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(54) **DIVIDING WALL ELEMENT FOR ROOM PARTITIONS AND THE LIKE WITH A FILLING OF HEAT INSULATING MATERIAL, ESPECIALLY MINERAL WOOL**

TRENNWANDELEMENT FÜR TRENNWÄNDE UND DERGLEICHEN MIT EINER FÜLLUNG AUS WÄRMEISOLIERENDEM MATERIAL, INSBESONDERE MINERALWOLLE

ELEMENT DE MUR DE SEPARATION POUR CLOISONS ET ANALOGUES, POURVU D'UNE CHARGE D'ISOLANT THERMIQUE, EN PARTICULIER DE LAINE MINERALE

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(56) References cited:
EP-B1- 0 050 450
WO-A-95/14136
WO-A1-01/34913
DE-A- 2 611 033
DE-A1- 3 444 881
DE-A1- 4 030 407
DE-A1- 10 147 831
DE-B- 1 213 778
DE-B- 1 560 817
DE-T2- 69 409 065
DE-U1- 20 109 037
DE-U1- 29 802 495
FR-A- 1 576 287
GB-A- 1 564 709
US-A- 3 712 846
US-A- 4 306 396
US-A- 4 317 503

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Description

[0001] The present invention concerns a dividing wall element in accordance with the preamble of Claim 1 hereinbelow.

[0002] Such dividing wall elements are for the most part constituted by gypsum plaster boards arranged at a certain distance from each other, possibly with a filling of heat insulation material. Such dividing wall elements are preferably used as room partitions and are distinguished by their light-weight structure and the speed with which they can be installed. Such dividing wall elements are therefore very often used for interior finishing work and in this connection have to comply with a series of criteria, namely compact and simple structure, ease of fabrication, stability, and quick and easy installation.

[0003] The prior art document DE-26 11 033 discloses a fire-protecting wall with outer walls of gypsum and internal layers of mats of fibre such as mineral wool. The document FR 1 576 287 discloses a dividing wall for noise-insulating with several layers, which are separated by flat rods and which has a paper structure in the middle.

[0004] The present invention sets out to design a dividing wall element for use as a room partition with excellent sound insulation properties, with a simple design and economic as far as costs are concerned.

[0005] In accordance with the invention this aim is achieved by means of the features set out in the characterizing part of Claim 1, while further appropriate developments of the invention are characterized by the features described in the dependent claims.

[0006] According to the invention, the filling between the outer skins, which are generally made of gypsum plaster board, consists of a sandwich arrangement of several layers of insulating materials, each differently specified as regards its heat or sound absorption capacity and / or its elastic behaviour. The multi-layer filling is particularly character ized by the fact that at least one layer of insulating material that is in direct contact with the outer skin, but preferably both layers of insulating material adjacent to the outer skins, is / are coupled with the outer skins - which are especially made of gypsum plaster board - as far as oscillation behaviour is concerned. This oscillation coupling of the outermost insulating layers is preferably obtained by designing the inner insulating layers with good elastic properties, so that upon incorporation between the outer skins they will build up restoring forces that act on the insulating layers adjacent to the outer skins, i.e. the two outermost insulating layers, and press them permanently against the outer skins. In this way one assures that the outer filling layers will oscillate with the outer skins, which has the effect of conferring excellent sound insulation properties upon the dividing wall element.

[0007] It will be appropriate (advantageous) if the inner layer is made of a material with a porous and / or open structure, namely mineral wool, and preferably a material with a small gross density in the range between 14 and 25 kg/m^3, preferably between 16 and 18 kg/m^3, especially 17 kg/m^3, which leads to a very considerable elastic capacity of the layer and the building up of appropriate restoring forces when the sandwich structure is incorporated between the outer skins. The outer filling layers, i.e. the layers adjacent to the outer skins, on the other hand, are designed to be heavier than this inner layer, especially with a gross density in the range between 100 and 370 kg/m^3, preferably between 150 and 185 kg/m^3, especially in the range between 160 and 175 kg/m^3. When the filling is formed in accordance with the invention, the outer skins with the immediately adjacent layers are designed to be as heavy and resilient as possible. The outer insulation layers will likewise be made of mineral wool. Preferably, however, these outer insulation layers should also have springy characteristics, since these are of advantage as regards the oscillation coupling and the sound absorption capacity.

[0008] If necessary, the central insulating layer can also be designed as a multi-layer system. The filling in accordance with the invention is accordingly made up of a mix of layers with good sound absorption capacity and substantial heat insulation, and this renders the dividing wall element suitable for being used in many different applications.

[0009] The dividing wall element can be advantageously constituted as a prefabricated element, more particularly, a composite element in which especially the outer layers of insulating material are attached to the two outer skins, possibly glued, and the insulating layers are also attached to each, preferably by gluing. But it is also possible to produce a kind of sandwich composite consisting of the central layer and the insulating layers adjacent to it more or less as a semi-finished product in which the individual layers are lying loosely in contact with each other and are kept together in a pre-stressed condition by means of band-like hoops. The semi-finished product is then placed between the outer skins, after which the hoops are removed,, so that the pre-compression will keep the outermost layer of insulating material firmly in contact with the outer skins.

[0010] A preferred embodiment of the invention will now be described with the help of the single figure attached hereto, which shows, albeit in a purely schematic manner, a cross-section through a part of a dividing wall element.

[0011] The dividing wall element 1 illustrated by the figure has two outer skins 2 and 3, which constitute the external surfaces of dividing wall element 1 and are for the most part made of gypsum plaster board. Between these outer skins or gypsum plaster boards 2, 3, which are separated by a certain distance, there is arranged a filling that in the example here illustrated consists of the layers, especially three layers of insulating material 4, 5 and 6. The insulating layers 4 to 6 are preferably made of mineral wool.

[0012] The two insulating layers 4 and 6 adjacent to the outer skins 2 and 3 are so constituted as to be heavy

as compared with the central insulating layer 5, but not to the point of being devoid of resilience. The central insulating layer 5 is characterized by a comparatively great elasticity. More particularly, the elastic behaviour of the of the central insulating layer 5 is so chosen that upon inclusion between the adjacent insulating layers 4 and 6, the appropriately oversized central layer will be compressed and build up restoring forces, so that the two insulating layers adjacent to the outer skins will be permanently pressed against these outer skins. This will assure an oscillation coupling between the outer insulating layers 4 and 6 and the two gypsum plaster boards 2 and 3, so that the these two layers can oscillate with the gypsum plaster boards 2 and 3. Since the two layers are heavy and therefore have a substantial mass, this produces advantageous acoustic properties to supplement the good insulating capacity of the dividing wall element.

[0013] In the illustrated embodiment the distance between the inner faces of the two outer skins 2 and 3 amounts to 100 mm. The two outer insulating layers 4 and 6 are designed to have a thickness of 32 mm each, while the central insulating layer has a thickness of 40 mm, which means that, taken together, the three insulating layers are oversized by 4 mm, this oversize being compensated by compression of the central layer. The two outer insulating layers 4 and 6 have a gross density of 175 kg/m^3, while the central insulating layer 5 has a much smaller gross density of 17 kg/m^3, i.e. the central insulating layer is characterized by a porous open structure as compared with the massive and heavy design of the outer insulating layers 4 and 6. Incorporation of the central insulating layer in the dividing wall element sets up restoring forces acting on the outer insulating layers 4 and 6, so that these will become acoustically or oscillationally coupled with the outer skins 2 and 3

[0014] In an alternative embodiment the distance between the two outer skins amounts to 50 mm. The two outer insulating layers will then preferably have a thickness of 12 mm each, while the thickness of the central insulating layer will once again amount to 40 mm. The gross density of the two outer insulating layer in this case amounts to 160 kg/m^3, while the central insulating layer has a density of 17 kg/m^3. However, the invention is not by any means limited to the two embodiments that have just been described and the particular values associated with them. In particular, embodiments in which only one of the insulating layers adjacent to the outer skins is oscillationally coupled with its outer skin due to a design that confers an appropriately high elasticity upon the inner insulating layer or layers can also be advantageous.

[0015] Although the described embodiments assume the outer skins 2, 3 to be constituted by gypsum plaster boards, it may also be appropriate to use sheet metal having a thickness of, say, 0.6 mm for the outer skins, in which case the overall thickness of the dividing wall element in accordance with the invention may be advantageously chosen in the range between 70 and 120 mm.

[0016] The improvement of the sound absorption characteristic R_W resulting from the filling with a sandwich-type structure in accordance with the invention was determined by means of two test series performed on CW profiles that had the customary commercial thickness of, respectively, 75 mm and 100 mm and were structured as shown in the figure. Similar sheets with single-layer fillings served as comparison standards in both test series.

[0017] The single-layer filling with an insulating material having a thickness of 70 mm yielded a sound absorption characteristic R_W of 43 dB independently of the gross density of the material and with flow resistances greater than 5 kPa s/m^2. When the single-layer filling had a thickness of only 60 mm, the sound absorption characteristic R_W was found to be reduced by 1 dB and had a value of 42 dB. The multi-layer filling in accordance with the invention consisting of two outer insulating layers having a thickness of 22 mm each and a gross density of 195 kg/m^3 that were combined with a 20 mm thick central insulating layer having a gross density of 19 kg/m^3, on the other hand, yielded a sound absorption characteristic Rw of 47 db. As far as the 75 mm thick CW profile is concerned, the sandwich-type filling in accordance with the invention therefore improved the sound absorption characteristic Rw by up to 5 dB.

[0018] Comparable improvements were obtained in the tests performed on 100 mm thick CW profiles. The flow resistance was set to at least 5 kPa s/m^2 in all cases. The comparison values were determined as 46 dB with a single-layer filling having a thickness of 95 mm and a gross density of 27 kg/m^3, and likewise as 46 dB when the thickness amounted to 80 mm and the gross density to 26 kg/m^3. A total of four multi-layer fillings in accordance with the invention were tested.

[0019] An embodiment of the filling with two 12 mm thick outer insulating layers and an 80 mm thick central insulating layer having gross densities of, respectively, 144 and 14 kg/m^3 yielded a sound reduction characteristic R_W of 48 dB. An embodiment of the filling with two 32 mm thick outer insulating layers and a 40 mm thick central insulating layer having gross densities of, respectively, 161 and 14 kg/m^3 yielded a sound reduction characteristic R_W of 49 dB. An embodiment of the filling with two 12 mm thick outer insulating layers and an 80 mm thick central insulating layer having gross densities of, respectively, 367 and 14 kg/m^3 yielded a sound reduction characteristic R_W of 50 dB. As far as the 100 mm thick CW profile is concerned, the sandwich-type filling in accordance with the invention therefore improved the sound absorption characteristic R_W once again by up to 5 dB.

[0020] Although preferred dividing wall elements with three insulating layers have here been described, the central insulating layer may itself be structured as a multi-layer system. Particularly suitable are also fillings with four insulating layers or two insulating layers. When only two insulating layers are used, only one of the insulating layers will be acoustically coupled with the outer skin, i.e.

designed as an appropriately heavy layer with a high gross density, while the other insulating layer will have a substantially smaller gross density and appropriately good elastic properties.

[0021] The essential thing is that the central layer should have an appropriately porous and / or open structure and be capable of building up permanent restoring forces.

Claims

1. A dividing wall element for room partitions and the like, made up of at least two outer skins (2, 3), especially gypsum plaster boards, arranged at a certain distance from each other, and a filling of heat insulation material (4, 5, 6), especially mineral wool, arranged in the hollow space between the outer skins (2, 3) where the filling of heat insulation material between the outer skins (2, 3) is structured into several insulating layers that are differently specified as far as their heat insulation, sound absorption and/or elastic properties are concerned, **characterized in that** at least one inner (5) of the insulating layers of the filling of heat insulating material, having a porous, open and/or cellular structure, in contact with a further (4, 6) of the insulating layers of the filling of heat insulating material adjacent to one of the outer skins (2, 3) is designed to possess such good elastic properties and is arranged oversize between the outer skins (2, 3) or the neighbouring insulating layers (4, 6) of the filling of heat insulating material, so that the inserted inner layer is compressed and will build up restoring forces so that said insulating layer/layers (4, 6) consisting of mineral wool adjacent to the outer skin/skins (2, 3) are permanently pressed against the outer skin/skins (2, 3), wherein the filling consist of mineral wool.

2. A dividing wall element in accordance with Claim 1, **characterized in that** the heat insulating layers (4, 5, 6) extend parallel to the outer skins (2, 3).

3. A dividing wall element in accordance with Claim 1 or Claim 2, **characterized in that** the heat insulating layers (4 to 6) are designed and / or arranged in such a manner that at least one insulating layer (4, 6) adjacent to an outer skin (2 or 3), is / are oscillation-coupled with the outer skin / skins, especially outer skins made of gypsum plaster board.

4. A dividing wall element in accordance with any one of the preceding claims, **characterized in that** the filling between two outer skins (2, 3) consists of three insulating layers (4, 5, 6), of which at least one layer (4, 6) adjacent to one outer skin, and preferably both the outer insulating layers, are designed for sound adsorption purposes to have a gross density and be resilient.

5. A dividing wall element in accordance with Claim 4, **characterized in that** the layers (4, 6) adjacent to the outer skins (2, 3) have a gross density between 100 and 370 kg/m^3, preferably between 160 and 175 kg/m^3, and that the central layer is designed to have a gross density of 14 to 25 kg/m^3, preferably 16 to 18 kg/m^3, and especially 17 kg/m^3.

6. A dividing wall element in accordance with any one of the preceding claims, **characterized in that** the filling is of such nature or of such a density as to have a flow resistance of at least about 5 kPas/m^2.

7. A dividing wall element in accordance with any one of the preceding claims, **characterized in that** the inner layer and the layers adjacent to it are kept together as a semi-finished product and in a prestressed (precompressed) condition by means of band-like hoops.

8. A dividing wall element in accordance with any one of the preceding claims, **characterized in that** the dividing wall element is a composite product consisting of the outer skins and the filling layer.

Patentansprüche

1. Ein Trennwandelement für Trennwände und dergleichen, aufgebaut aus wenigstens zwei äußeren Verkleidungen (2, 3), speziell Gipskartonplatten, welche in einem bestimmten Abstand voneinander angeordnet sind und aus einer Füllung aus wärmeisolierendem Material (4, 5, 6), speziell Mineralwolle, die in dem Hohlraum zwischen den äußeren Verkleidungen (2, 3) angeordnet ist, wobei die Füllung aus wärmeisolierendem Material zwischen den äußeren Verkleidungen (2, 3) in mehreren isolierenden Lagen strukturiert ist, die unterschiedlich spezifiziert sind, soweit es ihre Wärmeisolation, Schallisolation und /oder elastischen Eigenschaften betrifft, **dadurch gekennzeichnet, dass**
wenigstens eine Innere (5) der isolierenden Schichten der Füllung aus wärmeisolierendem Material welche eine poröse offene und /oder zellulare Struktur hat in Kontakt mit einer weiteren (4, 6) der isolierenden Schichten der Füllung von wärmeisolierendem Material, benachbart zu einer der äußeren Verkleidungen (2, 3) so entworfen ist, dass sie derartig gute elastische Eigenschaften aufweist und im Übermaß zwischen den äußeren Verkleidungen (2, 3) oder den benachbarten isolierenden Schichten (4, 6) der Füllung aus wärmeisolierendem Material angeordnet ist, so dass die eingefügte innere Schicht komprimiert wird und rücktreibende Kräfte aufbauen wird, so dass die isolierende Schicht/ Schichten (4,

6) bestehend aus Mineralwolle benachbart zur äußeren Verkleidung /den Verkleidungen (2, 3) permanent gegen die äußere Verkleidung /Verkleidungen (2, 3) gepresst werden, wobei die Füllung aus Mineralwolle besteht.

2. Ein Trennwandelement in Übereinstimmung mit Anspruch 1, **dadurch gekennzeichnet, dass** die wärmeisolierenden Schichten (4, 5, 6) sich parallel zu den äußeren Verkleidungen (2, 3) erstrecken.

3. Ein Trennwandelement in Übereinstimmung mit Anspruch 1 oder Anspruch 2, **dadurch gekennzeichnet, dass** die wärmeisolierenden Schichten (4 bis 6) auf solch eine Weise entworfen sind und /oder angeordnet sind, dass wenigstens eine isolierende Schicht (4, 6) benachbart zu einer äußeren Verkleidung (2 oder 3) schwingungsgekoppelt mit der äußeren Verkleidung / den Verkleidungen ist/ sind, speziell äußeren Schichten, die aus Gipskarton hergestellt sind.

4. Ein Trennwandelement in Übereinstimmung mit irgendeinem der vorherigen Ansprüche, **dadurch gekennzeichnet, dass** die Füllung zwischen zwei äußeren Verkleidungen (2, 3) aus drei isolierenden Schichten (4, 5, 6) besteht, von denen wenigstens eine Schicht (4, 6) benachbart zu einer äußeren Verkleidung und bevorzugt sowohl die äußeren isolierenden Schichten für schallisolierende Zwecke entworfen sind, um eine Rohdichte zu haben und nachgiebig zu sein.

5. Ein Trennwandelement in Übereinstimmung mit Anspruch 4, **dadurch gekennzeichnet, dass** die Schichten (4, 6) benachbart zu den äußeren Verkleidungen (2, 3) eine Rohdichte zwischen 100 und 370 kg/m^3 haben, bevorzugt zwischen 160 und 175 kg/m^3, und dass die mittlere Schicht dazu entworfen ist, eine Rohdichte von 14 bis 25 kg/m^3 zu haben, bevorzugt 15 bis 18 kg/^{3} und besonders 17 kg/m^3.

6. Ein Trennwandelement in Übereinstimmung mit irgendeinem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die Füllung von einer derartigen Natur oder einer derartigen Dichte ist, dass sie einen Strömungswiderstand von wenigstens 5 kPas/m^2 hat.

7. Ein Trennwandelement in Übereinstimmung mit irgendeinem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** die innere Schicht und die Schichten benachbart zu ihr als Halbfertigprodukt zusammengehalten werden und in einem vorgespannten (vorkomprimierten) Zustand mittels bandartigen Ringen.

8. Ein Trennwandelement in Übereinstimmung mit irgendeinem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Trennwandelement ein Verbundprodukt ist, das aus den äußeren Verkleidungen und der Füllschicht besteht.

Revendications

1. Elément de mur de séparation pour cloisons et analogues, constitué d'au moins deux revêtements extérieurs (2, 3), spécialement de plaques de parement en plâtre, disposés à une certaine distance l'un de l'autre, et d'une charge de remplissage constituée d'un matériau d'isolation thermique (4, 5, 6), spécialement de laine minérale, disposée dans l'espace creux compris entre les revêtements extérieurs (2, 3), dans lequel la charge de remplissage de matériau d'isolation thermique entre les revêtements extérieurs (2, 3) est structurée en plusieurs couches isolantes qui sont spécifiques de façon différente quant à leur propriétés d'élasticité, d'absorption sonore et/ou d'isolation thermique, **caractérisé en ce que** au moins la couche intérieure (5) des couches isolantes de la charge de remplissage de matériau d'isolation thermique, présentant une structure poreuse, ouverte et/ou cellulaire, en contact avec une autre couche (4, 6) des couches isolantes de la charge de remplissage de matériau d'isolation thermique adjacente à l'un des revêtements extérieurs (2, 3), est conçue pour posséder ces propriétés élastiques appréciables et est disposée de façon surdimensionnée entre les revêtements extérieurs (2, 3) ou au voisinage des couches isolantes (4, 6) de la charge de remplissage de matériau d'isolation thermique de sorte que la couche intérieure insérée soit comprimée et développe des forces de rappel de façon que ladite/lesdites couche(s) isolante(s) (4, 6) constituée (s) de laine minérale adjacente(s) au revêtement (aux revêtements) extérieur(s) (2, 3) soient en permanence comprimées contre le/les revêtement(s) extérieur(s) (2, 3) dans lequel la charge de remplissage est constituée de laine minérale.

2. Elément de mur de séparation selon la revendication 1, **caractérisé en ce que** les couches d'isolation thermique (4, 5, 6) s'étendent parallèlement aux revêtements extérieurs (2, 3).

3. Elément de mur de séparation selon la revendication 1 ou la revendication 2, **caractérisé en ce que** les couches d'isolation thermique (4 à 6) sont conçues et/ou disposées d'une telle manière qu'au moins une couche isolante (4,6) adjacente à un revêtement extérieur (2 ou 3), est/sont couplée(s) de façon oscillatoire avec le/les revêtement(s) extérieur(s), spécialement avec les revêtements extérieurs constitués de plaque de parement en plâtre.

4. Elément de mur de séparation selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la charge de remplissage entre deux revêtements extérieurs (2,3) est constituée de trois couches isolantes (4, 5, 6) dont au moins une couche (4, 6) adjacente à un revêtement extérieur, et de préférence, les deux couches isolantes extérieures, sont conçues à des fins d'adsorption acoustique pour présenter une densité brute et être élastiques.

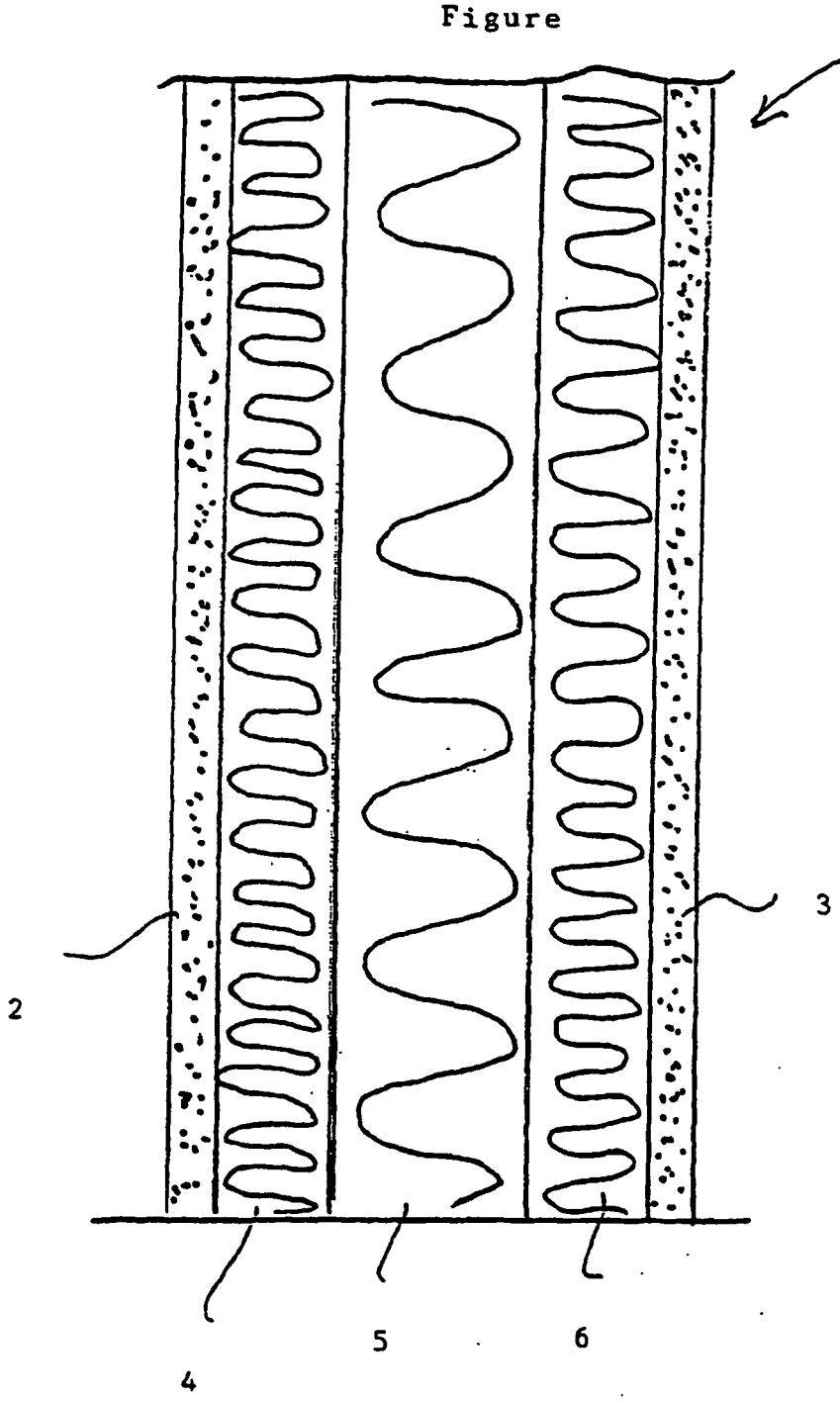
5. Elément de mur de séparation selon la revendication 4, **caractérisé en ce que** les couches (4, 6) adjacentes aux revêtements extérieurs (2, 3) présentent une densité brute entre 100 et 370 kg/m3, de préférence entre 160 et 175 kg/m3, et **en ce que** la couche centrale est conçue pour présenter une densité brute de 14 à 25 kg/m^3, de préférence de 16 à 18 kg/m^3, et spécialement de 17 kg/m^3.

6. Elément de mur de séparation selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la charge de remplissage est d'une nature telle ou d'une densité telle qu'elle présente une résistance à l'écoulement d'au moins 5 kPas/m^2 environ.

7. Elément de mur de séparation selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la couche intérieure et les couches adjacentes à celle-ci sont maintenues ensemble sous forme d'un produit semi-fini et dans un état précontraint (pré-comprimé) au moyen de colliers en forme de bande.

8. Elément de mur de séparation selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'élément de mur de séparation est un produit composite constitué des revêtements extérieurs et de la couche de remplissage.

Figure



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- DE 2611033 **[0003]**
- FR 1576287 **[0003]**