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(54) **Vékony, reflektáló hőszigetelés tetők alá**

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

THIN REFLECTIVE INSULATION FOR ROOF UNDERLAY

The invention relates to reflective thin flexible thermal insulation which can be used in the form of a leaf or sheet for all types of buildings, and is suitable both for new works or refurbishment works, in particular in order to improve old insulation which is kept in place.

Thermal insulation of this type has existed for some years, and makes it possible in particular to contribute to the thermal insulation of the walls, because of the low hemispheric emissivity of the reflective surfaces associated with non-ventilated air gaps.

This thermal insulation in each case comprises reflective outer cladding constituted by metal sheets or metallized plastic sheets which are totally impermeable to water and have very high resistance to the passage of water vapour.

When this insulation is used as a complement to preserved existing thermal insulation, which is very often the case during refurbishment works, and is placed on the outer side ("cold side") of a building wall which overlooks the exterior, the humidity which is contained in the inner volume of the building can no longer be discharged. This humidity is then liable to accumulate on the inner face of this reflective thin installation because of the greater permeability to water vapour of the inner partitions, of the existing thermal insulation, or in certain cases in the absence of a vapour barrier. Thus, in certain circumstances of temperature and humidity, fine droplets of water can form in contact with the reflective thermal insulation (dew point) and drop back towards the interior of the building, in particular onto the layer of preserved thermal insulation, or onto the bearing structure, which, in the long term, is liable to generate significant structural deteriorations.

In order to avoid the above-described disadvantages, this reflective thin flexible thermal insulation is therefore positioned on the inner side of a building, acting as a vapour barrier, which excludes it from use for refurbishment work from the exterior.

In addition, studies carried out in the main European laboratories have shown that the intrinsic thermal insulation performance of this insulation was limited to its thickness (R in m^2.K/W of between 0.30 and 0.90 m^2K/W) but that the thermal resistance R in m^2.K/W (square metre. degree Kelvin per watt) of the wall in which it is installed increases (R between 0.80 and 1.20 R m^2.K/W) when it is associated with inert air gaps. However, the global thermal resistance R of these walls does not make it possible to fulfil the insulation demands required by the thermal regulations in force in most European countries. Consequently, this reflective thin flexible thermal insulation can be used only as a complement.

The objective of the present invention is in particular to provide a thermal insulation of the type previously defined which makes it possible to avoid the disadvantages previously referred to, and which can be used as a complement to preserved thermal insulation in place, by being installed from the exterior without creating detrimental condensation both on the vertical wall and on the roof.

In this configuration, the insulation also provides the functions of a flexible roof underlay screen with high permeability to water vapour (H.P.V. screen).

The application of the invention relates in particular to use in a roof for application from the exterior above a framework which acts as a support for it.

According to the invention, the reflective thin flexible thermal insulation is characterized in that it comprises at least three elements constituted by breathable reflective inner and outer cladding separated by an interposed layer constituted by a mat which is open to the passage of the water vapour, the two inner and outer claddings being different and being constituted by a breathable reflective cladding which is impermeable to water situated towards the exterior, and a breathable cladding which is not impermeable to water and faces towards the interior of the building (warm side).

The term "breathable" designates a cladding which is permeable to water vapour, but which can be impermeable to water, in particular in the form of drops of water.

Preferably, the reflective thin flexible thermal insulation has cladding, the reflectivity of which is sufficient to return part of the thermal infrared radiation which it receives on each of the faces.

In summer, the thermal infrared radiation which is obtained from the roofing is reflected into a ventilated air gap which is provided between the roofing and the thin insulation, thus permitting a substantial reduction of the solar factor of the roofing, and improving the comfort of the occupants of the building in summer, and therefore preventing overheating of the interior volume.

In winter, the thermal infrared radiation obtained from the heated interior is reflected towards the habitable volume situated below, thus contributing towards limiting the thermal losses.

Advantageously, the outer cladding of the reflective thin insulation has spectral mean hemispheric emissivity ε, generally of 0.1, but preferably less than 0.02 measured in the wavelength band of between 3 μm and 25 μm for a temperature of between 20°C and 60°C. The mean reflectivity is a minimum of 90%, and preferably more than 98% of the total energy received.

The outer cladding of the thermal insulation can be constituted by at least one sheet which is impermeable to water, with significant permeability to water vapour, characterized by a permeation value W expressed in $kg/m^2.s.Pa$ (kilo per square metre.second. Pascal) of between 1.10^{-8} and 1.10^{-9} $kg/m^2.s.Pa$, i.e. an equivalent air height defined by the value Sd expressed in metres of between 1.10^{-2}m and 20.10^{-2}m.

The sheet can be obtained from interlaced synthetic fibres with minute "micrometric spaces" between the fibres which permit the passage of water vapour molecules, whilst remaining impermeable to water.

Advantageously, this sheet has a thickness of between 100 μm and 300 μm, and a mass surface density of between 50 g/m^2 and 120 g/m^2. The sheet can be obtained from synthetic material fibres based on polyethylene, or any other synthetic material with similar properties.

According to another embodiment, the sheet which is impermeable to water can be constituted by a very fine microporous layer in the form of a film containing porous micro-particles of lime silicate or any other similar porous material, the thickness of which is generally between 10 μm and 40 μm, with a mass surface density of between 10 g/m^2 and 40 g/m^2.

According to another variant, the sheet is constituted by a permeable membrane of a chemical nature known as hydrophilic.

Advantageously, the above-described sheets which are impermeable to water constituting the cladding of the thin insulation are made slightly emissive by an appropriate treatment of one of the faces of these sheets consisting of depositing under vacuum of a layer of fine metal particles protected by a specific transparent lacquer, in order to prevent rapid oxidation of their surface, which would reduce the reflectivity of the surface, whilst retaining their permeation.

According to a first variant, the reflective outer cladding of the insulation comprises two slightly emissive treated faces.

According to another embodiment, the outer cladding of the thin insulation is a composite sheet comprising a first reflective sheet with very low emissivity, and a second sheet impermeable to water of the above-described type, but not comprising any treatment, in order to make it slightly emissive.

In a first example, the reflective sheet of the above-described composite sheet is a reflective metal sheet, which in particular is made of aluminium or any other metal with reflective properties similar to those of aluminium.

Advantageously, this metal sheet is reinforced by complements which are associated by adhesive bonding or any other equivalent means which have the purpose of providing this metal sheet with mechanical properties.

According to a first arrangement, the metal sheet is associated with a transparent multilayer reinforced plastic film.

According to a second arrangement, the metal sheet is associated with a reinforcement such as a plastic mesh, the warp threads and weft threads of which are suitably distributed in order to optimize their performance.

According to a third arrangement, the reflective metal sheet is associated with a reinforcement constituted by a non-woven film of synthetic fibres.

In a second example, the reflective sheet of the above-described composite sheet is constituted by a reinforced multilayer reflective film.

This reinforced multilayer reflective film is composed of a first layer forming one of the claddings, constituted by a plastic film which has received on one of its faces a deposit under vacuum of fine metal particles, and by a second layer forming the other cladding, constituted by another, transparent film.

Between these layers, a reinforcement consisting of a mesh made of plastic material is inserted in order to provide this reflective film with the required mechanical properties.

The claddings and the reinforcement are fitted to one another by means of a layer of adhesive extruded between the two claddings and the reinforcement; whilst the extruded film is still molten, pressure exerted on both sides by a calender ensures the adhesion and final assembly.

As a variant, the second layer which forms the other cladding, and the reinforcement can be replaced by a non-woven film of synthetic fibres with mechanical properties similar to those of the plastic mesh.

The plastic materials which are used for the plastic films constituting the claddings, the mesh or the non-woven film of synthetic fibres, are composed of common polymers such as polyester, polyethylene, polypropylene, or any other polymer with similar properties used alone or in combination.

A reinforced multilayer reflective film of this type has a total thickness of between 60 and 200 µm, preferably 170 µm, and a mass of between 60 and 250 g/m^2, and preferably 170 g/m^2.

The reflective sheet of the composite sheet according to any of the above-described embodiments has breaking strength in traction measured according to standard EN 12 311-1 greater than 300 N/5 cm, irrespective of the direction of traction (longitudinal or transverse), and resistance to tearing (nail shank) measured according to standard EN 12 310-1 greater than 250 N, irrespective of the direction of traction (longitudinal or transverse).

The reflective sheet which constitutes the outer part of the composite sheet of the outer cladding of the insulation according to any one of the above embodiments is naturally impermeable to water and to water vapour. In order to make it compatible with the required usage, it is made permeable to water and to water vapour by an appropriate specific treatment.

This specific treatment, carried out by any appropriate electrical or mechanical means, consists of perforating this reflective sheet with a multitude of holes distributed uniformly over all of its surface, thus permitting the passage of the water vapour. These holes, the diameter of which is generally between 0.1 mm and 1 mm, and preferably 0.5 mm, represent approximately 3% of the total surface area of the reflective sheet.

The perforation of this reflective sheet leads to permeation W which is at least equal to, but preferably greater than that of the sheet permeable to water vapour and impermeable to water to which it will be secured in order to form the composite sheet which constitutes the outer cladding.

In order to form this composite sheet which constitutes the outer cladding of the thin insulation, the reflective sheet produced according to any one of the above versions is associated after perforation, by adhesive bonding, adhesion, welding, or any other similar means which does not block the holes, with a sheet which is impermeable to water but permeable to water vapour, of the above-described type, and the outer cladding thus constituted is thus impermeable to water and permeable to water vapour.

According to a preferred embodiment, the above-described composite sheet will have a reflective sheet selected from amongst the versions described, with a cladding or a reinforcement made of non-woven fibres which permits better distribution of the diffusion of the water vapour between the sheet which is impermeable to water and the pierced reflective sheet.

According to a preferred embodiment, the inner reflective cladding of the thin insulation is constituted by a reflective sheet selected from amongst any one of the versions described for the reflective sheet which constitutes the composite sheet of the outer cladding.

According to a first embodiment, after being pierced, the reflective sheet is assembled on the interposed layer which forms the mat by means of adhesive bonding, ultrasound welding, or any other similar means.

According to a second embodiment, the reflective sheet is not pierced, and is therefore totally impermeable to water.

According to the preferred assembly mode, the reflective sheet is secured on the flexible interposed layer by needling, knitting, or any other equivalent mechanical assembly, leading to it being pierced by a multitude of holes, thus making this sheet not impermeable to water and to water vapour.

Consequently, irrespective of the mode of assembly on the intermediate layer, the reflective sheet will be able to constitute only the breathable inner cladding which is not impermeable to water of the thin insulation facing towards the interior of the building (warm side).

The hydrophobic flexible interposed layer, situated between the claddings, forms a separator, the main function of which is to maintain a constant distance between the claddings. As a secondary function, this interposed layer has thermal insulation properties which can reduce the thermal conduction of the reflective claddings.

This interposed layer can:

- according to a first example, be constituted by a mat of synthetic fibres which have received a hydrophobic treatment, and are bonded to one another by adhesive bonding or by mechanical means such as needling, sewing, or by thermal means, or by any other equivalent means in order to form a three-dimensional network; or
- according to a second example, be constituted by an open-cell expanded foam made of a synthetic material such as polyethylene, polyester, polyurethane, or any other equivalent synthetic material; or
- according to a third example, be constituted by natural fibres such as glass wool or rock wool, or fibres of animal or vegetable origin.

Advantageously, this interposed layer has a thickness of between 5 mm and 20 mm, the mass surface density being between 100 and 1,000 g/m.

The reflective thin flexible thermal insulation has a coefficient of thermal conductivity λ which is at the most equal to 0.04 W/m.K (watts per metre.degree Kelvin).

Irrespective of the production mode, the thin insulation can comprise an adhesive strip which is incorporated on the surface, positioned in the area of overlapping of the widths, on one of the longitudinal edges, and protected by a peelable coating, in particular made of paper or film, which will be removed during the installation of the widths of insulation.

The invention also relates to building roof insulation with insulation as previously defined, characterized in that the thin insulation is designed to form an inert air gap above a layer of insulation, whilst being continuous at the crest of the roof, and folded back vertically at its lateral ends against the layer of insulation.

Apart from the above-described arrangements, the invention consists of a certain number of other arrangements which will be dealt with explicitly hereinafter with reference to particular embodiments which are described with reference to the appended drawings, but are in no way limiting. In these drawings:

figure 1 is a schematic view in partial vertical section of a roof with a reflective thin sheet of insulation according to the invention;

figure 2 is a vertical cross-section on an enlarged scale of a portion of reflective thermal insulation according to a first embodiment of the invention;

figure 3 is a vertical cross-section on an enlarged scale of a portion of reflective thermal insulation according to a variant of the first embodiment of the invention;

figure 4 is a schematic vertical cross-section on an enlarged scale of an example of a reflective composite sheet for the outer cladding;

similarly to figure 4, figure 5 shows another example of a reflective composite sheet for the outer cladding;

similarly to figure 4, figure 6 shows another example of a reflective composite sheet for the outer cladding; and

similarly to figure 4, figure 7 shows yet another example of a reflective composite sheet for the outer cladding.

Figure 1 shows a roof T comprising sloping rafters C on which there are laid out widths 1 of a reflective thin flexible thermal insulation I. The widths overlap for example at their edges parallel to the direction of being put into place, orthogonal to the line of the greatest slope of the roof. As a variant, the widths can be oriented with their largest dimension parallel to the line of the greatest slope, and the edges which overlap are then parallel to this line.

The insulation I comprises at least three elements I1, I2, I3 constituted by an outer cladding I1 and an inner cladding I3, which are separated by an interposed layer I2 constituted by hydrophobic fibres, open to the passage of water vapour.

Counter-laths d which are arranged above the insulation I along the rafters C are used to secure the insulation I on the rafters by nailing. Batons j orthogonal to the line of the greatest slope are secured parallel to one another on the counter-laths d, and permit coupling of the roof elements 2, for example tiles or slates.

A ventilation air gap A is thus formed between the upper face of the insulation I and the roof. The height h (figure 1) of this air gap A corresponds to the height of the counter-lath d. The air gap A opens out in the low part above the gutter G, and in the high part it communicates with the outer atmosphere.

A layer of thermal insulation 3, for example a layer of glass wool, is secured below the insulation I, spaced from it, such that a non-ventilated air gap B is provided below the lower face of the screen I.

The thin insulation can comprise an adhesive strip 4 which is incorporated on the surface, positioned in the area of overlapping of the widths, on one of the longitudinal edges, and protected by a peelable coating 5, in particular made of paper or film, which will be removed when the widths of insulation are installed.

The thin insulation I is continuous at the crest of the roof, and at its lateral ends it is folded back vertically against the layer of insulation 3 without a space liable to form a gap between the two vertical parts. The air gap B is inert, since it is closed at the high part and at the low part. It contributes to the thermal insulation.

The outer cladding I1 is reflective, and impermeable to water but breathable, i.e. permeable to water vapour. The inner cladding I3 is reflective, and breathable but not impermeable to water. Thus, the insulation I can be installed without problems from the exterior above the bearing structure C and the insulation 3, and below the roofing elements 2, for example during refurbishment of the roof. In fact the water vapour obtained from the interior of the building can pass through the insulation I which is

permeable to the vapour, such that there is no condensation of droplets of water which are detrimental to the layer of insulation 3.

Preferably, the reflective thin flexible thermal insulation I comprises, at least towards the exterior, a cladding I1 (figure 2), the reflectivity of which is sufficient for the insulation I to permit substantial reduction of the solar factor of the roof, thus improving the comfort of the occupants of the building in summer, and preventing overheating of the interior volume, and in particular of the roof timbers below the sloping roof.

Figure 3 shows a variant of the thermal insulation I, according to which each breathable reflective cladding I1, I3 has two slightly emissive faces m1a, n1a and m3a, n3a which are permeable to water vapour.

The claddings, I1, I3 have sufficient reflectivity to return part of the thermal infrared radiation which they receive on each of the faces.

In summer, the thermal infrared radiation obtained from the roofing is reflected into the ventilated air gap A (figure 1) provided between the roofing and the thin insulation I, which permits a substantial reduction of the solar factor of the roof, and improves the comfort of the occupants of the building in summer, by this means preventing overheating of the interior volume.

In winter, the thermal infrared radiation obtained from the heated interior is reflected towards the habitable volume situated below, thus contributing towards limiting the heat losses.

The outer I1 and inner I3 claddings of the reflective thin insulation advantageously have spectral mean hemispheric emissivity ε which is generally 0.1, but is preferably less than 0.02 measured in the wavelength band between 3 μm and 25 μm for a temperature of between 20°C and 60°C. The mean reflectivity is a minimum of 90%, and preferably more than 98% of the total energy received.

The outer cladding I1 of the thermal insulation can be constituted by at least one sheet L which is impermeable to water, with significant permeability to water vapour, characterized by a permeation value W expressed in $kg/m^2.s.Pa$ (kilos per square metre.second. Pascals) between 1.10^{-8} and 1.10^{-9} $kg/m^2.s.Pa$, i.e. an equivalent air height defined by the value Sd expressed in metres of between $1.10^{-2}m$ and $20.10^{-2}m$.

This sheet which is impermeable to water and permeable to water vapour can be constituted by synthetic fibres obtained from a polymer premixed with a solvent under high pressure and at a high temperature in order to form a paste which, according to a suitable process, is extruded through oscillating orifices into filaments which are deposited with a large thickness on a moving metal belt, these filaments then being bonded to one another by the pressure and heat provided by a calender in order to form a continuous sheet.

The sheet can be obtained from interlaced synthetic fibres with minute "micrometric spaces" between the fibres which permit the passage of water vapour molecules, whilst remaining impermeable to water.

Advantageously, this sheet has a thickness of between 100 μm and 300 μm, and a mass surface density of between 50 g/m^2 and 120 g/m^2. The sheet can be obtained from synthetic material fibres based on polyethylene, or any other synthetic material with similar properties.

According to another embodiment, the sheet L which is impermeable to water and permeable to water vapour can be constituted by a very fine microporous layer in the form of a film containing porous micro-particles of lime silicate or any other similar porous material, the thickness of which is generally between 10 µm and 40 µm, with a mass surface density of between 10 g/m^2 and 40 g/m^2.

According to another variant, the sheet L is constituted by a permeable membrane of a chemical nature known as hydrophilic.

The above-described production processes for the sheet L impermeable to water and permeable to water vapour which is the subject of the invention does not constitute any limitation to other methods which make it possible to obtain a sheet with similar properties.

Advantageously, the above-described sheets L which are impermeable to water constituting the claddings 11, 13 of the thin insulation I are made slightly emissive by an appropriate treatment of one of the faces of these sheets. This treatment consists of depositing under vacuum of a layer of fine metal particles protected by a specific transparent lacquer, in order to prevent rapid oxidation of their surface, which would reduce its reflectivity, whilst retaining their permeation.

According to a first variant (figure 3), two faces of the outer cladding 11 and of the reflective inner cladding 13 are treated in order to be slightly emissive.

According to other embodiments (figures 4 to 7), the outer cladding 11 of the thin insulation is a composite sheet comprising a perforated first reflective sheet 6 with very low emissivity, and a second sheet L which is impermeable to water but permeable to water vapour 7 of the above-described type. In a first example (figure 4), the reflective sheet 6 is a reflective metal sheet M, which in particular is made of aluminium or any other metal with reflective properties similar to those of aluminium.

Advantageously, this metal sheet M is reinforced by complements which are associated by adhesive bonding or any other equivalent means which have the purpose of providing this metal sheet with mechanical properties.

According to a first arrangement illustrated in figure 5, the metal sheet M is associated with a transparent multilayer reinforced plastic film 8.

According to a second arrangement (figure 6), the metal sheet M is associated with a reinforcement such as a plastic mesh 9, the warp threads and weft threads of which are suitably distributed in order to optimize the performance.

According to a third arrangement (figure 7), the reflective metal sheet M is associated with a reinforcement constituted by a non-woven film 10 of synthetic fibres.

In a second example, the reflective sheet 6 of the above-described composite sheet is constituted by a reinforced multilayer reflective film.

This reinforced multilayer reflective film is composed of a first layer forming one of the claddings, constituted by a plastic film which has received on one of its faces a deposit under vacuum of fine metal particles, and by a second layer constituted by another, transparent film. Between these layers, a reinforcement consisting of a mesh made of plastic material is inserted in order to provide this reflective film with the required mechanical properties.

The claddings and the reinforcement are assembled to one another by means of a layer of adhesive extruded between the two claddings and the reinforcement; whilst the extruded film is still molten, pressure exerted on both sides by a calender ensures the adhesion and final assembly.

As a variant, the second layer and the reinforcement can be replaced by a non-woven film of synthetic fibres with mechanical properties similar to those of the plastic mesh.

The plastic materials which are used for the plastic films constituting the claddings, the mesh or the non-woven film of synthetic fibres, are composed of common polymers such as polyester, polyethylene, polypropylene, or any other polymer with similar properties used alone or in combination.

A reinforced multilayer reflective film of this type has a total thickness of between 60 and 200 µm, and a mass of between 60 and 250 g/m^2.

The reflective sheet 6 of the composite sheet according to one of the above-described embodiments has breaking strength in traction measured according to standard EN 12 311-1 greater than 300 N/5 cm, irrespective of the direction of traction (longitudinal or transverse), and resistance to tearing (nail shank) measured according to standard EN 12 310-1 greater than 250 N, irrespective of the direction of traction (longitudinal or transverse).

The reflective sheet 6 which constitutes the outer part of the composite sheet of the outer cladding 11 of the insulation is naturally impermeable to water and to water vapour. In order to make it compatible with the required usage, it is made permeable to water vapour by an appropriate specific treatment.

This specific treatment, carried out by any appropriate electrical or mechanical means, consists of perforating the reflective sheet with a multitude of holes distributed uniformly over all of its surface. These holes, the diameter of which is generally between 0.1 mm and 1 mm, and preferably 0.5 mm, represent approximately 3% of the total surface area of the reflective sheet.

The perforation of this reflective sheet leads to permeation W which is at least equal to, but preferably greater than that of the sheet permeable to water vapour and impermeable to water to which it will be secured in order to form the composite sheet which constitutes the outer cladding.

In order to form this composite sheet which constitutes the outer cladding 11 of the thin insulation, the reflective sheet produced according to one of the above versions is associated after perforation, by adhesive bonding, adhesion, welding, or any other similar means which does not block the holes, with a sheet 7 which is impermeable to water and permeable to water vapour.

According to a preferred embodiment, the above-described composite sheet will have a reflective sheet selected from amongst the versions described, with a cladding or a reinforcement made of non-woven fibres which permits better distribution of the diffusion of the water vapour between the sheet which is impermeable to water and the pierced reflective sheet.

According to a preferred embodiment, the inner reflective cladding 10 of the thin insulation is constituted by a reflective sheet selected from amongst one of the versions described for the reflective sheet 6 of the outer cladding.

According to a first embodiment, the reflective sheet is pierced according to the same method as that described for the reflective sheet 6 of the outer cladding 11, then is assembled on the interposed layer

I2 by means of adhesive bonding, ultrasound welding, or any other similar means which does not block the holes for the passage of the water vapour.

According to a second embodiment, the reflective sheet 6 is not pierced, and is therefore totally impermeable to water and to water vapour. The reflective sheet 6 is then secured on the flexible interposed layer I2 by needling, knitting, or any other equivalent mechanical assembly. This leads to the piercing of the reflective sheet of the inner cladding I3 by a multitude of holes which make this sheet not impermeable to water, thus permitting the passage of the water vapour.

Consequently, irrespective of the mode of assembly on the intermediate layer of the reflective sheet, the inner cladding I3 will be breathable and not impermeable to water. This cladding I3 of the thin insulation I faces towards the interior of the building (warm side).

The hydrophobic flexible interposed layer I2, situated between the claddings I1, I3, forms a separator, the main function of which is to maintain a constant distance between the claddings. As a secondary function, this interposed layer has thermal insulation properties which can reduce the thermal conduction of the reflective claddings.

This interposed layer can:

- according to a first example, be constituted by a mat of synthetic fibres which have received a hydrophobic treatment, and are bonded to one another by adhesive bonding or by mechanical means such as needling, sewing, or by thermal means, or by any other equivalent means in order to form a three-dimensional network; or
- according to a second example, be constituted by an open-cell expanded foam made of a synthetic material such as polyethylene, polyester, polyurethane, or any other equivalent synthetic material; or
- according to a third example, be constituted by natural fibres such as glass wool or rock wool, or fibres of animal or vegetable origin.

Advantageously, this interposed layer has a thickness of between 5 mm and 20 mm, the mass surface density being between 100 and 1,000 g/m^2. The reflective thin flexible thermal insulation I has a coefficient of thermal conductivity λ which is equal to, or less than, 0.04 W/m.K (watts per metre.degree Kelvin).

The production process can comprise the following steps: unrolling of the interposed layer I2 onto the inner cladding I3, then assembly of the inner cladding I3 on the interposed layer I2 carried out by means of needling, then adhesive bonding of the outer cladding I1 on the intermediate layer I2, then pressing, calendering-heating, rolling, cutting and packaging.

Vékony, reflektáló hőszigetelés tetők alá

SZABADALMI IGÉNYPONTOK

1. Flexibilis, vékony és reflektáló hőszigetelés, ami lehet fólia vagy lemez, és felhasználható mindenféle épületek építéséhez és felújításához, különösen megmaradó régi szigetelés kijavítására, ami legalább három elemből áll: egy lélegző, reflektáló, vízátnemeresztő külső bevonatból (11) és egy lélegző belső bevonatból (13), ami az épület belseje (meleg oldala) felé néz, ahol a két bevonatot egy közbülső vízgőz áteresztő réteg (12) választja el, **azzal jellemezve, hogy**
   - a lélegző belső bevonat (13) reflektáló bevonat;
   - a lélegző belső bevonat (13) vízáteresztő bevonat , és
   - a közbülső réteget (12) egy gyékény alkotja.
2. Az 1. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a közbülső réteg (12) vastagsága 5 – 20 mm.
3. Az 1. vagy 2. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a külső bevonat (1) és a belső bevonat (13) átlagos reflektivitása legalább 90%.
4. Az előző igénypontok bármelyike szerinti hőszigetelés, **azzal jellemezve, hogy** a hővezetőképessége (λ) legalább 0.04 W/m.K (watt per méter.Kelvin fok).
5. Az előző igénypontok bármelyike szerinti hőszigetelés, **azzal jellemezve, hogy** a külső bevonat (1) legalább egy vízátnemeresztő fóliából (L) áll, ami jelentős vízgőz áteresztő képességgel rendelkezik, és permeációs értéke (W) 1.10^{-8} és 1.10^{-9} kg/m^2.s.Pa között van.
6. Az 5. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a fólia (L) vastagsága 10 és 300 μm, felületi súlya pedig 50 és 120 g/m^2 között van.
7. A 4. vagy 5. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a fóliát (L) egy nagyon vékony mikroporózus réteg alkotja, ami egy porózus mész-szilikát mikrorészecskékből vagy egyéb porózus anyagból álló filmet tartalmaz, aminek vastagsága 10 és 40 μm, és felületi súlya 10 és 40 g/m^2 között van.
8. A 4. vagy 5. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a fóliát (L) egy vegyi úton áteresztő, úgynevezett hidrofil membrán alkotja.
9. A 4 – 8. igénypontok bármelyike szerinti hőszigetelés, **azzal jellemezve, hogy** a vízzáró fólia (L) megfelelő kezeléssel egyik oldalán enyhén sugárzóvá van téve, amelyik oldal vákuumban finom fém részecskéket tartalmazó réteggel van bevonva, amiket speciális transzparens lakkréteg véd, hogy gyors felületi oxidációjukat - ami ezek reflektálási képességét csökkentené - megakadályozza, miközben áteresztőképességük megmarad.
10. A 9. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a reflektáló külső bevonatoknak (11, 13) két, enyhén sugárzóvá kezelt oldala van.
11. Az 1 – 9. igénypontok bármelyike szerinti hőszigetelés, **azzal jellemezve, hogy** a reflektáló külső bevonat (11) egy rétegelt fólia, ami egy csekély emissziós képességű és több lyukkal

perforált első reflektáló fóliát (6) és egy vízgőz (7) által átjárható, vízzáró második fóliát (L) tartalmaz, ami nagy vízgőz áteresztő képességgel rendelkezik, ahol az áteresztőképesség értéke (W) 1.10^{-8} és 1.10^{-9} kg/m^2.s.Pa között van, de nincs enyhén sugárzóvá téve.

12. A 11. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a reflektáló fólia (6) reflektáló fémfólia (M).

13. A 12. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a reflektáló fémfólia (M) alumíniumból van.

14. A 12. vagy 13. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a fémfólia (M) járulékos eszközökkel (8, 9, 10) van megerősítve, amik ragasztással vagy azzal ekvivalens módon vannak felerősítve, hogy a fémfólia mechanikai tulajdonságokkal rendelkezzék.

15. A 14. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a fémfólia (M) egy többrétegű, átlátszó, megerősített műanyag filmmel (8) van összekapcsolva.

16. A 14. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a fémfólia (M) egy műanyag rácsból (9) álló erősítéssel van ellátva.

17. A 14. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a fémfólia (M) egy olyan erősítéssel van összekapcsolva, ami egy műanyag szálakból álló nem szövött filmből (10) van képezve.

18. A 11. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a reflektáló fólia (6) egy többrétegű, megerősített reflektáló filmként van kialakítva.

19. A 11. vagy 18. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a reflektáló fólia (6) több, teljes felületén eloszlatott lyukkal van ellátva, amik átmérője 0,1 és 1 mm között van, és a fólia teljes felületének mintegy 3%-át teszik ki.

20. A 19. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a reflektáló fólia (6) áteresztőképessége (W) azonos vagy nagyobb, mint a vízzáró, de a vízgőzt (7) áteresztő fóliáé (L).

21. A 19. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a perforált reflektáló fólia (6) ragasztással, tapasztással, hegesztéssel vagy egyéb hasonló eszközzel - ami a lyukakat nem zárja le – van a vízzáró, de a vízgőzt (7) áteresztő fóliával (L) összekapcsolva, hogy kialakuljon a vékony, reflektáló és lélegző hőszigetelés külső bevonata (11).

22. A 13 -17. igénypontok bármelyike szerinti hőszigetelés, **azzal jellemezve, hogy** az épület belseje felé néző reflektáló bevonat (13) egy reflektáló fémfólia (6), ami hasonló a külső bevonatéhoz (11).

23. Az 1 -3. igénypontok bármelyike szerinti hőszigetelés, **azzal jellemezve, hogy** az épület belseje felé néző reflektáló bevonat (13) egy reflektáló, többrétegű, erősített film.

24. A 22 vagy 23. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** az épület belseje felé néző reflektáló bevonat (13) több, teljes felületén eloszlatott lyukkal van ellátva, amik átmérője 0,1 és 1 mm között van, és a fólia teljes felületének mintegy 3%-át teszik ki.

25. A 24. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a perforált belső bevonat (13) áteresztőképessége (W) azonos vagy nagyobb, mint a reflektáló külső bevonaté (11).

26. A 24. vagy 25. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a perforált belső bevonat (13) a közbülső rétegre (12) ragasztással, ultrahangos hegesztéssel vagy egyéb hasonló eszközzel - ami a lyukakat a vízgőz elől nem zárja le – van felerősítve.
27. A 22. vagy 23. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** az épület belseje felé néző perforált belső bevonat (13) tűzéssel, hurkolással vagy egyéb hasonló mechanikus úton van felerősítve, ami azt több helyen átlyukasztja, ami által vízzárósága megszűnik, és a vízgőzt áteresztí.
28. A 27. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a perforált belső bevonat (13) áteresztőképessége (W) azonos vagy nagyobb, mint a reflektáló külső bevonaté (11).
29. Az előző igénypontok bármelyike szerinti hőszigetelés, **azzal jellemezve, hogy** a bevonatok (11 és 13) hemiszférikus spektrális emissziós koefficiense (ε) 3 μm és 14 μm közötti hullámhossz tartományban, 20 és 60°C közötti hőmérsékleten azonos vagy kisebb, mint 0,1.
30. A 27. igénypont szerinti hőszigetelés, **azzal jellemezve, hogy** a bevonatok (11 és 13) közepes reflektáló képessége legalább 98%-a a teljes bejövő energiának.
31. Eljárás az 1 – 25 vagy 27 – 30. igénypontok bármelyike szerinti flexibilis, vékony és reflektáló hőszigetelés előállítására, **azzal jellemezve,** hogy az alábbi lépéseket tartalmazza:
    - feltekerjük a közbülső réteget (12) a belső bevonatra (13),
    - tűzéssel összekapcsoljuk a belső bevonatot (13) és a közbülső réteget (12),
    - felragasztjuk a külső bevonatot (11) a közbülső rétegre (12).

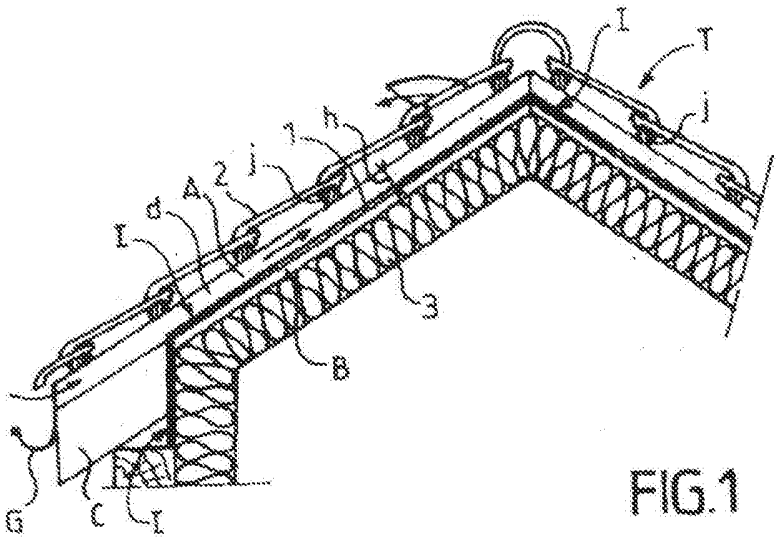


FIG.1

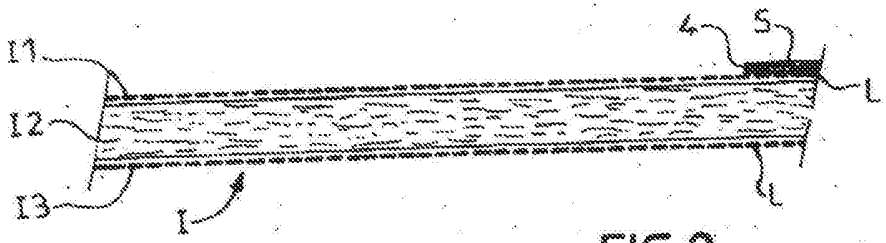


FIG.2

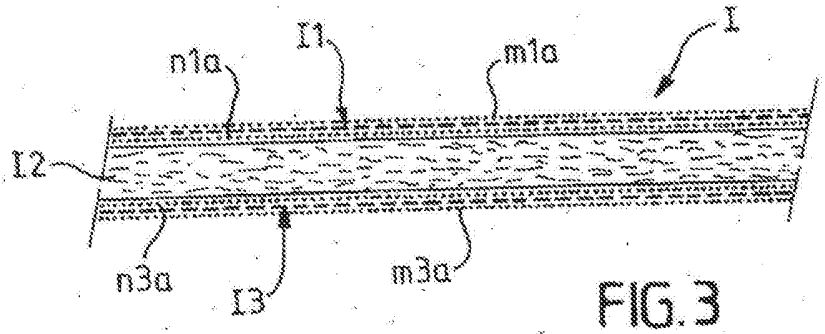


FIG.3

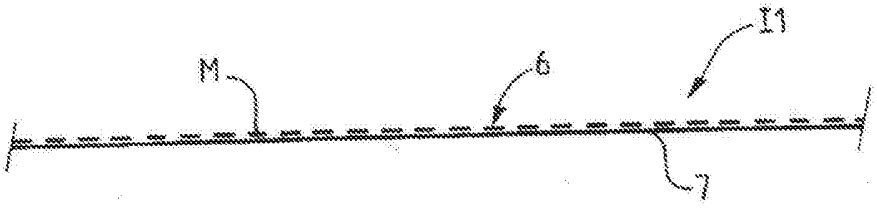


FIG.4

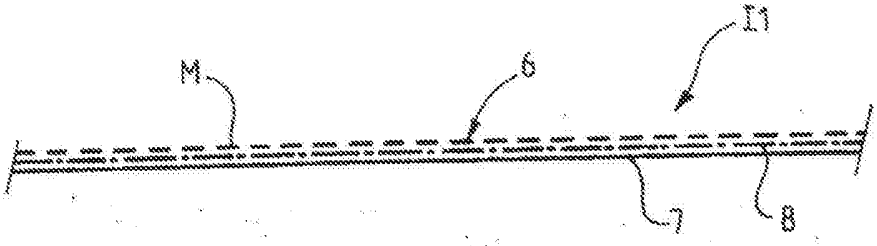


FIG.5

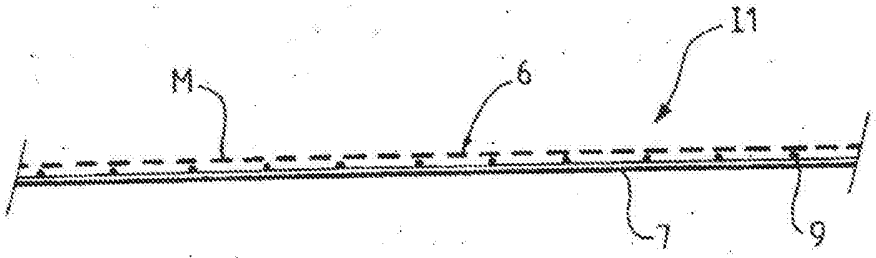


FIG.6

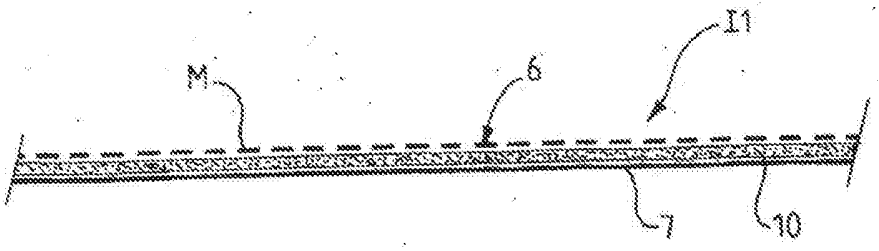


FIG.7