HU000027177T2

(19) **HU**

(11) Lajstromszám: **E 027 177**

(13) **T2**

MAGYARORSZÁG
Szellemi Tulajdon Nemzeti Hivatala

EURÓPAI SZABADALOM
SZÖVEGÉNEK FORDÍTÁSA

(21) Magyar ügyszám: **E 05 700944**
(22) A bejelentés napja: **2005. 01. 14.**

(96) Az európai bejelentés bejelentési száma:
EP 20050700944
(97) Az európai bejelentés közzétételi adatai:
EP 1704287 A1 **2005. 07. 28.**
(97) Az európai szabadalom megadásának meghirdetési adatai:
EP 1704287 B1 **2015. 12. 23.**

(51) Int. Cl.: ***E04C 22/96*** *(2006.01)*
E02D 31/02 *(2006.01)*
E04D 3/35 *(2006.01)*
E04D 13/16 *(2006.01)*
E04F 15/18 *(2006.01)*

(86) A nemzetközi (PCT) bejelentési szám:
PCT/EP 05/000350
(87) A nemzetközi közzétételi szám:
WO 05068742

(30) Elsőbbségi adatok:
102004002115 **2004. 01. 14.** **DE**

(72) Feltaláló(k):
RAIDT, Heinz, Peter, 44227 Dortmund (DE)
SCHRÖER, Jörn, 58313 Herdecke (DE)

(73) Jogosult(ak):
EWALD DÖRKEN AG, 58313 Herdecke (DE)

(74) Képviselő:
PINTZ ÉS TÁRSAI Szabadalmi, Védjegy és Jogi Iroda Kft., Budapest

(54) **Membrán**

EP1704287

MEMBRANE

DESCRIPTION

The invention relates to a dimpled sheet according to the preamble of claim 1, a composite panel having such a dimpled sheet and a method for the thermal insulation of a building according to the preamble of claim 13.

Known dimpled sheets of the aforementioned type are commonly used for foundation wall protection, wherein they are located between the ground and the outside of the foundation wall, or an insulation is so arranged there in order to also fulfil a drainage function.

Dimpled sheets currently used have no effect on the thermal insulation of buildings, because their thermal transfer resistance is extremely low due in particular to the low reflectance properties of the surfaces. Thus the currently used dimpled sheets of brown or black only have a reflectance of 2-5%.

Known composite panels of the aforementioned type are preferably used in other countries as floor panels, wherein they are used between heated living spaces and an unheated substrate, such as a concrete floor of a basement room or a living space built on the ground floor.

The structure of the composite panel comprises, for example, a base body made of a chipboard or a sheet of plywood and a dimpled sheet attached to the base body. The dimpled sheet serves both as a vapour barrier to moisture, which might possibly rise from the concrete floor, as well as for the elastic mounting of the floorboards, in order to achieve a certain damping effect.

However, the use such panels has the drawback that, despite the cavities between the dimpled sheet and the concrete base as well as in the dimples themselves, they only offer an insufficient insulation. Known solutions to this problem provide for the use of an additional insulating layer between the dimpled sheet and the base body. This may improve the overall thermal insulation although, due to the thickness required of the insulation layer, ceiling height is lost, which is problematic especially in the use of such a composite panel in old buildings. Furthermore, the production of such composite panels designed with a layer of insulating material is very time-consuming and, not least of all, extremely expensive due to the necessary additional insulation material.

US 5,399,406 discloses a panel material which comprises a plurality of truncated conical projections having a basic square shape, and that is used in conjunction with an upper and lower plate as a core element of a composite component. The projections have a particular basic hexagonal shape and are internally hollow. The panel material serves as a composite panel in conjunction with the top and bottom plate for use in the interior of buildings.

GB 2 079 415 A discloses an insulating material for the surfaces of ceilings or, for example, floors. The insulating material is formed by two flexible plastic sheets which have bulges in the form of bags that can be provided with a heat-reflective aluminium coating on the inside and/or outside. After joining the two films to the insulating material by welding, a composite arrangement is created with fully enclosed bags, which should bring about thermal insulation. The features of the preamble of claim 1 are known in this context.

JP 2003-332782 A discloses a thin sheet material which absorbs magnetic waves and is formed through two-layer structures. One layer structure is in the form of a metallic reflecting layer while the other layer structure is in the form of an electromagnetic wave absorbing layer.

US 2003/0148093 A1 discloses a composite material which consists of three layers and may be used for decorative purposes e.g. in building walls, as well as for thermal insulation. A middle layer is made of transparent plastic material with pigments and a titanium dioxin layer and covered by an upper and lower layer of transparent plastic material.

WO 82/03099 A discloses a protective plate for external building walls or floors. The protective plate is made of a plastic material and has a plurality of dimple-like protrusions, which are formed by crater-like concavities. The protective plate is preferably used as a protective plate between a bottom layer of chipboard and a cast layer, for example, to form a drainage.

DE 21 49 851 A1 discloses a planar insulation, particularly for buildings, tents or the like, comprising at least three interconnected layers. The middle layer includes a plurality of spacer members, which may be dimple-like in form and, in each case, form closed cavities. The cavities are filled with gas to fully prevent heat conduction between the two outer layers.

The invention therefore has the object of providing a dimpled sheet constructed as simply as possible with a high thermal resistance as well as improving the thermal insulation of a composite panel of the aforementioned type while maintaining the basic structure of known composite panels. Moreover, the invention has for its object a method for the thermal insulation of a building, in particular for thermally insulating a floor.

The invention solves the problem through a dimpled sheet according to the features of claim 1, a composite panel according to claim 9, and a method according to claim 13. Advantageous developments of the invention are described in the dependent claims.

A characteristic of the dimpled sheet according to the invention is a surface having a high reflectance. In the context of the invention, a high reflectance is understood to mean a surface reflection of more than 20%. Basically, the dimpled sheet may have hollow dimples formed on one or both sides of a plane, wherein the dimpled sheets preferably have dimples on one side for the production of the composite panel according to the invention. In this case, the dimpled sheet is fixed with its dimpled side facing away from a base body.

According to the invention, the dimpled sheet is made of pigmented plastic to reflect infrared radiation. Such a plastic dimpled sheet is particularly distinguished by its simple and cost-effective production as well as its malleability and flexibility. These properties also allow a particularly cost-effective and trouble-free production of a composite panel.

The total thermal resistance of the dimpled sheet and the composite panel comprises the heat transfer resistance to radiant heat and the heat transfer resistance to convective heat. Mathematically calculated, the total heat transfer resistance is the reciprocal of the sum of the thermal resistances to convective and radiant heat. The heat transfer resistance to radiant heat and thus the total thermal resistance may be influenced through the high reflectivity of the surface of the dimpled sheet.

The wide application range of the dimpled sheet according to the invention, e.g. for the construction of a floor, the sealing of building walls at or above the ground, or for isolation in the roof, enables the building to be provided with a particularly high and complete thermal insulation, leading to a significant reduction in heating costs.

Thus, as the high reflectivity of the surface of the dimpled sheet significantly improves the heat transfer resistance to radiant heat, it is necessary that the air layers are limited to the surface of the dimpled sheet. The use of the dimpled sheet according to the invention for the construction of the composite panel according to the invention ensures the existence of sufficient air layers at the surface of the dimpled sheet corresponding to the distribution of the dimples and open spaces.

The preferred use of a dimpled sheet with dimples formed on one side in a position of use of the composite panel, for example, when used as a floor plate, limits the air layers to large areas of the dimpled sheet. Thus, there is an air layer in the hollow chambers of the dimples formed between the dimpled sheet and the main body. A further labyrinthine contiguous air layer exists between the dimples. These extensive areas ensure that the total thermal resistance of the composite sheet is substantially increased by the high reflectivity of the dimpled sheet.

According to the invention, the surface of the dimpled sheet has a reflectance of more than 0.2 (20% reflectance), in particular more than 0.35 (35% reflection), or 0.5 (50% reflection). Even at a reflectance of 0.2, the heat transfer resistance of the dimpled sheet compared with dark dimpled sheets at a reflectance of 0.02 to 0.05, is higher by a factor of at least 1.2. In the case of a reflectance of

0.35 or 0.5, the thermal transfer resistance of the composite panel corresponds to approximately 1.4 and 1.7 times the value for dark dimpled sheets. Thus it may be ensured that high thermal insulation is achieved without the use of additional insulation materials while the insulation performance is increased.

According to another embodiment of the invention, the dimpled sheet has a smooth surface. Such a configuration of the surface structure of the dimpled sheet causes the reflectance of the dimpled sheet to be increased in a complementary manner, thereby achieving an additional increase in the heat transfer resistance to radiant heat, so that the total thermal resistance of the composite panel is further improved.

There are manifold possibilities for forming the dimpled sheet with a high reflectivity. According to one development of the invention, the surface of the dimpled sheet has a reflective coating. The coating of the dimpled sheet may be applied in a mechanical manner to the surface of the dimpled sheet by vapour deposition or otherwise, depending on the type of coating.

The coating may further be so formed that it is adapted to reflect electromagnetic radiation, or at least attenuate it. The attenuation amounts to at least 5 dB, preferably at least 10 dB, particularly preferably at least 15 dB. This design of the dimpled sheet according to the invention enhances its application range in a complementary manner, wherein increasing importance is given to the shielding of living and working spaces against unwanted electromagnetic radiation.

The coating may be produced, for example, by applying a pigment-containing liquid to the surface of the dimpled sheet, wherein the pigments remain on the surface of the dimpled sheet after the passage of the liquid and give the dimpled sheet its reflective properties.

According to the invention the plastic contains colour pigments, in particular titanium dioxide or metal pigments, for example, aluminium pigments. The pigments may be mixed prior to the extrusion of the dimpled sheet in a corresponding plastic melt, so that post-extrusion treatment of the dimpled sheet to increase its reflectance may be dispensed with. The titanium dioxide, but especially the metal pigments, for example, the aluminium pigments are characterised by their property that, even at low concentrations in the plastic melt, they facilitate the production of a dimpled sheet having a high reflectance. The positive properties of the plastic dimpled sheet, such as flexibility, impact resistance, strength, etc., are not adversely affected by the titanium dioxide.

The dimpled sheet according to the invention may be used, in principle, alone, for example for thermal insulation in flooring, roofing or walling. Moreover, the dimpled sheet may also be combined with other materials or building materials, such as seals or insulations, wherein the production of a corresponding prefabricated product is possible, which then has the advantages of the dimpled sheet according to the invention and of the further product(s).

When using the dimpled sheet for the production of the composite panel, the base body may be freely selected corresponding to the field of application of the composite panel. According to an advantageous development of the invention, the base body is formed from chipboard or plywood.

Chipboard and plywood panels are distinguished, inter alia, through their low-cost production, their simple processing and by their particularly good insulation properties, so that the features of the composite panel according to the invention may be further improved. Moreover, this embodiment of the invention allows particularly cost-effective manufacturing of the composite panel according to the invention.

In addition to the use of particle board or plywood as the base body, known thermal insulation may also be used, such as mineral fibre boards, in order to produce a composite panel. This may also be used in the roof area or for the insulation of the building walls.

According to another embodiment of the composite sheet, a metal foil or metallised plastic film is arranged on the dimpled sheet side facing the base body or between the dimpled sheet and the base body. This particularly simple embodiment further improves the heat transfer resistance of the composite body in a complementary manner.

According to a development of the composite panel, the base body comprises two pairs of parallel edges, wherein adjacent edges are provided with coupling elements in the form of a groove on one and a spring that fits into the groove on the other. This development has the advantage that the laying of the composite panel is facilitated and the composite panels may be connected to each other in a other form-fitting manner, which enhances the stability of the joining of several composite panels.

A characteristic feature of the inventive method for the thermal insulation of a building, in particular for thermally insulating a floor, is that first a dimpled sheet with a reflectance of more than 0.2 (20% reflection), especially more than 0.35 (35% reflection), or 0.5 (50% reflection), is placed on the surface to be insulated, in particular on the floor, and then a base body is applied to the dimpled sheet.

This method offers a particularly simple way of building a thermal insulation on the spot, for example, directly on the site. The laying of the dimpled sheet here is particularly simple on account of its flexibility and ease of processing.

When using a plastic dimpled sheet, the dimpled sheet that is normally available in the form of plastic rolls, only needs to be rolled onto the surface to be insulated in order to produce the thermal insulation. Then the base body is attached to the dimpled sheet.

An exemplary embodiment of the invention is explained below with reference to the drawings:

Fig. 1 shows a cross-section through a composite panel arranged on a concrete base.

Fig. 1 shows a dimpled sheet 3 and a base body 2, which together form a composite panel 1, in an installed position as a floor panel on a concrete base 5. The composite panel 1 has a two-layer structure consisting of the dimpled sheet 3 and the base body 2.

The dimpled sheet 3 is made of plastic and has diagonally-running dimples 4 on one side with end faces 6 running substantially parallel to the dimpled sheet plane, and which are in contact with the concrete base 5. In the mounted position of the composite panel 1, extensive air layers on the dimpled sheet 3 are limited on both sides of the dimpled sheet 3. The dimpled sheet 3 is bonded to a lower surface 7 of the base body 2 with its dimpled 4 side facing away. An upper side 8 of base body 2 forms a tread surface of the composite panel 1.

To achieve a high heat transfer resistance of the composite sheet 1, the plastic of the dimpled sheet 3 has a reflectance of 0.2 (20% reflection). The base body 2 is formed of chipboard.

A coating of the dimpled sheet with a paint containing metal pigments (not shown here), provides shielding against electromagnetic radiation of 17 dB in the range of 200 kHz to 10 GHz.

Two methods for producing a dimpled sheet with an infrared-reflecting surface are presented below by way of example.

Production may be effected through extrusion and continuous vacuum forming of 97% HDPE (e.g. Stamyland HD 7625, from the company Stamylan Germany) with 3% aluminium pigment concentrate (e.g. Mastersafe 10203, from the company Eckhart) to give a grammage of 600 g/m². The reflectance of a dimpled sheet manufactured in this way and measured in the infrared range of 2-20 µm with an integrating sphere, is 22%.

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MEMBRÁN

SZABADALMI IGÉNYPONTOK

1. Horpadásos (gödröcskés) lemez (dimpled sheet, Noppenbahn) (3) épületek falainak és padlóinak szigetelésére, ahol síkalakú (plane-shaped) homorú gombok (hollow knob) (4) vannak a horpadásos lemez (3) egyik vagy mindkét oldalán, valamint egy felület olyan visszaverési tényezővel, (reflectance), amely nagyobb, mint 0,2 [20% visszatükrözödés (reflection)], abból a célból, hogy növekedjék a hőátviteli ellenállás (heat transfer resistance), és tartalmaz egy olyan műanyagot, amely visszatükrözi az infravörös sugárzást, **azzal jellemezve, hogy** színes pigmentet van bekeverve a műanyagba olyan nagy visszaverő-képesség (reflectivity) érdekében, amely nagyobb, mint 0,2.

2. Az 1. igénypont szerinti horpadásos lemez (3), **azzal jellemezve, hogy** a felületnek nagyobb, mint 0,35 (35% visszatükrözödés) vagy nagyobb, mint 0,5 (50% visszatükrözödés) visszaverő-képessége van.

3. Az 1. vagy 2. igénypont szerinti horpadásos lemez (3), **azzal jellemezve, hogy** ennek lágy (smooth) felszíne van.

4. Az 1-3. igénypontok bármelyike szerinti horpadásos lemez (3), **azzal jellemezve, hogy** a felület úgy van tervezve, hogy tükrözze vagy gyengítse (attenuate) az elektromágneses sugárzást.

5. Az 1-4. igénypontok bármelyike szerinti horpadásos lemez (3), **azzal jellemezve, hogy** a felület az elektromágneses sugárzást gyengíti legalább 5 dB-vel, előnyösen legalább 10 dB-vel, különösen előnyösen legalább 15 dB-vel.

6. Az 1-5. igénypontok bármelyike szerinti horpadásos lemez (3), **azzal jellemezve, hogy** a felületnek van egy visszatükröző bevonata (reflective coating).

7. Az 1-6. igénypontok bármelyike szerinti horpadásos lemez (3), **azzal jellemezve, hogy** a műanyag tartalmaz titán-dioxidot vagy fém pigmenteket.

8. Az 1-7. igénypontok bármelyike szerinti horpadásos lemez (3), **azzal jellemezve, hogy** a horpadásos lemez (3) műanyag felületének van egy fém bevonata (metal coating).

9. Kompozit (összetett) panel (1), amely tartalmaz elsősorban egy üregképző (cavity-forming) padlólemezt

- egy alaptesttel (base body) (2), és
- egy horpadásos lemezzel (3) az alaptesten (2) elrendezve,

azzal jellemezve, hogy a horpadásos lemez (3) az 1-8. igénypontok bármelyike szerint van megtervezve.

10. A 9. igénypont szerinti kompozit panel (1), **azzal jellemezve, hogy** az alaptest (2) faforgácslapként (chip board) vagy rétegelt paneliként (plywood panel) van kialakítva.

11. Az 1-10. igénypontok bármelyike szerinti kompozit panel (1), **azzal jellemezve, hogy** egy fémfólia vagy fémesített (metallised) műanyag film van elrendezve az alaptesttel (2) szembenéző horpadásos lemez (3) oldalán.

12. Az 1-11. igénypontok bármelyike szerinti kompozit panel (1), **azzal jellemezve, hogy** az alaplemeznek (2) két pár párhuzamos éle van, ahol van két szomszédos él kapcsoló (coupling) elemekkel, ahol az egyik horony (groove) formájában ban, míg a másik el van látva egy olyan rugóval (spring), amely illeszkedik a horonyba.

13. Eljárás egy épület hőszigetelésére, elsősorban egy padló hőszigetelésére, **azzal jellemezve, hogy**

- először elrendezünk a szigetelendő felületen, elsősorban a padlón, egy, az 1-8. igénypontok bármelyike szerinti horpadásos lemezt (3), amelynek több, mint 20%, különösen több, mint 35% vagy 50% visszaverési tényezője (reflectance) van, és
- ezután egy alaptestet (2) viszünk fel a horpadásos lemezre (3).

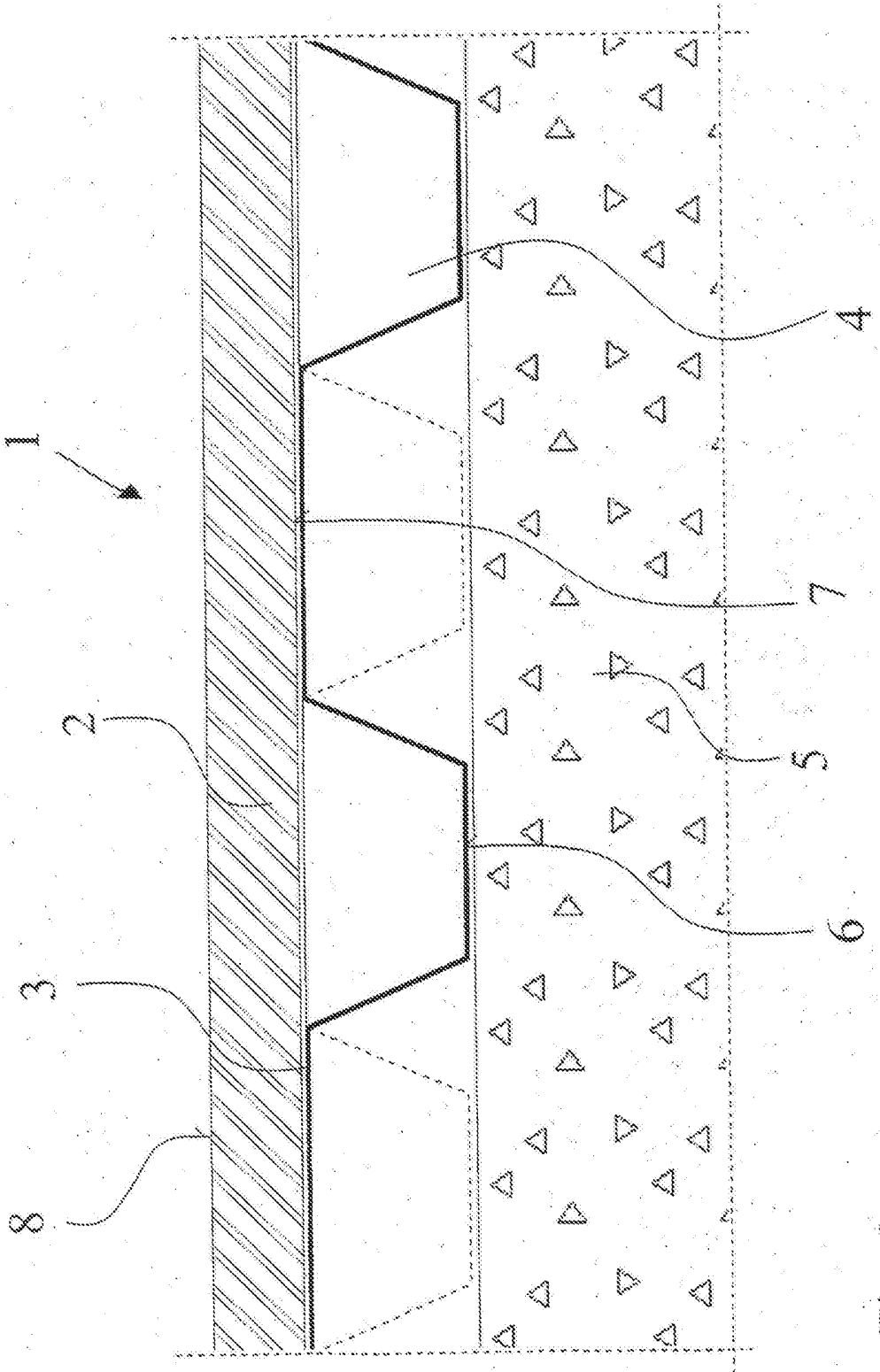

Fig. 1