(51) International Patent Classification:
E04C 2/52 (2006.01)        E04F 13/08 (2006.01)

(21) International Application Number:
PCT/IT20 11/000219

(22) International Filing Date:
27 June 2011 (27.06.2011)

(25) Filing Language:
English

(26) Publication Language:
English

(30) Priority Data:
TV2010A000992 29 June 2010 (29.06.2010) IT

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Declarations under Rule 4.17:
— as to applicant’s entitlement to apply for and be granted a patent (Rule 4.17(H))
— as to inventorship (Rule 4.17(iv))

Published:
— with international search report (Art. 21(3))
— with amended claims (Art. 19(1))

(54) Title: VENTILATED EXTERNAL INSULATION PANEL

(57) Abstract: A ventilated external insulation panel, for the migration and drainage of water vapour, wherein the face adhering to the walls to be covered is covered with grooves (STI) running vertically for the entire height of the panel, a regular grid of truncated-conical drainage holes (FI) covering the whole surface in contact with the wall, the thickness of the panel containing independent vertical ventilating and drainage channels (CAND) for the water vapour condensation perfectly aligned along the whole height of the panel and in direct communication, in their axis, with the drainage holes.

FIG. 2
This invention consists of a procedure for creating an external insulation panel covered, preferably but not exclusively, in exposed materials for aesthetic purposes.

This invention concerns a modular external insulation panel for creating the aforesaid ventilated cladding-insulation for walls.

It is technically known that the external perimeters of buildings are insulated by means of external cladding, or by applying glue on the contact surface between the panel and wall, with subsequent fixing using metallic inserts varying in numbers, diameter and type according to the technical data sheets of the manufacturers. The approximation is also known of the coupling of the single panels in their perimeter when the surfaces lack planarity or if the manual cutting of each single panel, due to the presence of windows and any other elements comprising a wall, is affected by the discretionary factor of the layer's sensibility and skill. The insulating capabilities of the external panels suffer from "weak" points in the joint areas, which influence the percentage of the "thermal" yield of the walls.

This in turn is influenced by the human component which is difficult to quantify. In any case, an accurate and extensive filling of all the joint lines between the panels, by means of thermal plaster or similar materials, reduces the loss of efficiency of the cladding, with significant costs, however, in terms of labour and materials, in the filling of the joint areas.

To present a surface that is up to standard, the finishing method of the external insulation
layers must include the spreading of at least two layers of skim plaster (including the connection and supply network in PVC) and one layer of plaster finish. The numerous surface finishes weigh heavily on the costs of external insulation coverings. It is known that water vapour generated in the rooms during the winter months and received from the outside during the summer months migrates in an invertible direction through the perimeter walls of buildings. In the cold months, when the water vapour does not find a suitable means of exit in the thickness of the walls, condensation may form which leads to the onset of mould and efflorescence that ruin the walls and impair the soundness of the environments. This is greatly increased in walls with poor sun exposure, or that are covered with external layers before an adequate period of drying, or worse still, if they are soaked with rain. To remedy this phenomenon, external insulation panels exist equipped with evenly distributed holes on the surfaces which favour migration of the vapours from the walls, through the panels, towards the outside. This type of solution is affected by the narrowing of the migration of the vapour that occurs on the outside of the panel in contact with the skim plaster and plaster finish, which obstructs the open channels of the panel due to the numerous layers applied and due to the different diameters of the drainage channels. Moreover, the holes present on the panels do not have a directionality associated to the force of gravity, i.e. in case of condensation in the thickness of the panel, the water does not find the "descending" channels which favour evacuation, but horizontal holes, and which in case of frost, can harm the durability and stability of the panels.

The coverings in exposed materials or composite materials for aesthetic purposes generally require the solid elements to be installed on a bed of mortar, which are filled at the same time as the wall is being built or after the covering has been completed. This has a great impact on the ceiling or horizontal structures supporting the weight of the exposed
solid materials of an average value of around 1300 daN/m³, as well as a long deposition period correlated to the skill of the layer, and to the perfect parallelism and/or verticality of the gaps, of the filling materials and the planarity of the surfaces built. Once again, the economic impact of the laying is a dominating factor in calculating the costs for creating a wall in insulating materials for aesthetic purposes, starting with the assumption that given the same corresponding figures, all the layers have the same level of preparation and professionalism in this specific field, something that we know is difficult to achieve.

A determining factor in the durability, at least in aesthetic terms, of the walls covered in natural materials is the resurfacing of capillary humidity at the foot of the walls that damages the surfaces due to the presence of efflorescence that if neglected and not corrected may even damage the stability of the entire wall. The restoration costs are high and the results are not always final.

Another important issue in "seismic" areas is the stability of the wall surfaces in the presence of earthquakes. The thinness of the coverings, especially in high walls exceeding two above-ground floors, is the weak element of exposed external coverings since they are not adequately anchored and secured to the supporting walls of the structure. Bracing methods now exist for external wall coverings that involve constraining in points, by means of metallic hooks, the covering outside the supporting walls, but without any continuous evenness on the entire surface covered. This can cause collapses due to the resonance of the wall surface because it is anchored in points and, therefore, weak between each point, and because there is no possibility for pre-tensioning the connection hooks between the walls because they are simply anchored to the mortar bed of the internal and external walls for each course or unit of laying surface. The construction costs and times of this type of solution are easy to estimate.
There are also prefabricated panels in polyurethane covered externally in exposed brick battens where the insulation and bricks are joined by gluing the polyurethane material on regularly distributed and designed battens in pre-arranged brickwork. The panels are anchored to the wall with glue and metal anchors. This solution has the same problem of the perimeter joint zones between one panel and another and requires the battens to be manually glued in the joint zones because the panels do not have finger-joints like exposed bricks. As demonstrated by the state of the art, the insulation properties of the polyurethane panels gradually deteriorate over time due to oxidisation and UV solar rays, this is why most external coverings are made with polystyrene whose special properties do not change over time. Combined systems exist where rigid insulation panels of various thicknesses are laid in relation to the maximum transmittance to be obtained in the planned wall, together with exposed brick or external stone cladding secured with the aforementioned hooks. However, this does not solve the problem of stability of the coverings in seismic areas, nor the impact of the weights on ceilings, least of all the permeability to vapour because they are not completely ventilated, nor the node of rising humidity, loss of continuity of the insulation when panels are joined in succession.

In the Dutch industrial patent **WO 2009/061185 A1**, air is used as a vehicle to ventilate walls or ceilings and consequently all the channels have spaces, diameters and connections functional to its movement. The problem with this type of system is that it does not account for the water vapour which deteriorates the wall structures and soundness of the buildings, for which a sufficient number of truncated-conical horizontal holes are not installed which guide, by the force of gravity, the water condensation to vertical drainage channels, which in turn, convey the liquid collected (water) downwards to the discharge outlets at the bottom of the wall. This Dutch invention, furthermore, has the limitation that
the ventilation system is based on the functioning of valves that, depending on the time of
day or season (summer or winter), open and close in combinations defined by tabular
instructions and that must be controlled by automatic systems, computers, sensors, or
manually. The WO 2009/061185 A1 system has the drawback of not being able to
disregard seasonal or daytime adjustments (automatic or manual) of valves and complex
systems that inevitably require periodic maintenance and checking of functionality and
efficiency because they are not based on natural principles of hygrometry and air
psychometrics, for which it can move through the walls, due to natural variations in
environmental pressure and temperature that to not require any form of automatic control
or mechanical forcing with evident energy savings and no need for periodic controls. This
invention (WO 2009/061185 A1) also has the drawback that if the valve system blocks
when completely opened or closed, it would produce, in the first case, a continuous
dispersion of internal heat from the building in the winter season, and in the second case, a
complete interruption of the ventilation during the summer months with the consequent
rising of the temperature inside the building. Furthermore, the Dutch industrial patent WO
2009/061185 A1 defines a "system" for constructing ventilated walls or ceilings with the
penalising factor that a building must be built right from its foundations with this method,
and must be applied to the entire edifice for guaranteeing its complete functionality, without
the possibility for partial or localised applications unless the wall and/or ceiling is
demolished and rebuilt. Moreover, the system is not an element that can be industrialised
or mass produced, but a construction method that can only be implemented when building
new prefabricated edifices.

None of the aforementioned methods for constructing insulating walls covered in exposed
materials for aesthetic purposes adequately fixes the problem of a correct and complete
ventilation of the walls without invalidating the level of anchoring, thickness of insulation,
perfect installation and planimetric distribution of the exposed coverings and speed of laying and production.

This invention aims at providing a procedure for producing an external insulation panel that is modular, ventilated, insulating and preferably but not exclusively, covered with exposed materials for aesthetical purposes, which does not present the problems of the frontal technique reported above.

This invention also aims at creating a procedure for manufacturing a similar insulation-covering-ventilation panel that can be produced on an industrial scale and that, once formed, is easy to transport like a common external insulation panel, and extremely easy to install, secure and fill, and whose insulation and ventilation properties remain unaltered on the entire surface covered, without any solution of continuity in the joining of the panels, which allows obtaining a perfectly covered surface with insulating materials with normal horizontal and vertical gaps, which favour the constant and continuous drying of the walls in the presence of ventilation channels on the whole area.

Another aim of this invention is to create a panel that does not have functional limits, that is not equipped with any kind of mechanical, automatic, electronic or manual adjusting system, and that functions by principles of "natural physics" exclusively dependant on the weather conditions and on the operating temperature maintained inside the buildings.

Purely by way of a non-limiting example, below is a description of a special form of implementing the procedure to create the panel in question, making reference to the attached figures, including:

- figure 1 is a plan view with relative section of semi-panel defined as "A" according to this invention facing the wall;
- figure 2 is a plan view with relative section of the semi-panel defined as "A" according to this invention facing towards semi-panel "B";
• figure 3 is a view plan with relative section of the semi-panel defined as "B" according to this invention facing towards semi-panel "A";

• figure 4 is a view plan with relative section of the semi-panel defined as "B" according to this invention facing towards the external covering;

• figure 5 is a perspective view of semi-panel "A" seen from the laying side towards the wall;

• figure 6 is a perspective view of semi-panel "A" seen from the internal side of the union with semi-panel "B";

• figure 7 is a perspective view of semi-panel "B" seen from the internal side of the union with semi-panel "A";

• figure 8 is a perspective view of semi-panel "B" seen from the gluing side of the external covering battens;

• figure 9 is a perspective view of the coupling phase of two or more complete panels;

• figure 10 is a perspective view of the final coupling phase of a discrete number of complete panels;

As mentioned, according to this invention, with reference to the figures, the semi-panel defined as "A" (e.g. the one shown in figure 1) is joined to semi-panel "B" in figure 2 by gluing the coupling faces FA1 and FB1 suitably shaped and complementary to each other.

It should be noted that face A2 of panel "A" has grooves with triangular section ST1 extended along its entire height which contain, in a regular grid, truncated-conical conveying holes F1 that drain the water vapour and any liquid from the wall to the ventilation channel of the panel.

Face FA1 of semi-panel "A" is equipped with flanges AL1 along the entire height that insert into the corresponding groves on Face FB1 of semi-panel "B", upon spreading of the
adhesive glue on the grooves of face FB1, which after being pressed to secure the panels, guarantees that the adhesive glue is maintained in watertight compartments without any discharge to obstruct the ventilation channels.

Figure 9 clearly shows the presence of the ventilation channels CAN1, perfectly aligned along the entire height of the panel, together with the truncated-conical drainage holes F1. As shown in figures 1 to 10, the perimeters of semi-panels "A" and "B" are equipped with a complementary rebate (BAT1) in the finger joints and height joints. The external face of semi-panel "B" is equipped with pilasters L1 that act as laying guides for the battens of the exposed covering materials. The perfect coupling between several panels guarantees the correct levelling of the battens and subsequently, of the gaps and entire wall.

On completion of the execution phases of the panel, the vertical ventilation channels passing through the entire height of the panel is evident to any observer or expert, even when a number of panels are aligned. It is also evident that the contact surface between the panel and laying wall contains the drainage holes for the water vapour and any liquid, orthogonal to the vertical ventilation channels. The holes have a truncated-conical section directed towards the ventilation channels to guarantee outflow, by gravity, of any type of liquid or vapour generated or exiting from the walls. Grooves are also evident along the entire height of the panel (on the face in contact with the anchoring wall) to accommodate and compensate for any excess glue used to secure the wall of the panels with the metallic wedges, and for conveying any surface liquid towards the ground and for guaranteeing a micro-ventilation of contact exactly on the laying line between the existing wall and the panel composed.

It should be noted how the panels have a finger finish in a longitudinal direction, corresponding to the "half measure" layout of the battens of any exposed covering
material, without the need, both horizontally and vertically, to manually add battens for completing the architectural composition;

All the panels have battens along the perimeter to guarantee perfect surface continuity of the insulation even in the joining areas; in particular, the battens in the vertical overlapping areas are male-female on "L" sections, as are those in the horizontal overlapping areas.

It is evident how the theme of the batten and spatial continuity of the insulation was also resolved in the finger joints that result to be perfectly secure and impenetrable.

The glue used to assemble the two semi-panels "A" and "B" is not visible and cannot be found in any way in the panels because it is spread on watertight and compensating compartments that do not allow it to exit. This also guarantees continuity without any reduction to the section due to the presence of glue, of the ventilation channel along the entire height of the panel and consequently, the wall.

The external exposed part of the panel, the part that can be covered in battens of cladding materials, is perfectly uniform in terms of vertical and horizontal gaps, and the finger joints are not legible after several panels have been assembled. The panels maintain perfect geometric regularity in the distribution of the covering battens, both horizontally and vertically of any type of flat wall.

It is also evident that the resistant sections of the insulating panels, in the finger joint zones, are increased and distributed in such a way to guarantee all the special characteristics of the panel (ventilation, insulation, etc.) without any deterioration of the mechanical resistance in the finger joints, which are considered cantilevered elements and therefore more fragile, both in the storage, transport and securing phases.

In this panel, the element that migrates between the inside and outside of the building is the water vapour for which a corresponding number of truncated-conical horizontal holes "F1" were prepared that guide, with the force of gravity, the condensation water to the
vertical draining channels "CAN 1", which in turn, once again by force of gravity, convey the liquid collected (water) down towards the discharge outlets at the foot of the walls. The vertical channels "CAN 1" have a triple function of: 1 - conveying to the ground any condensation of water vapour present in the walls; 2 - ventilating and drying the insulation panel regardless of the drainage to which it is subjected, guaranteeing better durability over time; 3 - ventilating the panel, mainly in the summer months, in order to cool it and reduce the quantity of heat accumulated, actually removing it from the walls of the building that "naturally" maintain a constant temperature without increases due to the sun's rays.

According to this invention, the procedure for creating the panels consists of the following phases: inject the polystyrene on the pre-constructed metallic formwork in order to form the external portion of the modular panel defined as "A", after arranging the rosettes for securing the regularly distributed panels to the wall;

1. Inject the polystyrene on the pre-constructed metallic formwork in order to form the internal portion of the modular panel defined as "B", with a thickness varying in relation to the level of insulation that the panel must guarantee;

2. Apply a layer of glue in the hollow areas inside panel "B" for securing semi-panels "A" and "B";

3. Combine semi-panels "A" and "B" according to the only possibility of joining between the hollow zones of semi-panel "B" and the fins protruding from panel "A", until the parts are perfectly joined;

4. Pass the rollers through the panels at a pre-fixed distance to guarantee that the parts are perfectly secured and the adhesive glue is evenly spread;

5. Pass on mobile tracks the panels packed with the grooved face, after covering them with battens of exposed covering materials towards the top, in order to spread the panel-batten adhesive glue;
6. Spread the battens in exposed covering materials on the polystyrene panel, in the appropriate grooves in module and final passing from the panel geometry;

As an expert in the sector knows, the procedure to create a panel according to this invention can be easily produced on an industrial scale, with consequent high manufacturing precision, reduced production times and costs. Furthermore, as illustrated here, once created, the panel can be easily moved without the need for special precautions or for disassembling some of its parts.

This panel can be applied in different conditions and on various types of walls, with all the accessories and technical specifications for the laying supplied. It can be installed on buildings of any height and has been subjected to mechanical tests of resistance, tear and cutting, as well as cyclical thermal stress which confirmed its outstanding qualities of durability and insulation, regardless of the climatic zone of application and thermal stress it is subjected to.
CLAIMS

1. Ventilated external insulation panel, for the migration and drainage of water vapour, based on basic principles of hygrometry and psychometrics of air, without the use of complicated mechanical, electrical or manual systems, **characterised** by the fact that the face adhering to the walls to be covered is covered, preferably but not exclusively, with grooves running vertically for the entire height of the panel (ST1 - fig.5) and by the fact that a regular grid of truncated-conical drainage holes (F1 - fig.5) covers the whole surface in contact with the wall (F1 - fig.5) and by the fact that its thickness contains independent vertical ventilating and drainage channels for the water vapour condensation (CAN1 - fig.9), perfectly aligned along the whole height of the panel and in direct communication, in their axis, with the drainage runoffs.

2. Ventilated external insulation panel, as per claim 1, characterised by the fact that the grooves (ST1 - fig.5) can have a triangular section with a vertex in the direction of the drainage holes.

3. Ventilated external insulation panel, as per the above claim, characterised by the fact that its entire perimeter contains complementary rebates (BAT1- fig.7 e fig.8) in the finger joints and in the height joints.
1. Ventilated external insulation panel, for the migration and drainage of water vapour, based on basic principles of hygrometry and psychometrics of air, without the use of complicated mechanical, electrical or manual systems. Its thickness contains independent vertical ventilating and drainage channels for the water vapour condensation, perfectly aligned along the whole height of the panel and in direct communication, in their axis, with the drainage channels. The panel is characterised by the fact that the face adhering to the walls to be covered is covered, preferably but not exclusively, with grooves running vertically for the entire height of the panel and by the fact that a regular grid of truncated-conical drainage holes covers the whole surface in contact with the wall.

2. Ventilated external insulation panel, as per claim 1, characterised by the fact that the grooves can have a triangular section with a vertex in the direction of the drainage holes.

3. Ventilated external insulation panel, as per the above claim, characterised by the fact that its entire perimeter contains complementary rebates in the finger joints and in the height joints.
**INTERNATIONAL SEARCH REPORT**

**PCT/IT2011/000219**

**A. CLASSIFICATION OF SUBJECT MATTER**

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**ADD.**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**EPO-Internal**

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
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<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
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**Further documents are listed in the continuation of Box C.**

| X | See patent family annex. |

* Special categories of cited documents:
  * "A" document defining the general state of the art which is not considered to be of particular relevance
  * "E" earlier document but published on or after the international filing date
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**Date of the actual completion of the international search**

13 September 2011

**Date of mailing of the international search report**

21/09/2011

**Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016**

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