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(54) **MULTY-LAYER PROTECTION PANEL AND SYSTEM FOR BASEMENT WALLS**

(57) Multi-layer protection panel (10) for basement walls (20), made up of three layers (101,102,103) coupled in such a way as to thermally insulate, drain, protect from water and also ventilate at extrados the wall; it is made up of a first insulating layer (101) of XPS with vertical ventilation channels (104) on the back face, a second draining layer (102) consisting of a bossed plastic membrane, and a third filtering layer (103) consisting of a geotextile. Said second and third layer, being flexible, frontally skirt above and below the insulating layer as an upper selvedge (107) and a lower selvedge (108), for protection purposes and for transpiration; on the front face, in combination with said lower selvedge, a filtering pocket (105) open from the bottom is frontally integrated, for the housing of the holed pipe (40) of longitudinal drainage. Furthermore, a protection system for basement walls that provides the use of said panel (10) is described.

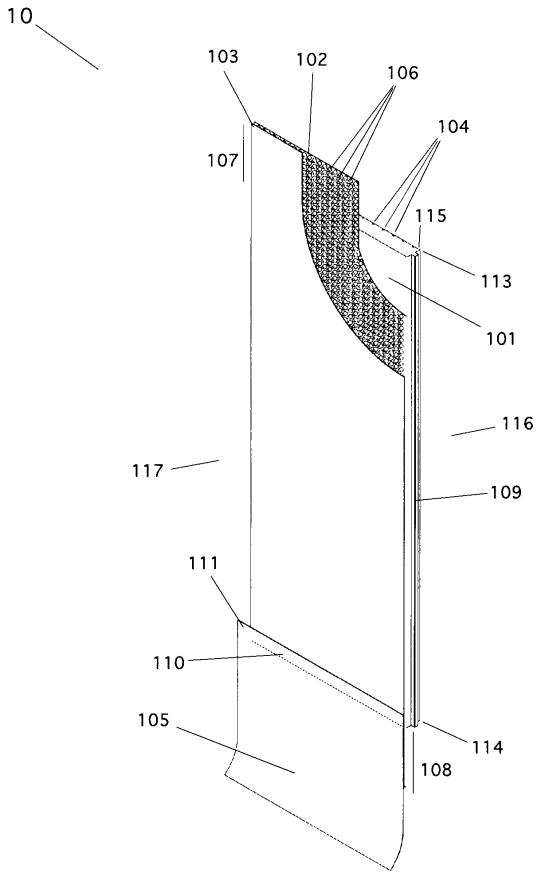

Fig. 1

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Description

[0001] The present invention relates to a multi-layer protection panel and system for basement walls. In more detail, said protection panel is of the composite type and integrates different functions, it being intended to thermally insulate, drain, protect from water and ventilate at the extrados the walls in contact with the ground, also with a draining pocket for housing the longitudinal drainage pipe placed below; furthermore, the invention describes a protection system for basement walls providing the use of said panel.

[0002] The invention finds specific application in the building industry and in particular in the sector of semi-finished components for building such as, as a non-exclusive example, the insulating panels and the draining membranes for underground masonry works.

[0003] In the field of the products for building the panels for thermal insulation are widely known and widespread, which are also called insulating panels, and which are made of a rigid and cheap material, of extremely reduced weight but with high insulating efficiency, such as expanded polystyrene, also known by the English acronym EPS, or extruded polystyrene, which is also known as XPS. Generally, said panels of EPS or XPS are single-layer, having a thickness between 2 cm and 20 cm, and have smooth surfaces and rabbeted side edges, that is to say, provided with complementary profile steps, to be automatically aligned during laying and facilitate the continuous installation of adjacent panels. Such panels are widely used at the extrados of vertical walls and also in the interspaces between partition walls, in the floors and in the cover pitches; in particular, the panels of XPS feature perfectly closed and uniform cells and are more suitable where, in addition to the thermal-insulating power, one also requires compressive strength and/or water repellency, as for example in case of underground rooms or in inverted roofs.

[0004] Moreover, nowadays in the building sector different types of membranes are used, having different purposes: for example, one should remember the vapour membranes, the waterproofing bituminous membranes, the draining membranes, the geomembranes as well as the separating sheets of non-woven fabric. In more detail, the waterproof membranes of the thin type in the form of a smooth, single-layer plate, made of a plastic material like polyethylene or polypropylene are widespread, which can be easily applied on the screeds and on the floors to ensure watertightness or with a separating function, below fragile coverings such as marble slabs, preventing cracks and detachments. In particular, the membranes of the bossed type are known and widespread, that is to say, thin, shaped plates with cavities and protrusions, for example cylindrical, frusto-conical or shaped as a truncated pyramid, in such a way as to act as a spacer between the layers and/or to compensate for any possible crushing; often, therefore, such bossed membranes are used in underground buildings as a waterproofing and external protection element, being arranged vertically at the extrados of basement rooms and sometimes horizontally on the screeds.

[0005] In practical modern building it is also known and advantageous to apply a filtering layer outside said bossed membranes, in adhesion on the head of said protrusions, in such a way as to obtain a draining space that is particularly suitable in case of vertical basement walls. Recently, to this purpose, some companies operating in the building sector have launched on the market integrated solutions of thin and bossed membranes that are efficiently pre-coupled with a filtering layer for the purpose of drainage, for example of a water-permeable geotextile, such as a non-woven fabric of polypropylene of the type called spunbonded or spunlace, being provided in one single coil in the form of a draining and waterproofing membrane of the multi-layer type. For example, see the product called TMD by the Italian company TeMa Technologies and Materials, 31029 Vittorio Veneto TV, www.temacorporation.com. Furthermore, one should also remember the draining geocomposites or geomats, made up of a spacing core of polypropylene wires in the form of a mat or of a three-dimensional geonet of polyethylene, with the filtering layer coupled on one or on both faces; to this purpose, in particular, see the product called Qdrain by said Italian company TeMa Technologies and Materials S.r.l., which also can be provided with a polyolefin sheet of the waterproof type coupled on the face opposite to the filtering layer.

[0006] Among the most suitable materials for making said waterproof and bossed membranes there are the resins of the type called olefins, and in particular said polyethylene, which can be low-density, medium-density or also high-density, being respectively called LDPE, MDPE and HDPE; as an alternative, said polypropylene, also known by the acronym PP, or thermoplastic polyolefins, known by the acronym TPO, are suitable. In some cases, polystyrene is also used, which is known by the acronym PS. Such raw materials can be virgin or regenerated, the latter being derived from the recovery of products in the post-production or post-consumption phase.

[0007] The operators of the building sector know that making a suitable protection for underground rooms, by thermally insulating and draining water at the extrados, is an extremely delicate operation that also affects comfort, maintenance costs and the duration of the building. In fact, although the materials and the technologies for waterproofing and draining are widespread, the known problem of allowing the transpiration of the underground rooms and obtaining an effective ventilation at the extrados, in a natural way, easily and with limited costs, in such a way as to simultaneously provide suitable protection of the wall and also to solve the known problems of humidity, mould and poor healthiness in underground rooms, has not been solved yet. Basically, a more integrated solution with respect to the currently available solutions is not known and is highly desirable, in the form of a modular and multifunction prefabricated element,

which simultaneously allows to thermally insulate, drain, protect from water and also ventilate said basement wall, it being easy to be carried and laid, cheap, safe, long-lasting, and also intended to limit the consumption of building material.

Prior art

[0008] For the purpose of determining the prior art related to the proposed solution, a conventional check was made, searching public archives, which has led to find some prior art documents, among which:

D1: DE3113807 (Hacker);

D2: EP0799939 (Graf et al.)

D3: DE19593489 (Kolossow);

D4: EP0874089 (Diehl)

D5: Viadrain, of the Italian company Geosintex S.r.l., via L. Da Vinci 12, I-36066 Sandrigo VI (www.geosintex.com);

D6: Jackodur KF300 Jackodrain, of the German company Jackon Insulation GmbH, Carl-Benz-Strasse 8, D-33803 Steinhagen (www.jackon-insulation.com);

D7: Gemadrain, of the Italian company Sirap Insulation S.r.l. - Soprema Group, via Kennedy 54, 1-25028 Verolanuova BS (www.sirapinsulation.com).

[0009] The prior art document D1 describes an insulating panel of foamed material for underground rooms which has a face provided with vertical grooves for the purpose of draining. D2, on the other hand, proposes an improved solution of an insulating and draining panel in which the smooth face is positioned adherent to a wall that has been previously waterproofed with a bituminous sheath, while the opposite face, that is to say, at the extrados, is provided with vertical draining grooves and is also frontally coupled with a waterproof filtering layer in such a way as to facilitate the water flow below the panel, where a holed drainage pipe is longitudinally arranged in a ballast.

[0010] D3 describes a multi-layer panel for insulating and draining basement walls, which is of the composite type it being made up of an insulating plate of foamed polystyrene, laterally rabbeted for the purposes of side-by-side positioning, which is externally coupled with a rigid draining element formed by a thin, three-dimensionally shaped layer, for example a bossed or waved fabric, which is filled on the back with mortar of cement, sand and scrap material in such a way as to get harder and adhere to said insulating plate; furthermore, a filtering layer is frontally joined, on the head of the protrusions, in order to ensure drainage without obstructions.

[0011] D4, on the other hand, proposes a rigid plate of polystyrene of the back draining type being provided with water draining grooves on the face facing the wall, wherein said wall has been previously waterproofed; the opposite face facing the ground, that is to say, at the extrados, is coupled with a larger filtering layer in such a way as to skirt as a selvedge on two adjacent edges, that is to say, bordering each other, to enable a partial overlapping of said filtering layer during the laying of adjacent plates. Said draining grooves are provided in multiple configurations, for example, in an orthogonal or diagonal grid; as an alternative, again for the purpose of draining the face facing the wall, there are cylindrical elements that protrude like spacers. Therefore, such a solution reverses the logic of drainage with respect to the above-described panels, since the plates are substantially adjacent to a basement protection barrier, while on the back there is a conventional waterproofing of the wall and the installation of the conventional holed draining pipe in the ballast is also provided.

[0012] D5 is a particular solution of trench longitudinal drainage, consisting of a draining core of a diamond meshed three-dimensional geonet, of high-density polyethylene wires, enclosed between two filtering layers of a material of the non-woven geotextile type, welded to each other in such a way as to form a pocket intended to house a slotted draining pipe.

[0013] Finally, D6 and D7 are two similar solutions of a multi-layer panel for basement walls, of the insulating and draining type, made up of an insulating plate of extruded polystyrene that has a smooth surface facing the wall, and, on the other hand, on the face facing outwards, is coupled with a draining element consisting of a bossed membrane of HDPE that in its turn is coupled at the extrados with a filtering layer of a material of the geotextile type, being facing the ground. Said plate of polystyrene is laterally rabbeted for the purpose of laying continuity, in such a way as to be laid aligned and adherent to the surrounding elements; said filtering layer is skirting on one side as a selvedge in order to enable partial overlapping and protect said draining element from obstructions.

[0014] Therefore, it is reasonable to consider as known the solutions of panels or membranes for insulating and/or draining and/or externally waterproofing underground buildings, which provide:

- a rigid and smooth single-layer panel, of an insulating material such as XPS, which is also laterally rabbeted to facilitate continuous side-by-side positioning;
- a thin and smooth waterproof sheet, of a plastic material;
- a sheet of the bossed type, with protrusions of cylindrical, frusto-pyramidal or frusto-conical shape;
- filtering layers frontally associated with said bossed sheet, in such a way that the permeated fluids flow

in the interspace created by said bosses, as a waterproof and draining membrane;

- draining and filtering elements for underground structures, where a geomat of wires or a geonet with three-dimensional development acts as a spacing element interposed between non-woven synthetic filtering layers, forming permeable layers that if necessary are combined at the back with impermeable layers;
- a waterproof barrier of the bituminous type heat applied directly at the extrados of underground walls or foundations;
- an insulating panel comprising grooves for the vertical drainage of water, which are alternatively integrated on the front surface, that is to say, against the ground, or on the back surface, that is to say, in contact with the waterproofed wall for a drainage of the reverse type, and wherein a filtering layer in contact with the ground is also provided;
- a multi-layer protection panel, wherein the insulating-layer is foamed and smooth and has the face facing the ground coupled with a three-dimensional draining body of fabric, filled on the back with rigid mortar and frontally coupled with a basement filtering layer;
- a multi-layer insulating and draining panel in which a smooth plate of XPS is externally coupled with a draining element consisting of a bossed membrane of HDPE with a front filtering layer of geotextile skirting on one side, with respect to said plate and said bossed waterproof layer, as a selvedge;
- a composite element as a filtering and draining pocket, for housing a draining pipe inside trenches in the ground.

Drawbacks

[0015] In conclusion, we have observed that the described solutions have some drawbacks or, anyway, some limits.

[0016] In general, the above-mentioned panels provide mechanical protection and allow to thermally insulate underground rooms but, however, do not perform properly and in an integrated way, that is to say, simultaneously, the functions of draining, waterproofing and ventilation of the basement wall. Furthermore, it has been observed that the solutions currently available on the market are not easy as far as laying is concerned, they being improvable in their coupling logic and in the sealing of adjacent elements.

[0017] In fact, it is known that the vertical draining grooves in an insulating panel of expanded polystyrene can get clogged if positioned against the ground and without a filtering layer, and can also get easily squeezed since the foamed material is subjected to the lateral pressure of the ground, as for example in D1 and D2; such problems locally limit drainage and sometimes are the cause of infiltrations and humidity in underground rooms.

Among the solutions of insulating panels that integrate at the front an effective draining layer with protrusions and a filtering layer, wherein the back of said protrusions is also filled with mortar of cement as for example in D3, it has been observed that said filling unnecessarily increases the weight and the cost of the panel, and also that the three-dimensionally shaped fabric is difficult to process and does not guarantee waterproofing. Nowadays, such a solution is considered as obsolete and inadequate because such a draining layer can be easily replaced with a modern bossed membrane, of plastic material having a small thickness and suitable resistance for application, improving its behaviour, function and long-lastingness.

[0018] At present, among the most effective solutions of insulating panels present on the market, as the multilayer panels with a bossed plastic membrane as in D6 and D7, it has been observed that they simplify laying against the ground since they are lightweight, laterally rabbeted, externally waterproof and also with the external filtering layer that skirts to ensure continuity at the extrados; however, such panels do not provide sufficient protection from the water of the underground wall, there being in any case vertical interruptions of the waterproof layer, that is to say, in the underground portion of wall corresponding to the width of the panel from the ground level and up to the lower drainage pipe. The external taping between the plates, in fact, does not prevent the drain water that falls vertically from penetrating from the edges of the panel and wetting the corresponding wall portion, therefore it is necessary in any case to preliminarily waterproof the whole underground wall, for example by means of a conventional application of a priming layer and a bituminous layer, implying long times and high costs.

[0019] Furthermore, the operators of the sector know that the slotted pipe, longitudinally laid below said draining layer, must be placed in a ballast for the purpose of ensuring operating efficiency and in order not to get clogged; it has also been observed that the modern prefabricated draining devices for trenches, of the filtering pocket type, in which said slotted pipe is housed below a draining core enclosed between two filtering layers as for example in D5, could contribute to limiting the costs connected with the supply and laying of said ballast but, however, they are expensive to purchase and are also redundant in the sizes and in the function if partially superimposed to other draining and/or filtering elements, as can occur in combination with the above-described panels.

[0020] Furthermore, as to the conventional solutions available on the market, it has been observed that insulating and draining panels are not known that also allow to efficiently ventilate said basement wall, for a healthy transpiration outwards, as on the other hand occurs for above ground masonries; in particular, it has been observed that the need to preliminarily waterproof the external surface of the wall makes any solution of ventilation

from outside ineffective, as for example would occur if cavities open towards the surface to be ventilated were integrated in said insulating panel. To this purpose, one should remember the insulating panel with reverse drainage as for example in D4, that is to say, provided with grooves on the back surface that are positioned behind the wall to drain downwards the water that if necessary is drawn from the opposite face, directly against the ground, that substantially acts as a protection barrier; in this case, in fact, said grooves do not serve in any way to ventilate but only to drain, since the water is in direct contact with the external surface of the wall which, therefore, must be previously waterproofed. Furthermore, with such a draining solution there is a greater risk of infiltrations.

[0021] Therefore, there is the need for the companies of the sector to find some optimal solutions for obtaining the following aims.

Summary of the invention

[0022] These and other aims are achieved by the present invention according to the characteristics as in the appended claims, solving the mentioned problems by means of a multi-layer protection panel (10) for basement walls (20), made up of three layers (101,102,103) coupled in such a way as to thermally insulate, drain, protect from water and also ventilate at extrados the wall; it is made up of a first insulating layer (101) of XPS with vertical ventilation channels (104) on the back face, a second draining layer (102) consisting of a bossed plastic membrane, and a third filtering layer (103) consisting of a geotextile. Said second and third layer, being flexible, frontally skirt above and below the insulating layer as an upper selvedge (107) and a lower selvedge (108), for protection purposes and for transpiration; on the front face, in combination with said lower selvedge, a filtering pocket (105) open from the bottom is frontally integrated, for the housing of the holed pipe (40) of longitudinal drainage. Furthermore, a protection system for basement walls that provides the use of said panel (10) is described.

Aims

[0023] By the considerable creative contribution, the effect of which constitutes an immediate technical progress, several aims are achieved.

[0024] Firstly, the protection panel proposed by the invention allows to simultaneously and easily:

- thermally insulate underground rooms;
- drain rainwater preventing it from getting into contact with the basement wall, and thus creating a substantial and effective external waterproofing, where all the drained water is conveyed in vertical continuity downwards and up to the holed pipe of longitudinal drainage;
- create ventilation on the external surface of said basement wall, allowing it to transpire, with greater healthiness for the inhabitants of the basements, greater comfort, longer duration of the structures, less maintenance problems, less humidity and/or moulds. The configuration of the invention, in particular, overcomes the conventional need to preliminarily apply on said wall the waterproofing layers, like the known and widespread bituminous layers that, by sealing the surface, prevent transpiration outwards.

[0025] Secondly, the proposed solution is considerably easier as far as laying is concerned and cheaper, with respect to the known and conventional solutions, to obtain efficient mechanical protection, thermal insulation, drainage, protection from water and ventilation of the basement walls.

[0026] Thirdly, the rigid insulating layer is more protected from above against infiltrations and/or obstructions of the ground, since the front draining and filtering layers are larger with respect to the rigid insulating layer, to skirt above and be joined to a head section intended to fix them; simultaneously, by this solution humid air is allowed to go back behind the panel and exit from above, for a healthy and natural ventilation.

[0027] Fourthly, the conventional ballast, that is provided at the base of the wall, or outside the wall footing, for housing the holed pipe of longitudinal drainage, has been eliminated, or considerably reduced; to this purpose, in the invention the front draining and filtering layers are larger to skirt below the rigid insulating plate and up to below said holed pipe, substantially forming a draining pocket that is intended to house it, keeping it in the correct position and protecting it from any infiltrations and/or obstructions.

[0028] These and other advantages will appear from the following detailed description of some preferred embodiments with the aid of the enclosed schematic drawings whose details are not to be considered limitative but only illustrative.

Content of the drawings

[0029]

Figure 1 is an axonometric view of the protection panel according to the invention, in which the front layers are partially shown in order to facilitate understanding.

Figure 2 is an axonometric view of the protection panel according to the invention, shown with the upper and lower selvedge in the configuration of use and adjacent in continuity to a second panel identical to it but horizontally sectioned to facilitate understanding.

Figure 3 is an axonometric view of the protection

panel according to the invention in the configuration of use, also with the head fixing section, and the holed pipe of longitudinal drainage in the filtering pocket, below.

Figures 4a and 4b are cross-sections, that is to say, horizontal, of the protection panel according to the invention, according to the section line X1-X1 of Fig. 5, where in 4a the layers are joined as a prefabricated product while in 4b said layers are separate, that is to say, before assembly.

Figure 5 is a longitudinal section, that is to say, vertical, of the protection panel according to the invention shown below the ground, laid behind the underground room according to a protection system that provides the use of adjacent panels, with said fixing section and said holed pipe of drainage in the filtering pocket, as in Fig. 3; hatched boxes, named VI and VII respectively, refer to the enlarged details as in Figures 6a-b and 7a-b.

Figures 6a and 6b are enlarged details, as in box VI of Fig. 5, in which 6a is a section while 6b is an axonometric view.

Figures 7a and 7b are enlarged details, as in box VII of Fig. 5, where 7a is a section while 7b is an axonometric view.

Practical realization of the invention

[0030] Also with reference to the figures (Figures 1-7) the present invention relates to an innovative multi-layer protection panel (10) for basement walls (20), that is to say, substantially vertical building structures and in contact with the ground, and to the protection system that makes use of said panel (10). The proposed solution allows, in an easy and economical way, to thermally insulate, drain, protect from water and from external stresses, and also to ventilate at extrados the external wall of an underground room (201,202) (Fig. 5). Said panel (10) is of the composite type, comprising multiple layers precoupled with each other as a prefabricated element; in particular, it is made up of a first insulating layer (101), consisting of a rigid plate of XPS with particular ventilation channels (104) on the back face, a second layer (102) of the draining type consisting of a bossed plastic membrane, and a third filtering layer (103) consisting of a geotextile; said second and third layer, being flexible, skirting frontally above and below the insulating plate forming an upper selvedge (107) and a lower selvedge (108) respectively, for protection purposes and for transpiration. On the front face, in combination with said lower selvedge, a filtering pocket (105) open from the bottom is integrated, for the housing of the holed pipe (40) of longitudinal drainage, instead of the conventional ballast (Figures 1, 3).

[0031] It can observed that by the proposed solution one does not obtain real ventilation, since no air enters, but an efficient ventilation of the wall is obtained because in the channels there is a pressure movement that tends to equalize the pressure inside the underground rooms (202) with the external pressure, at the ground level (301) or at a depth (302) close to it where said pressure is substantially equal to the outside. Therefore, for the purposes of the invention, the head fixing of the panel must not necessarily be above ground level but can be a little below it, for example at a depth of some centimetres, in such a way as to hide the panel from view and also to prevent water from entering (Fig. 6a).

[0032] It can be observed, moreover, that said protection panel (10) has such a length as to cover in height the wall to be drained, eliminating the horizontal joints that may cause some infiltrations in the course of time; laterally, on the other hand, each panel is jointed, it being of the modular type. The proposed protection system, therefore, cannot be defined as waterproof; however, the invention frontally provides high protection from water in vertical continuity and up to the draining pipe placed below the wall, following without interruptions the natural flow of the liquid, and also enables said ventilation at the back. To this purpose, the invention provides not to seal at the extrados the underground wall, avoiding for example the laying of the conventional waterproof bituminous layers, and enables transpiration.

[0033] In particular, said first insulating layer (101) is in correspondence of the back face (116) of the panel, to be laid behind the wall (20), and consists of a rigid plate of XPS wherein the back face (116) is provided with multiple ventilation channels (104) parallel to each other and arranged vertically at full height, that is to say, from the lower edge (114) to the upper edge (113), in such a way as to be placed in direct contact with the external surface (201) of said wall creating space for transpiration; it can be observed that such a ventilation system is created by means of a pressure variation inside said channels (104) and up to the upper end of the panel (101,102,103) (Figures 1, 4a-b). Said first insulating layer (101) has a continuous rabbet (109) of the male-female type in the two opposite vertical sides (115), for high lateral waterproofing in case of adjacent panels (10) (Figures 1-2).

[0034] Said second layer (102) consists of a thin bossed membrane of HDPE, which is joined on the smooth front of said first layer (101) in such a way as to keep the protrusions or bosses (106) facing the ground (117, 30). On the other hand, said third layer (103) is of the filtering type and consists of a geotextile, that is to say, a water-permeable fabric of artificial material that is characterised by tensile strength and is used to improve the geotechnical characteristics of soils; it is frontally joined on the head of said bosses (106) to form a draining space in correspondence of the front face (117), that is to say, facing the ground (30) (Figures 1, 4a-b).

[0035] In more detail as to the invention (10), the sec-

ond layer (102) and the third layer (103) are joined to each other as a draining and flexible membrane, have a width (L) equal to that of said first layer (101), that is to say, laterally aligned, and have, on the other hand, a greater height (H) with respect to it (101) skirting above (113) and below (114) to form an upper selvedge (107) and a lower selvedge (108) respectively in such a way as to convey the water downwards in vertical draining continuity, from a height close to the ground level (301,302) and up to the base of the wall (20), that is to say, where the housing of a holed pipe (40) of longitudinal drainage is provided. To this purpose, said upper selvedge (102,103,107) protrudes by at least 15 cm from the upper edge (113) of the first layer (101) in such a way as to adapt to the wall and to said first insulating layer and so as to be joined by means a fixing section (50) of the step-like type, intended to be laid at a depth close to the ground level, for protection from backfilling and from water and also to allow behind the wall (20, 201) said pressure variation (Figures 1-3).

[0036] Said lower selvedge (108), on the other hand, extends downwards for at least 20 cm from the lower edge (114) of the first layer (101) and up to the provided draining depth, that is to say, in correspondence of the holed pipe (40) of longitudinal drainage that is conventionally laid at the base of the underground structures, often around the wall footing (203) (Figures 5, 7a-b); in particular, it can be observed that said drainage is at full height, in vertical continuity, that is to say, from said section (50) and up to said holed pipe (40), wherein said lower selvedge (108) enables a partial winding from behind of said pipe (40) to convey directly to it all the water drained from the panel (10) with a vertical flow from the top downwards, like a drainpipe (Figures 1-3, 5).

[0037] Furthermore, said panel (10) integrates at the front a filtering pocket (105) for said holed pipe (40), open from the bottom, of a geotextile that is partially superimposed to said third layer (103) in correspondence of said lower selvedge (108) and welded to it only on the upper edge (110) in such a way as to protrude from the bottom to enable a partial winding from the front of said holed pipe (40) that is laid between them (105, 108), which act in combination from the front and from the back respectively, draining the overlying ground (112) instead of a housing on gravel (Figures 2-3, 5, 7a-b).

[0038] In more detail as to the preferred embodiment of the invention, said first, second and third layer (101,102,103) have a width (L) of 60 cm, net of said rabbet (109), with an overall thickness (S3) of 60 mm wherein said first layer (101, S1) is of 50 mm and the front draining layers (102,103, S2) are of 10 mm as a whole. The layer of geotextile that forms said pocket (105) has in-plane dimensions of 65 cm of width and 50 cm of height, wherein the pocket is 5 cm wider than the underlying layers (101,102,103) to protrude from one side as a lateral selvedge (111) and overlap in filtering continuity the pocket of an adjacent panel (10). Said ventilation channels (104) have, individually, cross-section sizes of 5 mm x 5 mm, with a distance between centres between the channels of 40 mm.

[0039] Tests have demonstrated that the above-mentioned preferred values, with a tolerance of +/- 20%, are particularly advantageous from a point of view of technical performances, of industrial production, of transport and laying; however, it will be evident to a person skilled in the art that the proposed solution can be adapted to various configurations, also with different sizes with respect to those indicated. As to the thickness of the panel (10), in fact, an insulating layer (101) having a thickness (S1) between 20 mm and 200 mm is suitable for invention; for example, nowadays, for similar uses, panels of XPS having a standard thickness of 30 mm, 40 mm, 50 mm, 60 mm, 80 mm, 100 mm or 120 mm are used. Likewise, said draining and filtering layers (102,103) can have thicknesses (S2) other than the preferred ones indicated above, being for example greater or smaller to be adapted to particular environmental conditions. For the purposes of the invention, the overall height of the panel, comprising the rigid part (H), the flexible selvedges (107,108) and the filtering pocket (105), is substantially equal to the provided draining depth and such as to cover the underground wall (20, 201,202) at full height, that is to say, from the section (50) of fixing to the holed pipe (40) of longitudinal drainage. For example (Figures 1, 3, 5), the height (H) of the rigid layer (101) can be between 140 cm and 320 cm wherein one generally provides values of about 160 cm for the partially underground rooms (202) (Fig. 5) or about 280 cm for the completely underground ones, to which one must add the height of said selvedges (107,108) which is of at least 15 cm and 20 cm respectively, and the height of the skirting part of the pocket (105) that is of about 30 cm for the purpose of enabling an easy winding of said pipe (40) in combination with the lower selvedge (108).

[0040] From an industrial production point of view, said second and third layer (102,103) can advantageously be joined by means of heat coupling; on the other hand, said first and second layer (102,103) can be joined by means of the application of adhesive. Finally, said pocket can be welded by heat deposition of a rectilinear band of bitumen (110) (Figures 1, 4a-b).

[0041] In the present description of the invention said second layer (102) is a bossed membrane of HDPE acting simultaneously as a spacing element and as a waterproof membrane, for the purpose of draining; moreover, it protects from external mechanical stresses and simplifies the coupling with the other layers, both on the front and on the back, having even supporting surfaces on both faces. Therefore, it was observed that such a solution is particularly effective, economical and easy to be produced industrially. As an alternative to said bossed membrane, where required by particular production needs, an equivalent solution of the composite type is provided, as a spacing core pre-coupled with a waterproof sheet; for example, the draining geocomposites of single wires of PP or the three-dimensional geonets of

HDPE, which at the front are coupled with said third filtering layer (103) of geotextile and at the back are joined to a polyolefin sheet, which in its turn is coupled at the back with said first insulating layer (101) of XPS, are suitable for invention.

[0042] Therefore, an advantageous protection system for basement walls (20) is described that provides the use of the above-described multi-layer protection panel (10), to thermally insulate, drain, protect from water and also ventilate at the extrados an underground room (202) (Figures 1-3, 5-7). This system provides, in particular:

a) the laying of multiple protection panels (10) (Figures 1-2), identical to each other, having said three insulating-draining-filtering layers (101,102,103), said ventilation channels (104), said upper and lower selvedges (102,103, 107,108) so as to protect at the extrados the whole surface of the underground wall (20, 201) and convey the drained water downwards, in vertical continuity and without joints, directly up to the holed pipe (40);

b) a filtering pocket (105) open from the bottom, of geotextile, which is joined and partially superimposed to said third layer (103) of each panel (10) to drain said holed pipe (40), enabling its winding in combination with said lower selvedge (102,103, 108); said pocket (105) protruding from one side as a lateral selvedge (111) to overlap in filtering continuity said pocket (105) of an adjacent panel (10);

c) a continuous side rabbet (109), of the male-female type, in the two vertical sides (115) opposite to each other of the first layer (101) of each panel (10), in such a way as to obtain high waterproofing between adjacent panels (10);

d) a section (50) of the step-like type (Figures 3, 5, 6a-b) which joins and fixes at the head to said wall (20, 201), in horizontal continuity, the upper selvedges (107) of the adjacent panels (10, 109), being mounted at a depth (302) close to the ground level (301); and wherein said profile (50) and said selvedges (102,103, 107) protect frontally (117) and from above from water and from backfilling, and also enable said pressure variation on the back face (116), that is to say, behind the underground wall (20, 201);

e) a partial winding of said holed pipe (40) with the lower selvedge (108), from the back and towards the front, to longitudinally collect the drained water (Figures 3, 5, 7a-b);

f) a partial winding of said holed pipe (40) with said filtering pocket (105), from the front and backwards, in such a way as to filter the ground and obtain internal space (112) above the pipe (40), facilitating drainage; and wherein said filtering pocket (105) acts in combination with said lower selvedge (108), partially overlapping it below the pipe (40) (Fig. 7a);

g) a vertical taping (60) from the outside in correspondence of said rabbet (109, 115), at full height (Fig. 2).

Reference:

[0043]

(10) protection panel for basement walls;
(101) first layer, of the insulating type of XPS;
(102) second layer, of the draining type;
(103) third layer, of the filtering type;
(104) ventilation channel;
(105) filtering pocket open from the bottom, of geotextile;
(106) protrusion or boss;
(107) upper selvedge;
(108) lower selvedge;
(109) continuous rabbet with male-female interlocking;
(110) pocket fixing welding;
(111) lateral selvedge of the filtering pocket;
(112) space inside the pocket, for drainage;
(113) upper edge of the first layer;
(114) lower edge of the first layer;
(115) side edge;
(116) back face, facing the wall;
(117) front face, facing the ground;
(20) basement wall;
(201) extrados of the wall, surface facing the ground;
(202) underground room;
(203) wall footing;
(30) ground;
(301) ground level;
(302) laying depth of the fixing section;
(40) holed pipe of longitudinal drainage;
(50) fixing section;
(60) adhesive tape;
(L) width of panel, net of the rabbet;
(H) height of insulating plate or first layer;
(SI, S2, S3) thickness, respectively: of the first layer (SI), of the second and third layer (S2) together, of the three layers (S3) together.

Claims

1. Multi-layer protection panel (10) for basement walls (20), which is of the composite type, integrates different functions such as thermal insulation and drainage from the outside, and comprises the following layers which are pre-coupled with respect to each other as a prefabricated element:

- a first layer (101) of the insulating type, in cor-

respondence of the back face (116), that is to say, facing said wall (20), which consists of a rigid plate of XPS having a thickness between 20 mm and 200 mm, with side rabbet for the alignment between adjacent panels (10);
- a second layer (102) of the draining type, consisting of a waterproof embossed membrane of HDPE having a small thickness, which is joined to said first layer (101) with the protrusions or bosses (106) facing the ground (117, 30);
- a third layer (103) of the filtering type, consisting of a water-permeable geotextile, which is joined frontally, that is to say, on the head of said bosses (106) to form a draining space in correspondence of the front face (117), that is to say, facing the ground (30); said third layer (103), skirting as a selvedge with respect to the rigid insulating layer (101) to partially overlap it in filtering continuity;

and wherein said protection panel (10) is **characterised in that** said first layer (101) of XPS material has the back face (116) provided with multiple ventilation channels (104) which are parallel to each other and arranged vertically at full height, that is to say, from the lower edge (114) to the upper edge (113), in such a way as to be positioned in direct contact with the external surface (201) of said wall (20), that is to say, at the extrados, creating the space for transpiration; and wherein said second and third layer (102,103), joined to each other with the same dimensions as a draining and flexible membrane, have a width (L) equal to said first layer (101), that is to say, laterally aligned, and have, on the other hand, a greater length with respect to it (101) skirting above (113) and below (114) to form an upper selvedge (107) and a lower selvedge (108), respectively, in such a way as to convey the water downwards in vertical draining continuity, at full height, that is to say, from a height close to the ground level (301,302) and up to the base of the wall (20) where the housing of a holed pipe (40) of longitudinal drainage is provided; and wherein, to this purpose, said upper selvedge (102,103,107) protrudes by at least 15 cm from the upper edge (113) of the first layer (101)) and up to the provided ground level (301,302), for junction and front protection from backfilling and from water; and wherein, said lower selvedge (108) extends downwards for at least 20 cm from the lower edge (114) of the first layer (101) and up to the provided draining depth, to enable a partial winding from behind of said holed pipe (40), directly conveying to the holed pipe (40) all the water drained vertically from the panel (10); and wherein a filtering pocket (105) of geotextile for said holed pipe (40) is also frontally integrated, open from the bottom and partially superimposed to said third layer (103) in correspondence of said lower selvedge (108), being welded on the upper edge (110) and protruding from the bottom to enable a partial winding from the front of said holed pipe (40) and to join from below in combination with said lower selvedge (108), draining the above ground (112) in place of a housing on gravel; and wherein said first insulating layer (101) of XPS has a continuous rabbet (109) of the male-female type in the two opposite vertical sides (115), for high lateral waterproofing between adjacent panels (10); said protection panel (10) being such that it simultaneously: insulates, drains, protects from water and from mechanical stresses and also enables the ventilation of said wall (20, 201) at the extrados.

2. Multi-layer protection panel (10) for basement walls (20) according to claim 1, **characterised in that** said ventilation channels (104) have, individually, section sizes of 5 mm x 5 mm, with a distance between centres between them of 40 mm; and wherein the indicated values are meant with a tolerance of +/- 20%; and wherein said ventilation occurs by means of pressure variation inside said channels (104); and wherein said ventilation also occurs at the back of said upper selvedge (107) being laid behind the underground wall (20, 201).

3. Multi-layer protection panel (10) for basement walls (20) according to claims 1 and 2, **characterised in that** said pocket (105) is 5 cm wider, with a tolerance of +/- 20%, with respect to the underlying layers (101,102,103) to protrude from one side as a lateral selvedge (111) and overlap in filtering continuity said pocket (105) of an adjacent panel (10).

4. Multi-layer protection panel (10) for basement walls (20) according to at least claims 1 and 2, **characterised in that** said first, second and third layer (101,102,103) have a width of 60 cm, net of said rabbet (109), with an overall thickness (S3) of 60 mm wherein said first layer (101, S1) is of 50 mm and the draining and filtering front layers (102,103, S2) are of 10 mm as a whole.

5. Protection system for basement walls (20), intended to thermally insulate, drain, protect from water and from mechanical stresses and also to ventilate at the extrados an underground room (20, 201,202); said system providing multiple multi-layer protection panels (10), identical and adjacent to each other, each of which comprises the following pre-coupled layers as a prefabricated element:

- a first layer (101) of the insulating type, facing said wall (20), consisting of a rigid plate of XPS with side rabbet;
- a second layer (102) of the draining type, consisting of a spacing membrane of the type of HDPE with a small thickness, embossed and

waterproof, which is frontally joined to said first layer (101) with the bosses (106) facing the ground (30);

- a third layer (103) of the filtering type, of a water-permeable geotextile which is frontally joined on the head of said bosses (106) to form a draining space in correspondence of the front face (117);

and wherein at the base of said wall there is a draining holed pipe (40) laid longitudinally at the lower end of said panels, in a housing of the draining type; and wherein said protection system is **characterized in that** it provides:

a) the laying of panels (10) having said first layer (101) of XPS with the back face (116) provided with ventilation channels (104) which are parallel to each other and arranged vertically at full height to be positioned behind the external surface (201) of the underground wall and create space for transpiration, which occurs by means of a natural pressure variation inside said channels (104); and wherein said second and third layer (102,103), joined to each other with the same dimensions as a draining and flexible membrane, have a width (L) equal to said first layer (101), that is to say, laterally aligned (115), and have, on the other hand, a greater height with respect to it (101, H) to form an upper selvedge (107) and a lower selvedge (108), in such a way as to protect the whole surface of the underground wall (20, 201) conveying the drained water downwards, in vertical continuity without joints, that is to say, directly up to said holed pipe (40);

b) a filtering pocket (105) open from the bottom, of geotextile, which is joined and partially superimposed to said third layer (103) of each panel (10) to drain said holed pipe (40), enabling its winding in combination with said lower selvedge (102,103, 108); said pocket (105) protruding from one side as a lateral selvedge (111) to overlap in filtering continuity said pocket (105) of an adjacent panel (10);

c) a continuous side rabbet (109) of the male-female type, in the two vertical sides (115) opposite to each other of the first layer (101) of each panel (10), in such a way as to obtain high waterproofing between adjacent panels (10);

d) a section (50) of the step-like type which joins and fixes at the head to said wall (20, 201), in horizontal continuity, the upper selvedges (107) of the adjacent panels (10, 109), being mounted at a depth (302) close to the ground level (301); and wherein said profile (50) and said selvedges (102,103, 107) protect frontally (117) and from above from water and from backfilling, and also enable said pressure variation on the back face (116), that is to say, behind the underground wall (20, 201);

e) a partial winding of said holed pipe (40) with said lower selvedge (108), from the back and towards the front, to longitudinally collect the drained water;

f) a partial winding of said holed pipe (40) with said filtering pocket (105), from the front and backwards, in such a way as to filter the ground and obtain internal space (112) above the pipe (40), facilitating drainage; and wherein said filtering pocket (105) acts in combination with said lower selvedge (108), partially overlapping it below the pipe (40);

g) a vertical taping (60) from the outside in correspondence of said rabbet (109, 115), at full height.

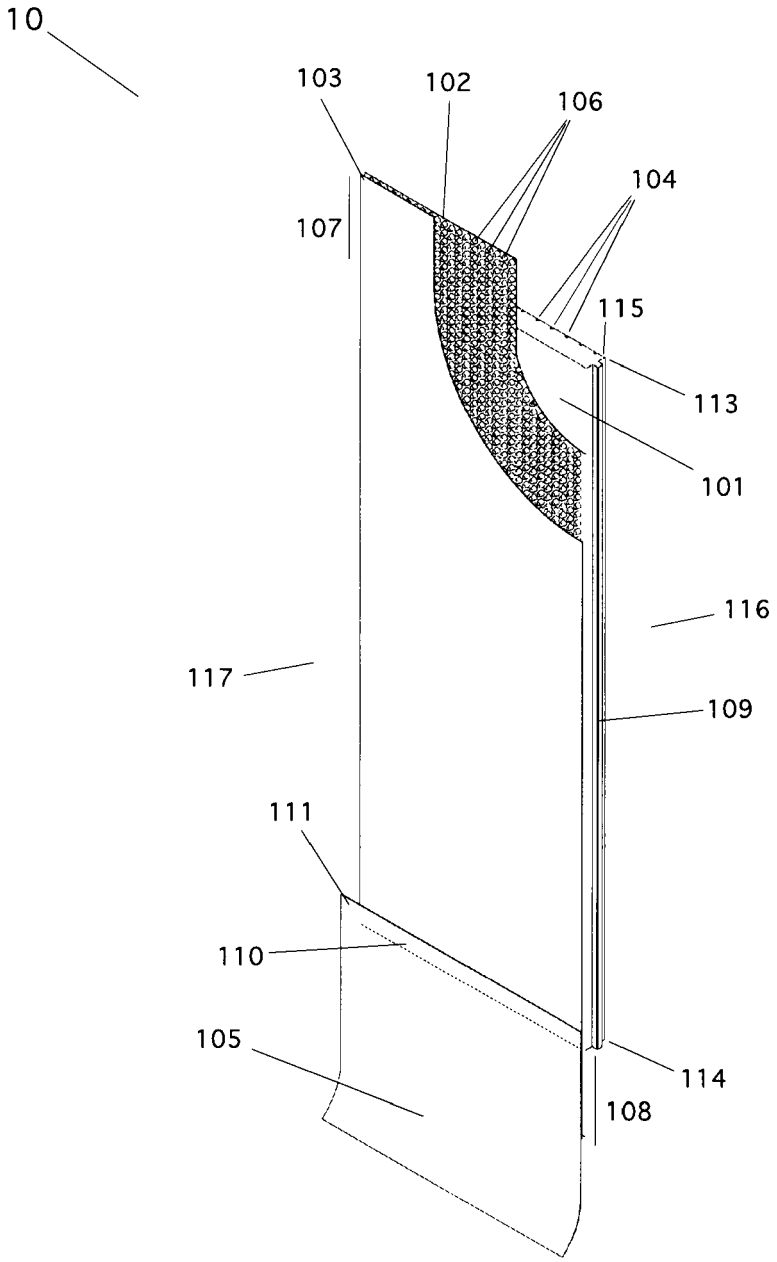
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Fig. 1

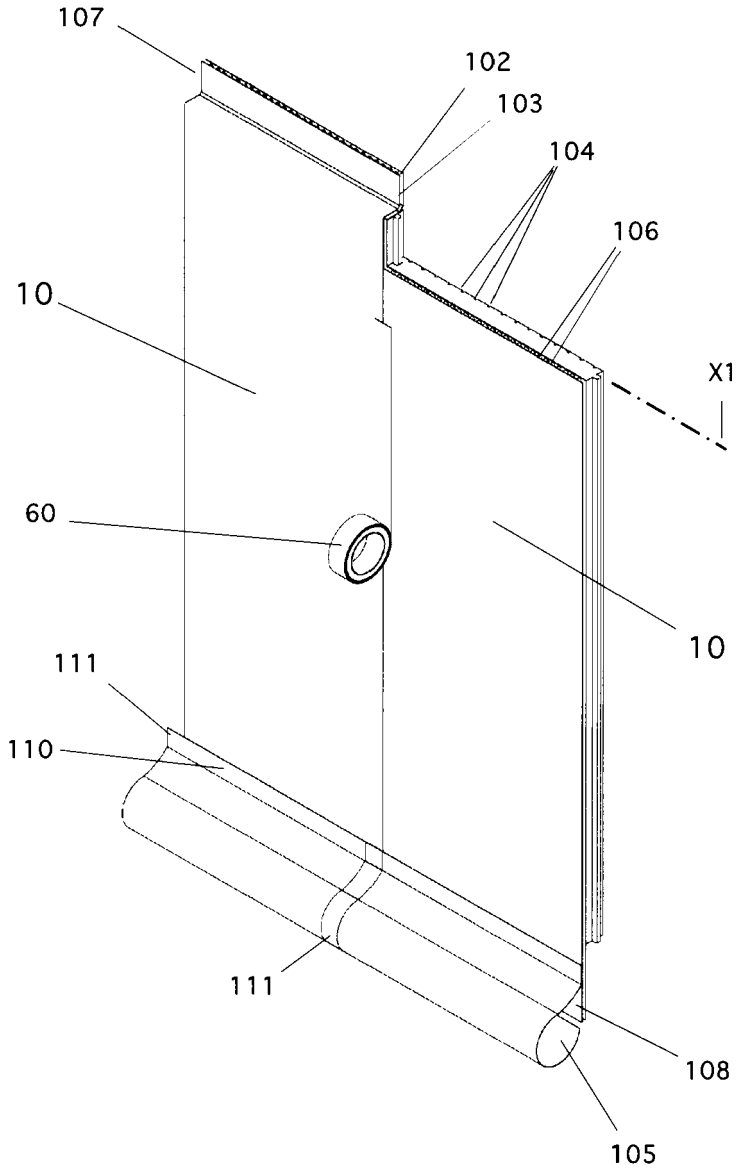

Fig. 2

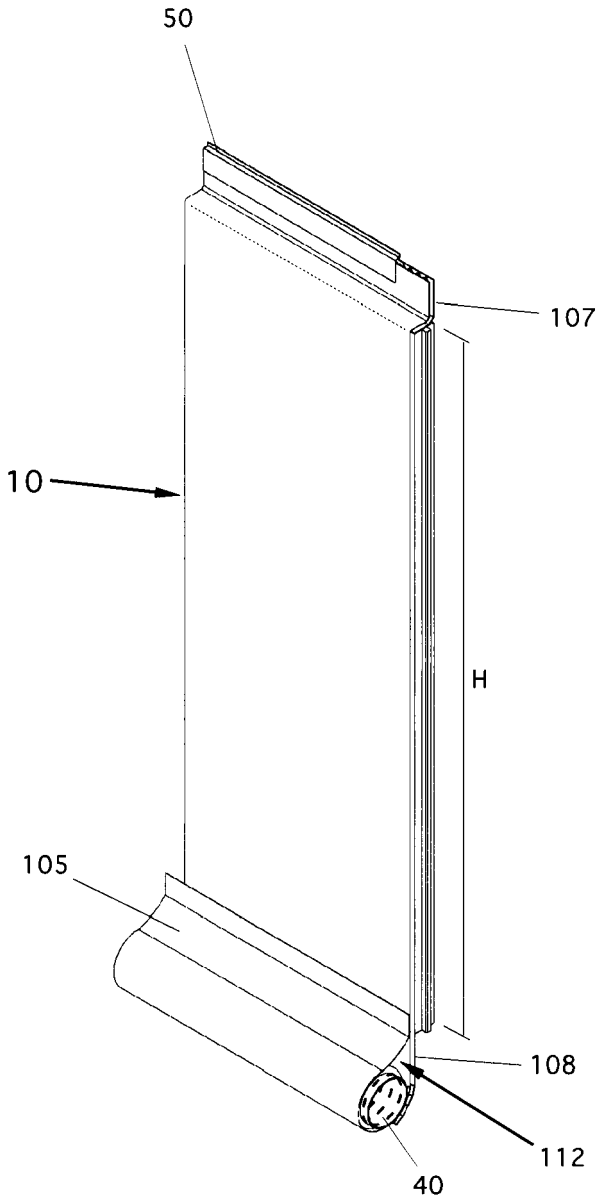

Fig. 3

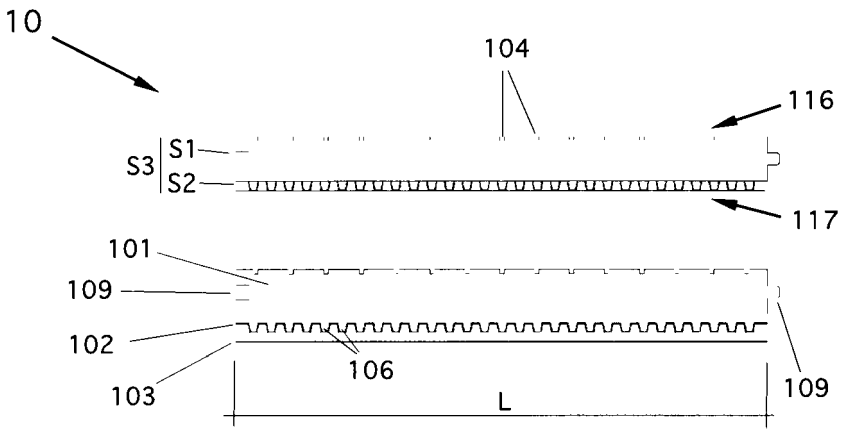

Fig. 4a

Fig. 4b

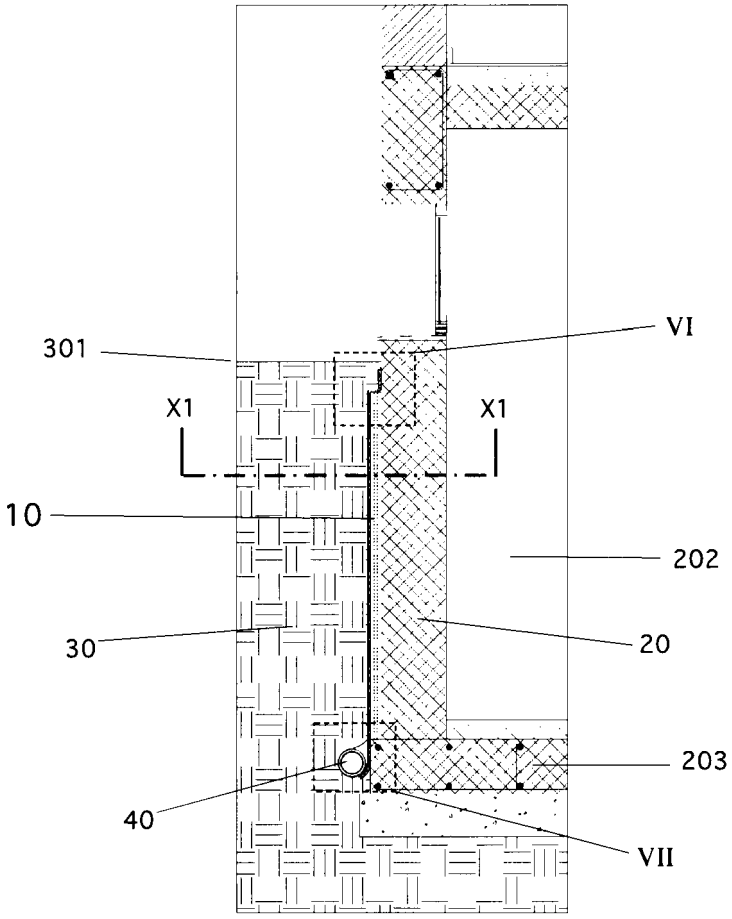

Fig. 5

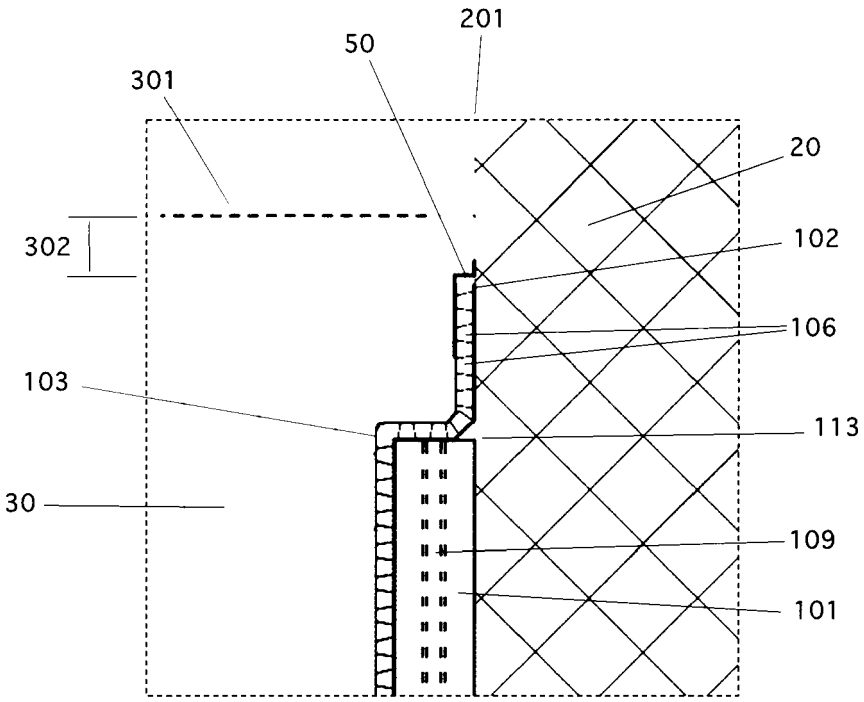
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Fig. 6a

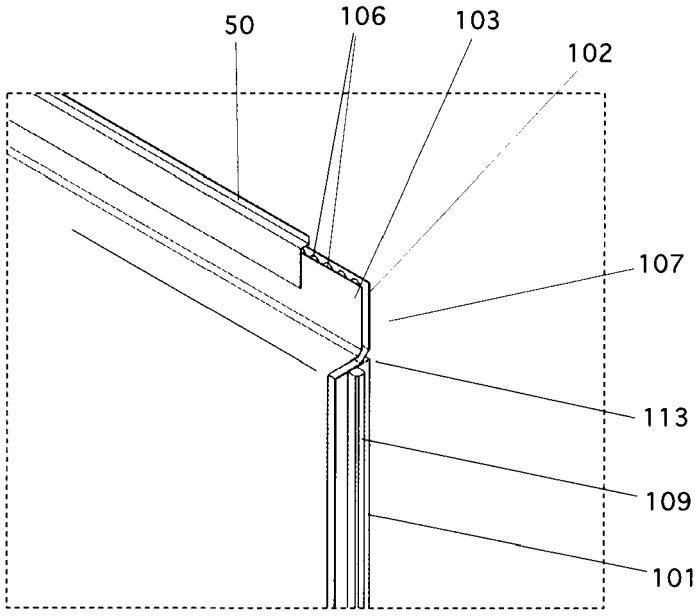
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Fig. 6b

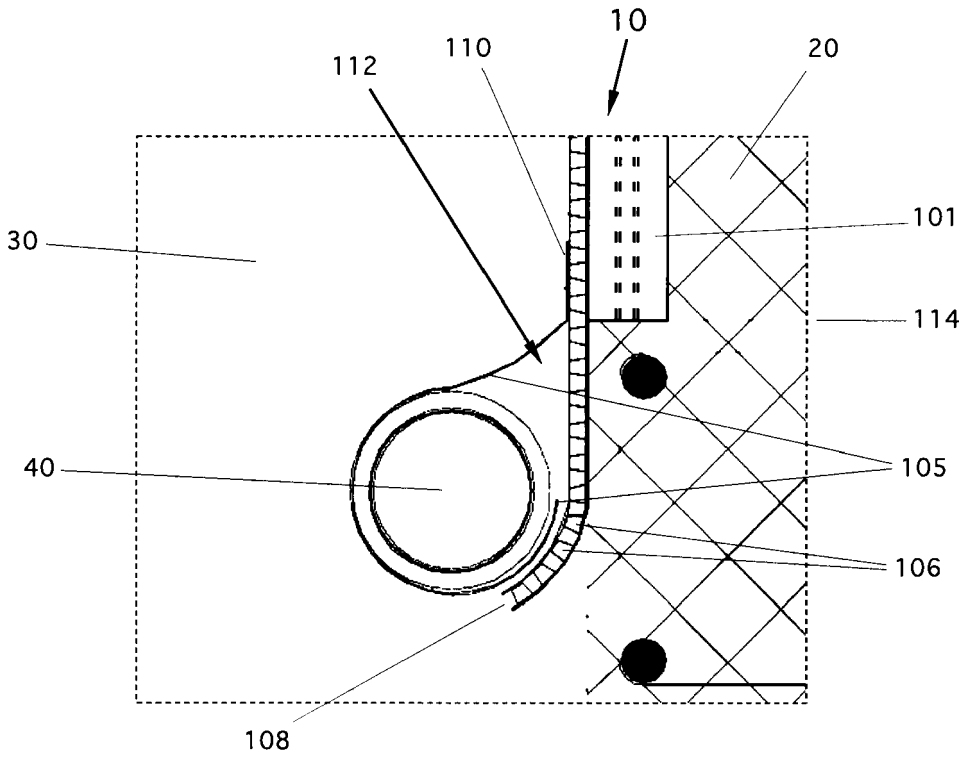
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Fig. 7a

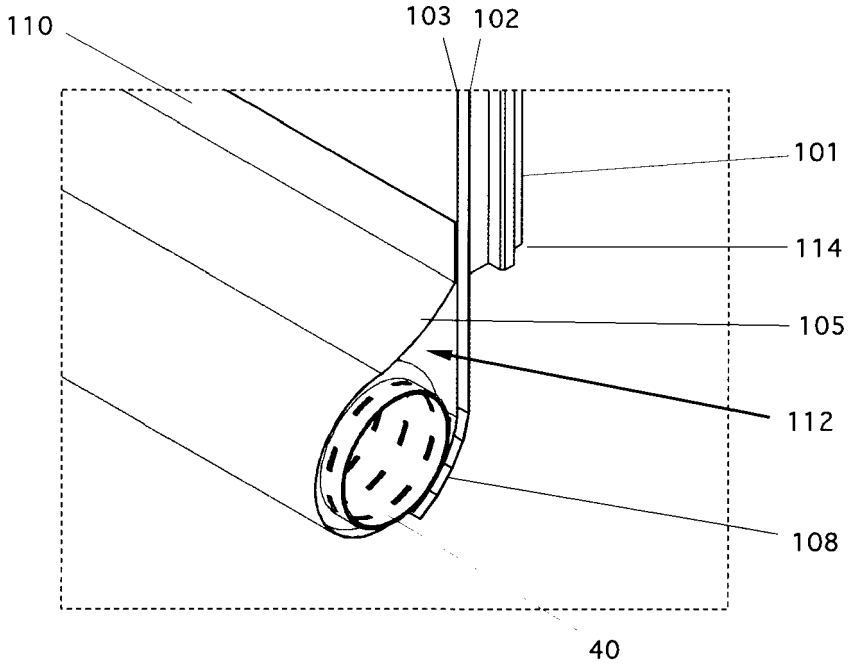
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Fig. 7b

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EUROPEAN SEARCH REPORT

Application Number
EP 17 00 1569

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	CA 2 183 376 A1 (GRAUL RUSSELL CHARLES [CA]) 16 February 1998 (1998-02-16) * page 4, line 1 - page 5, line 9 * * figures *	1	
A	US 4 704 048 A (AHLGRIMM JOHN [US]) 3 November 1987 (1987-11-03) * column 5, line 26 - column 9, line 61 * * figures *	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 January 2018	López-García, G

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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