 The second phase change material 31 is a wax with a melting point of between 20 and 45°C. The wax is typically between 2 to 10 mm thick. In our most preferred embodiment the wax has a melting point of 25°C and is 8mm thick.

15 In order to make a tile T according to the invention, it is conveniently made upside down and then turned over for use. To do so, the second phase change material 31 is located in the cavity 23 of the second part 20 and the heat conducting layer 32 is provided across the exposed surface of the second phase change material 32 to seal the cavity 23. The protuberances 35 of the heat conducting layer 32 are
20 uppermost. The first phase change material 31 is then located on the heat conducting layer 32 and around the protuberances 35. This is conveniently achieved by providing a mould on the heat conducting layer 32 and pouring molten first phase change material 31 into the mould cavity. The mould cavity will have a volume equivalent to that of the cavity 13 of the first part 10. The first phase change material
25 is allowed or caused to solidify and the mould removed. The first part 10 is then located over the solidified first phase change material 31 such that the wall portion 12 of the first part 10 abuts the wall portion 22 of the second part 20. The free or distal ends of the protuberances 35 are located in the corresponding cavities 14 provided in the base portion 11 of the first part 10. The protuberances 35 help to
30 accurately and easily locate the first part 10. The join between the first and second parts 10, 20 may be sealed by an appropriate adhesive to prevent any leakage of the phase change materials.

35 In use, the tile T is located at a site, which may be as part of a suspended ceiling or as a wall panel. As the temperature of the room increases so does the temperature of the tile T. When the first phase change material 31 reaches its melting point, it will melt and thereby absorb heat energy. The protuberances 35 aid in the transfer of heat from the exterior of the tile T to the first phase change material 31. As the

temperature increases, heat will be conducted through the heat conducting layer 32 and into the second phase change material 33. If the temperature rises above the melting point of the second phase change material 33 it will melt, thereby absorbing further heat energy.

As the temperature of the second phase change material 33 falls it will solidify thereby releasing heat energy via the heat conducting layer 32 to the first phase change material 31. As the temperature of the first phase change material 31 falls below its melting point it will solidify thereby releasing heat energy via the protuberances 35 to the exterior space.

In this way, heat energy from the room can be stored within the tile T and released back to the exterior of the tile T when the exterior temperature drops.

The use of a double layer of different phase change materials 31, 33 enables the tile T to absorb heat energy more efficiently than is possible with only one material. Also, the heat conducting layer 32 provides for efficient thermal transfer between the two phase change materials 31, 33. Moreover, the protuberances 35 encourage heat absorption by providing a thermal bridge closer to the room-presenting face 1 of the tile T than would otherwise be possible.

Because the cavities 13, 23 are sealed, the tile T can be used in a vertical orientation, for example as a wall cladding panel, without fear of the two phase change materials 31, 33 mixing in use.

If it is desired to use the tile as a floor tile, the first 10 and/or second 20 part may be formed from a material other than a ceramic material in a resinous matrix. Indeed, the choice of materials for the first and second parts will depend on the use to which the tile is to be put and/or the aesthetic requirements of the site of use. If the tile is intended to carry a load the first 10 and/or second part may be formed from a material capable of carrying such a load, for example a solid stone such as slate or marble.

Claims

1. A heat absorbing panel (T), the panel (T) comprising a first part (10) and a second part (20) which are secured together at their respective peripheries, the two parts (10, 20) defining a cavity (C) therebetween, the cavity (C) retaining a body comprising a wax-based phase change material (31, 33) **and characterised in that** a heat conducting material (32) is located within and extends across the cavity (C) to seal in the phase change material.
2. A panel according to Claim 1, wherein the body comprising the phase change material comprises a first phase change material having a melting point between 5 and 40°C and a second phase change material have a melting point between 20 and 45°C.
3. A panel according to Claim 2, wherein the heat conducting material separates the first and second wax phase change materials.
4. A panel according to Claim 1, 2 or 3, wherein the heat conducting material comprises elongate members which extend into the phase change material.
5. A panel according to Claim 1, wherein a thermal bridge is provided between the first part and the heat conducting material.

EP1234567

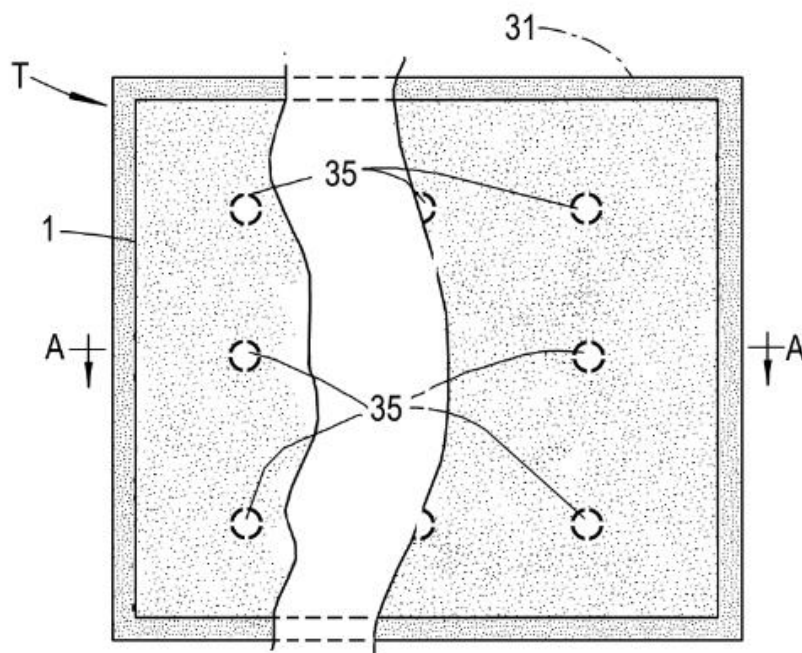


Fig.1

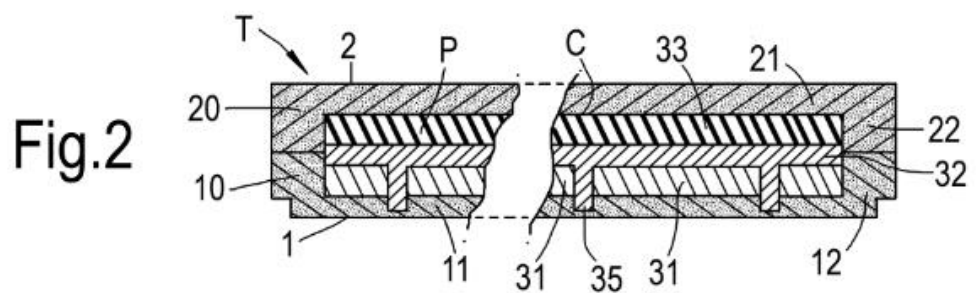


Fig.2

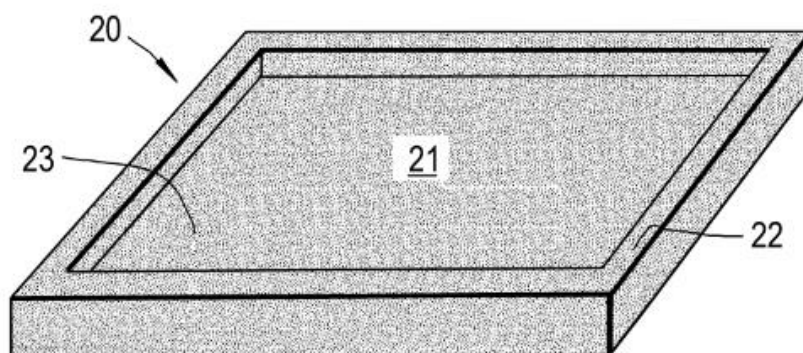
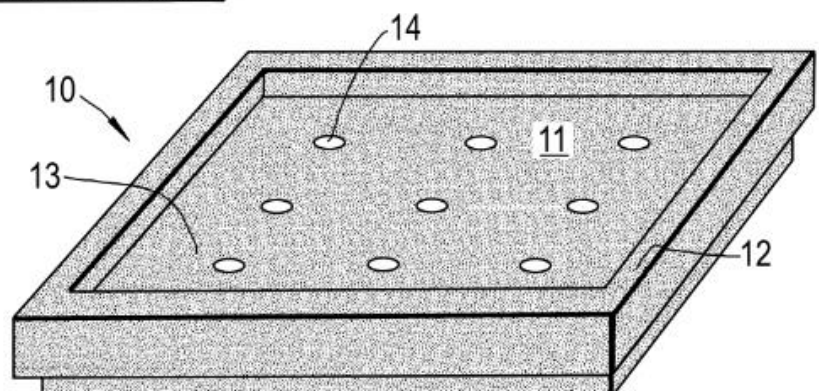


Fig.3

Fig.4



Excerpt from *Advances in Internal Heat Management*

(Published 12 February 2008)

In the field of heat management, Glass Ceilings Co have very recently proposed deploying phase change materials in building components such as wall panels, ceiling tiles and floor
10 tiles. These building components help to regulate the internal temperature of a room.

The Glass Ceilings Co product is called Retile and it is aimed at providing a building component comprising a phase change material which is economical when compared to conventional building components.

15

The Retile product is a gypsum ceiling tile with an internal cavity. The cavity is packed with two layers of wax, a first layer is virgin wax and the second layer is recycled wax. Each layer of wax is typically formed from more than one slab and each slab is encased in a plastic bag to prevent mixing and to retain the wax during use. Because the plastic bags are thin, they
20 do not interfere with performance of the wax.

By using recycled wax the cost of the wax (and hence the tile) is cheaper than it would be using entirely virgin wax. Even though recycled wax usually has a lower melting point than virgin wax the performance of the tile is not noticeably degraded. Indeed, using waxes of
25 different melting points may actually enhance the performance of the tile. Advantageously, placing the wax units in bags means that different amounts of each wax type can be provided according to need and budget.

Glass Ceilings Co currently supply Retile in a 50:50 virgin and recycled wax format, as shown
30 below, in exploded form, in **Figure A**. Usually, the phase change material (PCM) is a paraffin wax.

Whilst paraffin wax is not expensive, its use does add to the cost of the production of ceiling tiles. Other known PCMs are even more expensive.

Figure A

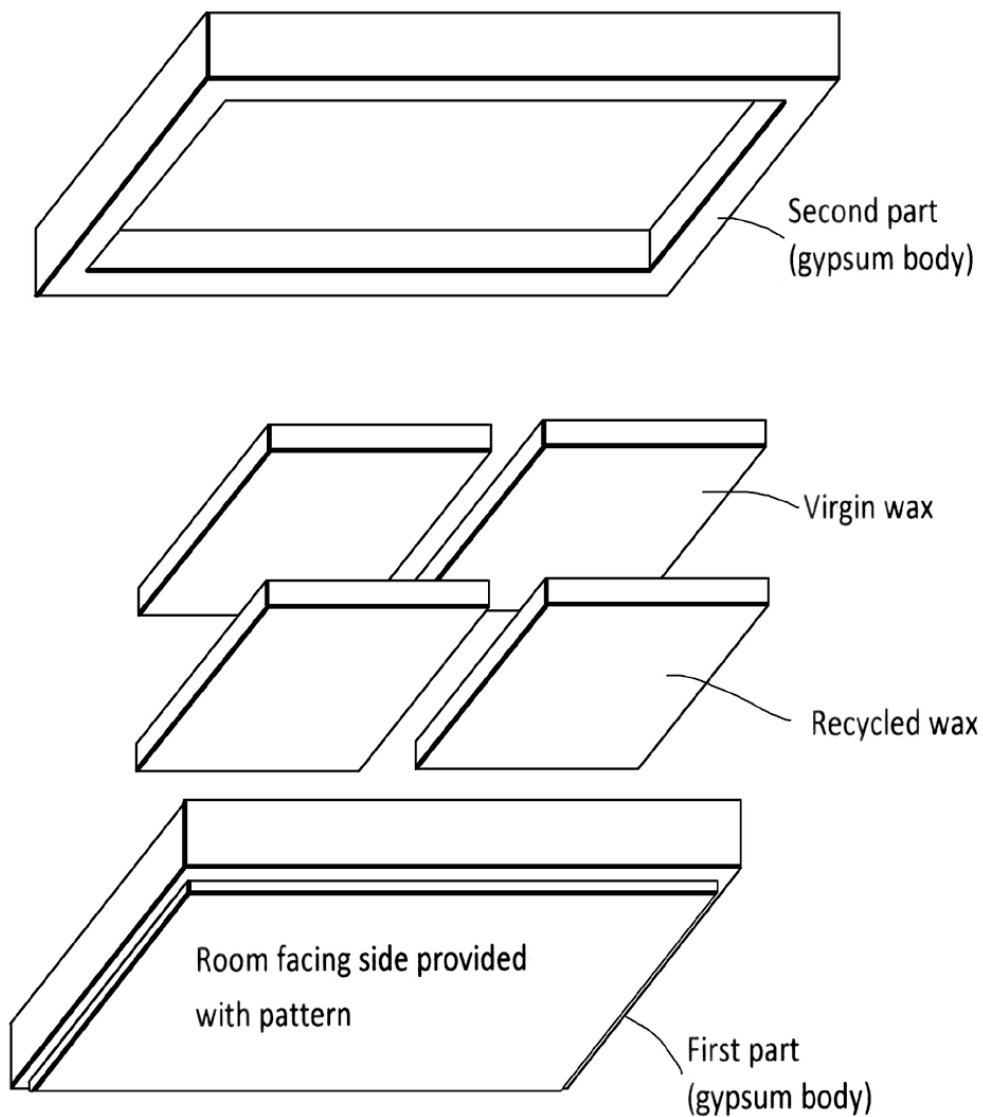


Figure A. Exploded view of the new Retile ceiling tile comprises stacked bags of recycled wax and virgin wax. The recycled wax is nearer to the room facing side of the tile. The room facing side will usually be patterned with a decorative design to improve aesthetics.

Phase Change Materials
US6123456 (published 15 August 2009)

This invention relates to phase change materials and uses thereof.

10

Phase change materials are well known. In most cases the phase change is endothermic in one direction (*i.e.* it takes in energy) and exothermic in the reverse direction (*i.e.* it gives out energy). When a phase change occurs at a constant pressure (*e.g.* atmospheric pressure), the temperature of the material undergoing the phase change does not alter until all of the substance has changed phase.

15

Waxes (*e.g.* paraffin waxes) and Glauber salts are distinct types of phase change materials. It is well known that both can be modified to change phase from solid to liquid at and around room temperatures. Both have been deployed as phase change materials in interior cladding panels.

20

One of the problems with phase change materials is that they can lose their efficacy over time, especially when particles of phase change material are simply mixed with particles of matrix material and the mixture moulded to form an article.

25

It is an object of the invention to provide a phase change material which is easy to use and which does not suffer from the above problem.

Accordingly an aspect of the invention provides a phase change article, the article comprising a body of phase change material encapsulated in a retaining body.

30

We believe that the decrease of efficacy over time for phase change materials is due to movement of the phase change material within the tile, especially when provided as dispersed particles within a matrix tile material. For example, we believe that in such articles, where particles of phase change material are dispersed in a solid matrix of material, the particles can move within the structure as they melt and solidify (for example they can move under the effect of gravity).

35

Preferably the retaining body is formed of a polymer.

In order to ensure efficient heat exchange into and out of the phase change material, the retaining body preferably comprises a polymer provided with metal particles, or carbon particles.

40

The retaining body ensures that the phase change material does not flow away from its intended site of use.

The article may be a particle *e.g.* having a small aspect ratio or a fibre *e.g.* having a large aspect ratio.

10

We believe that our phase change materials will have particular utility in wall, floor and ceiling panels.

In panels, we prefer to use fibres because we have found such use can increase the strength of the panels, especially when many fibres are formed into a mat.

15

In order to explain the invention, reference is made to the following exemplary figures.

Fig. 1 is a first embodiment of an article according to the invention.

20

Fig. 2 is a second embodiment of an article according to the invention.

Fig. 3A to 3C are step-wise views of the production of a tile according to the invention.

In **Fig. 1** there is shown a particle 1 comprising a shell 2 of cured resin defining an inner volume 3 which is filled with a phase change material 4. The particle 1 is shown as being spherical but it may be any shape with a small aspect ratio (*i.e.* the ratio of length l to width w of less than 10. The length l and width w of the particle 1 will typically be from 0.5mm to 1mm.

25

In **Fig. 2** there is shown a fibre 11 comprising a sheath 12 of cured resin defining an inner volume 13 which is filled with a phase change material 14. The fibre 11 is shown as being spherical in cross section but it may have any cross-sectional shape. The fibre 11 may be any length l' and the width w' is preferably from 0.75mm to 2mm. The fibre 11 has a large aspect ratio (*i.e.* the ratio of length l' to width w' of more than 20).

30

In the first case, a liquid epoxy resin mixture is prepared and small, usually spherical (although they can be any shape), particles of phase change material are dropped into the liquid epoxy resin mixture. When the particles are removed from the epoxy resin mixture the external surface of the particle is coated with liquid epoxy. Once the epoxy resin is cured the solidified epoxy resin encapsulates the phase change material to form a particle 1, as shown in **Fig. 1**. A portion of the particle 1 has been removed to show the shell 2.

35

40

In the second case, a liquid epoxy resin mixture is prepared and elongate strands of phase change material are drawn through a bath of liquid epoxy resin mixture. As the strands are removed from the epoxy resin mixture, the external surface of each strand is coated with liquid epoxy resin. Once the epoxy resin is cured the solidified epoxy encapsulates the strand to form a fibre 11, as shown in **Fig.**

10 2.

It is possible to suspend small metal (or other heat conducting species) flakes or beads in the liquid epoxy resin mixture. As the particle or strand is removed from the liquid epoxy resin mixture the small metal flakes or beads will coat the particle or strand along with the liquid epoxy resin. Once the resin cures, the metal flakes or beads will form part of the shell 2 or sheath 12 encapsulating the phase change material 4, 14. The presence of the metal flakes or beads increases the heat conductivity of the shell 2 or sheath 12.

In a preferred embodiment, we disperse steel beads in the resin to a loading of about 10 v/v% (*i.e.* the volume of steel beads is 10% the volume of the resin). The steel beads are typically spherical with a diameter of about 0.1mm.

We make our strands from a Glauber salt and cool them to 0 to 5°C before drawing them through an epoxy resin bath. The bath comprises steel beads mixed into, and homogeneously dispersed in, resin. The strands are continually drawn through the bath and once they exit the bath are exposed to an air stream and/or UV light which solidifies or cures the resin, thereby encapsulating the strand and forming a fibre 11.

Because the sheath 12 is relatively thin, the fibre 14 is flexible and can be formed into a mat by bending the continuous length of fibre 14 back on itself.

Reference is made to **Fig. 3A** to **3C** which show how we make a panel 20. To form the panel 20, a mat 25 of fibre 11 is located in a mould (not shown) and a mixture consisting of particles 1 (formed from the same Glauber salt) and a binder is poured into the mould to partially surround and submerge the mat 25. The binder is caused to solidify to form a body 21 with parts of the fibre 14 protruding from the upper and lower major surfaces (see **Fig. 3A**). The body 21 is then placed in a second mould (not shown) and a fluid tile material is injected into the mould. The tile material (which may be a plastic preferably incorporating mineral or stone particles) solidifies to form a half tile body 22 with the protruding parts of the fibre 14 secured in the body 22 (see **Fig. 3B**). The process is repeated to form the second half tile body 23 to form a complete panel 20 (see **Fig. 3C**). Advantageously, the

surface of the tile mould may be provided with a pattern to impart a corresponding pattern onto the surface of the panel 20.

The two parts 22, 23 are sealed together.

10

The fibre 11 not only confers heat absorption and emission characteristics on the panel 20 but also helps to consolidate and secure the tile bodies 22, 23 making the panel 20 stronger.

15

It will be appreciated that the panel 20 could be used as a part of a laminate structure. The particles 1 and/or fibre 11 can be deployed in place of slabs of phase change material in other non-panel related uses.

[Claims omitted]

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Cont...

US6123456

