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(54) **Barrier sheet**

(57) The invention relates to a barrier sheet (1) comprising an elongated windproof membrane (2), a wind, water and radon-proof adhesive layer (3), and an elongated radon-proof membrane (4). It also relates to a method for manufacturing a barrier sheet (1) comprising an elongated windproof membrane (2), a wind, water and radon-proof adhesive layer (3), and a radon-proof membrane (4), comprising the steps of; providing an elongated windproof membrane (2), an elongated radon-proof membrane (4) and an adhesive substance (9), advancing the windproof membrane (2) while applying adhesive substance (9) to the middle section (10) of the windproof membrane (2), applying a protective sheet (7) to at least the adhesive substance, cooling the barrier sheet (1), and applying adhesive substance (3) to a first side area (5) of the radon-proof membrane, the adhesive substance being coherent with at least a part of the adhesive substance being applied to the windproof membrane (2) so that the first side area (5) of the radon-proof membrane is connected to the windproof membrane (2).

The invention further relates to the use of the above barrier sheet and a method for providing radon gas protection in a building comprising the steps of; covering the inner surfaces of a basement with radon membrane, arranging a barrier sheet (1) comprising an elongated windproof membrane (2), a wind, water and radon-proof adhesive layer (3), and a radon-proof membrane (4) between the walls of the basement and the framework of a building, and connecting the radon-proof membrane (4) to the radon membrane.

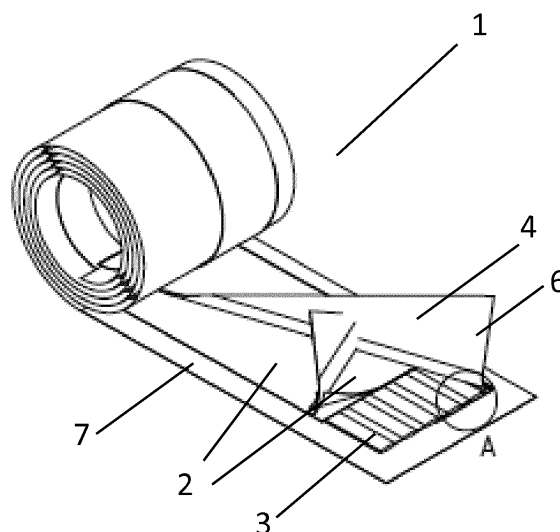


Fig. 1a

Description

Field of the Invention

[0001] The present invention relates to a barrier sheet suitable for use in buildings, and more specifically for use between the foundation and wall structures of a building. It further relates to a method for manufacturing such a barrier sheet. The invention also relates to a method for providing an improved radon gas protection in a building and the use of a barrier sheet for obtaining radon protection in a building.

Prior Art

[0002] When constructing buildings with wooden structures on concrete foundations or substructures, a protective barrier is provided between the concrete basis, which emits moisture, and the adjoining wooden structure, which should be kept as dry as possible. Between standing walls and the foundation below there is a high pressure from the standing structure, which demands a barrier that can withstand the pressure from the wall without being weakened and thereby possibly losing some of its ability to protect against humidity from below. It is also a requisite for a barrier that is easy to arrange in an air- and watertight manner at the construction site. To fulfil this, an elongated barrier sheet comprising a wind barrier being windproof but breathing, and waterproof, but permeable to vapour, such as a band in a felt or paper material or any other suitable specialized material, whereon a bitumen or asphalt layer is provided, is commonly used.

[0003] Furthermore, there is increasing concern related to radon gas emissions from the ground, inside buildings. As it is proven that breathing radon gas over time can be pathogenic, it is increasingly requested when building houses that there is a radon barrier towards the ground below the building. Radon-tight membranes are therefore installed either prior to forging the concrete floor or placed on the raw concrete before covering with final flooring material.

[0004] In the transition between the wall-to-concrete barrier sheet and the radon membrane, it has been cumbersome to provide a good connection which is watertight and radon proof. At the present, the barrier sheet is arranged in the wall construction and the radon membrane is laid on the floor, on the insulation or in the ground under the building. The radon membrane is then laid on to cover the top of the foundation to prevent radon gas from penetrating the housing materials and entering the building.

[0005] There is a need for a barrier sheet which provides both a watertight or windproof connection and a tight connection to the radon barrier of the building. In other words, there is a need for a barrier sheet with a safe radon-proof connection between the flooring radon membrane and the external wall construction.

[0006] There is also a need for a simplified method for

shielding a construction from humidity, radon penetration and other undesired exposure to the surroundings. Furthermore, there is a desire to obtain an improved shielding of buildings against radon gas penetration.

[0007] It is therefore an object of the present invention to provide an improved barrier sheet providing both a watertight and airtight connection and a radon gas barrier. It is also an object to present a simplified method for providing a construction with an improved moisture and gas barrier.

[0008] These and other objects will become apparent from the following description.

Description of the Invention

[0009] In a first aspect, the invention relates to a barrier sheet comprising an elongated windproof membrane, a wind, water and radon-proof adhesive layer and an elongated radon-proof membrane. The adhesive layer of the barrier sheet is longitudinally laid on the middle part of the windproof membrane. A first side area of the radon-proof membrane of the barrier sheet is longitudinally connected to the adhesive layer. The second side area of the adhesive layer is suitable for connection to a separate membrane.

[0010] A barrier sheet providing protection against humidity, wind and radon gas will improve the protection of a building, as a combined sheet as above mentioned ensures solid and sturdy connection between the different protective elements required in a building. Furthermore, a barrier sheet providing a connection area for a further radon gas protection arrangement, simplifies the connection process for the construction workers.

[0011] In a further aspect, the barrier sheet comprises a removable protective sheet covering at least the adhesive layer. The protective sheet protects the adhesive layer against external impurities, such as dust, dirt or other particles. It furthermore simplifies the handling of the barrier sheet prior to being laid on a foundation structure and enables the manufacturer to roll the barrier sheet on rolls.

[0012] The adhesive layer can be a bitumen layer or an asphalt layer, both being sturdy and partly flexible materials providing a solid layer, which to some extent will follow the surface of the neighbouring surfaces.

[0013] In one aspect of the invention, a number of perforations are made in the first side area of the radon-proof membrane. The perforations promote penetration of the adhesive layer through the radon-proof membrane to ensure a good connection between the different elements of the barrier sheet.

[0014] In one aspect of the invention, the colour of the windproof membrane is different from the colour of the radon-proof membrane. As it is impossible to turn the membrane when a wall is built on top of the foundation and barrier sheet, it is very important that the barrier sheet is laid with the correct surface upwards, that is, with the windproof membrane upwards, and the radon-proof

membrane downwards. A colour coding of the different elements will provide a further ensurance against mistakes.

[0015] In one aspect of the invention, a separate portion of the adhesive layer is arranged between the windproof membrane and the first side area of the radon-proof membrane. When the adhesive layer is arranged as two or more bands, strips or trails, at least one fold in the barrier sheet is provided along which one or more of the membranes can be folded towards the centre of the barrier sheet, so that the barrier sheet forms a multiple layer band, where the outer areas of the membranes can be folded out on the construction site. The folding lines between the separate portions of the adhesive layer promote a compact arrangement of the membranes on the barrier sheet.

[0016] The invention further relates to a method for manufacturing a barrier sheet comprising an elongated windproof membrane, a wind, water and radon-proof adhesive layer, and a radon-proof membrane, comprising the steps of:

- providing an elongated windproof membrane, an elongated radon-proof membrane and an adhesive substance,
- advancing the windproof membrane while applying adhesive substance to the middle section of the windproof membrane,
- applying a protective sheet to at least the adhesive substance,
- cooling the barrier sheet, and
- applying adhesive substance to a first side area of the radon-proof membrane, the adhesive substance being coherent with at least a part of the adhesive substance being applied to the windproof membrane, so that the first side area of the radon-proof membrane is connected to the windproof membrane.

[0017] A continuous process for manufacturing the barrier sheet ensures a constant and regular quality of the final product. Furthermore, it enables a high manufacturing capacity, which gives a good utilisation of the production site and lower manufacturing costs.

[0018] In one aspect of the invention, the radon-proof membrane is applied to the windproof membrane after applying adhesive substance to the windproof membrane, but before cooling the barrier sheet. In another aspect of the invention, the windproof membrane and adhesive layer is heated or reheated, and provided with the radon-proof membrane after the cooling step. The flexibility of the process makes it easy to adapt the process to the settings of the site where a manufacturing installation is to be constructed while maintaining a good quality of the final product.

[0019] In a further aspect, the method according to the invention further comprises the step of providing a number of perforations in the first side area of the radon-

proof membrane prior to adhering it to the adhesive substance. The perforations in the first side area ensure a good adhesion between the adhesive layer and the radon-proof membrane.

[0020] In one aspect, the method according to the invention further comprises the step of applying protective sheet to the barrier sheet after connection of the radon-proof membrane to the adhesive layer. The protective sheet protects the adhesive layer against impurities prior to being used on a construction site. As the adhesive layer can also stick to the hands or clothes of a construction worker or to other elements, the protective sheet also prevents such sticking, which can be annoying and provide stress to the workers.

[0021] In a further aspect, the method further comprises the step of rolling the barrier sheet comprising windproof membrane, adhesive layer, radon-proof membrane and protective sheet onto rolls of predefined length. As the barrier sheet is arranged in rolls, it improves and eases the handling of the product. The storing of the barrier sheet in rolls also saves place and gives a good overview of the product both for the manufacturer, the vendor and the end user.

[0022] The invention also relates to a method for providing radon protection in a building comprising the steps of:

- covering the inner surfaces of a basement with radon membrane,
- arranging a barrier sheet comprising an elongated windproof membrane, a wind, water and radon-proof adhesive layer, and a radon-proof membrane between the walls of the basement and the framework of a building,
- connecting the radon-proof membrane to the radon membrane covering the inner surfaces of the basement.

[0023] As the barrier sheet according to the invention is a product providing a number of individual protection aspects, the process of providing a good and overall protection of a building is greatly simplified. This again leads to a quicker installation of all necessary protection membranes and an improved securing of transitions between building elements.

[0024] The invention also relates to the use of a barrier sheet as mentioned above, as a protective layer between a basement wall structure and the framework of a building. As the barrier sheet has incorporated wind, water and radon gas protection, an improved protection is provided in the transition region between the foundation of a building, often being made in concrete or the like, and the upper wall structures, made in wood, plaster or other materials more susceptible to being influenced by environmental factors, such as rain and wind. The combined protection also ensures that the radon barrier of a building is constant over the wall and into the interface between foundation and wall structure.

Brief Description of the Drawings

[0025] In the following, the invention will be further described with reference to the attached drawings illustrating examples of the invention.

Fig. 1a shows a perspective view of a roll of barrier sheet according to the invention.

Fig. 1b shows a section A of the barrier sheet in fig. 1a.

Fig. 2 shows a side view of the roll of barrier sheet in fig. 1a.

Fig. 3 shows a perspective view of a section of a wall provided with a barrier sheet according to the invention.

Fig. 4 shows a cross-sectional side view of a section of the wall section in fig. 3.

Fig. 5 shows an example of a manufacturing process to produce a barrier sheet according to the invention.

Detailed Description

[0026] Figs. 1a and 1b show an example of a barrier sheet 1 according to the invention. The barrier sheet 1 comprises a wind barrier or windproof membrane 2, an adhesive layer 3 and a strip or band of a radon-proof membrane 4. The central part of the windproof membrane 2 is covered with an adhesive substance 3. The adhesive substance 3 can be applied as a continuous layer, a number of rows, bands or dots, or a combination of these. The radon-proof membrane 4 is connected to the adhesive substance 3, so that one longitudinal first side area 5 of the membrane 4 is at least partly embedded in or connected to the adhesive substance, while the opposite second side area 6 is free to be folded out. A releasable and protective film or sheet 7 covers at least the adhesive substance 3 of the barrier sheet. The releasable protective film or sheet 7 shields the adhesive substance from the second free side area of the radon proof membrane, so that the membrane 4 can be easily folded out.

[0027] The radon-proof membrane 4 can advantageously be connected to a row of adhesive substance 3 being separate from a further band or row of adhesive substance 3. The gap between the rows or bands provides a folding line for the radon-proof membrane 4, so that the membrane 4 can be folded without tampering with the adhesive layer or layers 3.

[0028] The adhesive substance 3 is preferably a non-rigid material with a limited flexibility so that the surfaces of the substance will fit into the surfaces of the neighbouring building material. It is advantageous that the adhesive substance has a high viscosity. Furthermore, the substance is preferably non-reactant with water or air. In this way, the substance will create a mainly waterproof airtight and radon-proof filler in the gap or interface between a concrete foundation and a wooden wall construction. The adhesive substance 3 can for example be bitumen or asphalt.

[0029] As the radon-proof membrane 4 is partly integrated in, or at least in direct contact with, the adhesive layer 3, a tight and sturdy transition is created from the radon-proof membrane to the interface between the foundation and the above structure. To improve the connection of the radon-proof membrane with the adhesive substance, a number of perforations such as holes or incisions are made in the first side area 5, e.g. along the edge of the membrane 4. When the membrane 4 comes into contact with the adhesive substance 3, the substance will flow through the perforations, providing contact between the substance on each surface of the membrane 4 and a thereby a continuous layer of adhesive substance. The perforations ensure the contact and mechanical bonding between the adhesive substance and the surface of the radon-proof membrane 4, as the perforations will promote embedding of the radon-proof membrane in the adhesive substance 3.

[0030] The barrier sheet 1, according to the shown embodiment, is rolled into a roll, which is practical when the barrier sheet 1 is stored, transported or sold. In a building site it is also practical to roll out the barrier sheet when it is needed. The protective sheet or film covering at least the adhesive substance is removed when the barrier sheet is mounted in a building or other construction.

[0031] Figs. 3 and 4 show a perspective view and a sectional view, respectively, of a section of a wall provided with a barrier sheet 1 according to the invention. The barrier sheet is laid on a foundation wall 13, such as a concrete foundation, with the radon-proof membrane 4 facing downwards and towards the inside of the building. The side sections 14 of the windproof membrane 2 are projecting out from the upper surface of the foundation. Beams 11, such as sole plates, studs or pillars 12 and/or other wall elements are mounted on the part of the barrier sheet provided with adhesive substance 3 on the surface facing the basement structure. The wall elements are normally wooden elements, but can also be in other materials, such as aluminium, plaster, steel, glass wool etc.

[0032] The strip of radon-proof membrane 4 is folded down over the inside surface of the foundation, forming a pendant element or skirt along the side of the foundation 13. The side sections 14 of the windproof membrane 2 are folded upwards on the wall elements, thereby covering and protecting the lower part of the wall elements. The side sections 14, forming a wind barrier facing the outside of the building and a vapour barrier facing the interior of the building, are then covered by panelling, plasterboards or the like. The second side area 6 of the radon-proof membrane is folded downwards onto the basement or foundation structure, forming a skirt or hanging portion, to which a further radon membrane can be connected.

[0033] When a radon membrane is installed in a building provided with a barrier sheet 1 according to the invention, it is easy to connect or adhere the radon membrane to the skirt of the radon-proof membrane, ensuring an airtight protection up to and into the interface between

the foundation 13 and the above wall construction 11, 12. As the connecting area between the foundation/wall interface and the foundation surface is lowered and distanced from the interface between the foundation and standing structure, it greatly simplifies the finalization of the radon protection and improves the user-friendliness of a radon protection system.

[0034] It is an advantage if the radon-proof membrane 4 has a different colour from the windproof membrane, to ensure that the correct membrane is connected to the radon membrane and that the windproof membrane or wind barrier merely protects the lower part of the wooden construction. The radon-proof membrane can e.g. be grey, blue or green, while the windproof membrane is white or yellow. However, it should be obvious that the suggested colours are merely examples serving to clarify how the membranes can be distinguished from each other by choosing different colours on each element. Even if the texture of the radon-proof membrane clearly differs from that of the windproof membrane, it would be very unfavourable if a construction worker makes a mistake during construction, as it would be impossible to rectify such a mistake later. Therefore, it is practical to provide extra precautions against mistaking the two barrier membranes.

[0035] Fig. 5 shows a schematic view of a manufacturing process for a barrier sheet according to the invention. The process starts at the right hand side of the figure and ends on the left hand side.

[0036] A roll 15 of windproof membrane is unwound and forwarded to a container 16 with adhesive substance, where adhesive substance is applied to a central part of the windproof membrane. The adhesive substance can be applied in one or more continuous bands, rows or strips, or in discontinuous application patterns, if desired. The adhesive substance is preferably a substance with a high viscosity, such as asphalt or bitumen. If asphalt or bitumen is used, the substance is hot when being applied and is cooled in a bath 17 after the application step. A protective sheet 7 is applied to the adhesive layer after application of the adhesive substance to the windproof membrane and before the cooling step.

[0037] Before entering step for applying the radon-proof membrane, the barrier sheet is advantageously passed through an accumulator 18. Thereafter, the protective sheet 7 is separated from the windproof membrane 2 and the adhesive layer 3, so that the radon-proof membrane 4 can be applied to the adhesive substance. To ensure a tight adhesion between the adhesive substance and the radon-proof membrane, the barrier sheet is heated and passed through a roller press before being rolled onto rolls of predefined lengths. Heating of the adhesive substance can be done in the roller press 19 if the roller press is provided with heated rolls.

[0038] Finally, the protective sheet comprising a windproof membrane 2, a radon-proof membrane 4, an adhesive and protective layer 3 and a protective sheet, is passed through a folding mechanism 20 and onto a final

roll 21 of protective sheet. It is also conceivable to apply the radon-proof membrane to the adhesive layer mainly at the same time as the adhesive substance is applied to the windproof membrane. In such a case, a roll of radon-proof membrane is arranged in the vicinity of the roll of windproof membrane. The radon-proof membrane and the windproof membrane are simultaneously unrolled, combined and provided with adhesive substance before entering a cooling phase and being provided with protective sheet.

[0039] As the radon-proof membrane is tightly adhered to the adhesive layer, a sturdy bar is created preventing radon gas from fluctuating into the interface between the foundation and above wall structure and therefrom further into the building.

Claims

1. Barrier sheet (1) comprising an elongated windproof membrane (2), a wind, water and radon-proof adhesive layer (3), and an elongated radon-proof membrane (4),
 - the adhesive layer (3) being longitudinally laid on the middle part of the windproof membrane ,
 - a first side area (5) of the radon-proof membrane (4) being longitudinally connected to the adhesive layer, the second side area (6) of the layer (4) being suitable for connection to a separate membrane.
2. Barrier sheet (1) according to claim 1, further comprising a removable protective sheet (7) covering at least the adhesive layer (3).
3. Barrier sheet according to claim 1 or 2, wherein the adhesive layer (3) is a bitumen layer or an asphalt layer.
4. Barrier sheet according to any of the preceding claims, wherein a number of perforations are made in the first side area (5) of the radon-proof membrane (4).
5. Barrier sheet according to any of the preceding claims, wherein the colour of the windproof membrane (2) is different from the colour of the radon-proof membrane (4).
6. Barrier sheet according to any of the preceding claims, wherein a separate portion of the adhesive layer (3) is arranged between the windproof membrane (2) and the first side area (5) of the radon-proof membrane (4).
7. Method for manufacturing a barrier sheet (1) comprising an elongated windproof membrane (2), a

wind, water and radon-proof adhesive layer (3), and a radon-proof membrane (4), comprising the steps of:

- a. providing an elongated windproof membrane (2), an elongated radon-proof membrane (4) and an adhesive substance (9), 5
- b. advancing the windproof membrane (2) while applying adhesive substance (9) to the middle section (10) of the windproof membrane (2), 10
- c. applying a protective sheet (7) to at least the adhesive substance,
- d. cooling the barrier sheet (1),
- e. applying adhesive substance (3) to a first side area (5) of the radon-proof membrane, the adhesive substance being coherent with at least a part of the adhesive substance being applied to the windproof membrane (2), so that the first side area (5) of the radon-proof membrane is connected to the windproof membrane (2). 20

8. Method according to claim 7, further comprising the step of:

- a. providing a number of perforations in the first side area (5) of the radon-proof membrane prior to adhering it to the adhesive substance. 25

9. Method according to claim 7 or 8, further comprising the step of: 30

- a. applying protective sheet (7) to the barrier sheet after connection of the radon-proof membrane (4) to the adhesive layer (3). 35

10. Method according to any of the claims 7-9, further comprising the step of:

- a. rolling the barrier sheet (1) comprising windproof membrane (2), adhesive layer (3), radon-proof membrane (4) and protective sheet (7) on- to rolls of predefined length. 40

11. Method for providing radon gas protection in a building comprising the steps of: 45

- a. covering the inner surfaces of a basement with radon membrane,
- b. arranging a barrier sheet (1) comprising an elongated windproof membrane (2), a wind, water and radon-proof adhesive layer (3), and a radon-proof membrane (4) between the walls of the basement and the framework of a building, 50
- c. connecting the radon-proof membrane (4) to the radon membrane. 55

12. Use of a barrier sheet according to any of the claims 1-4 as a protective layer between a basement wall

structure and the framework of a building.

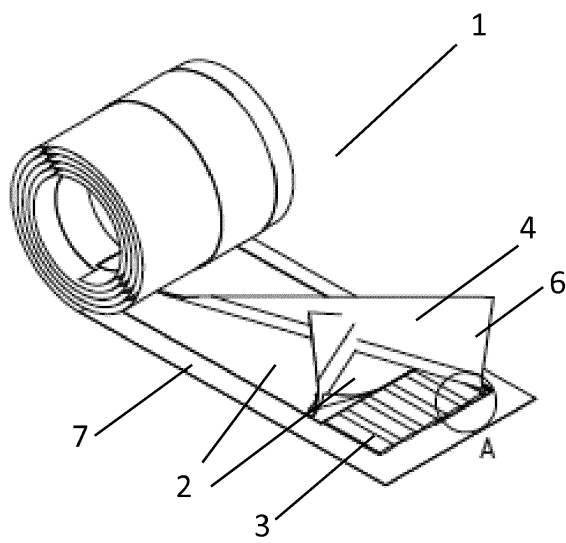


Fig. 1a

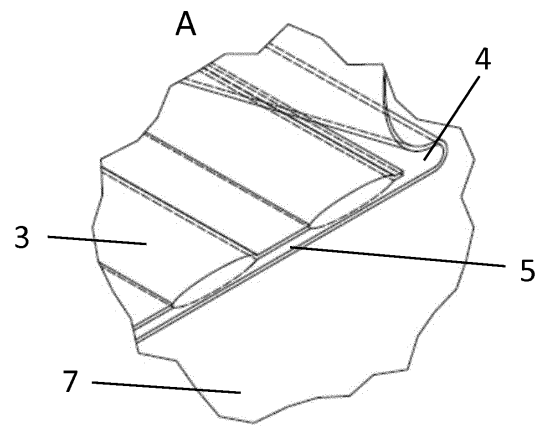


Fig. 1b

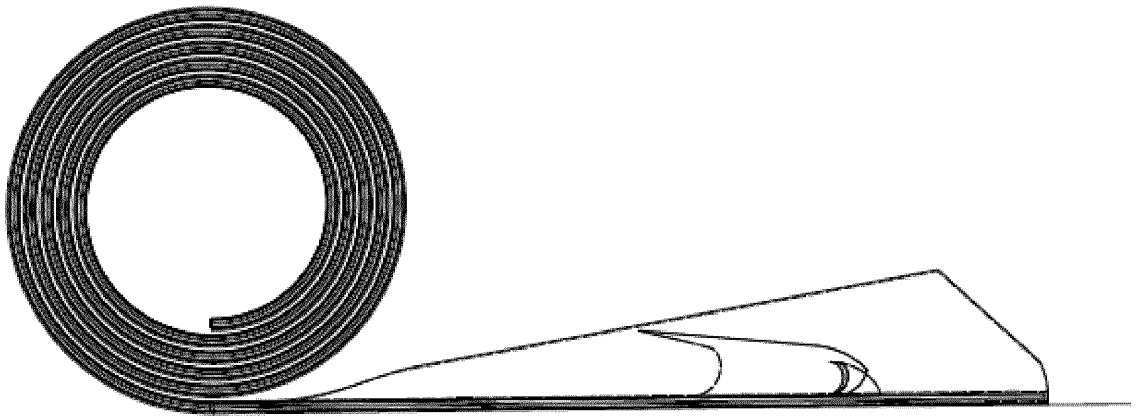


Fig. 2

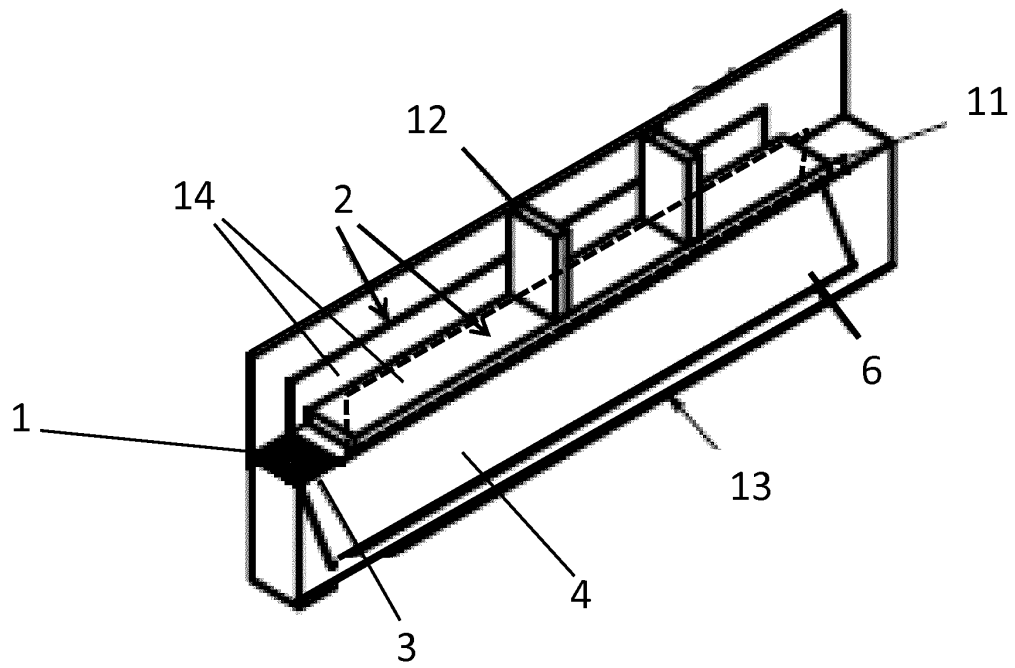


Fig. 3

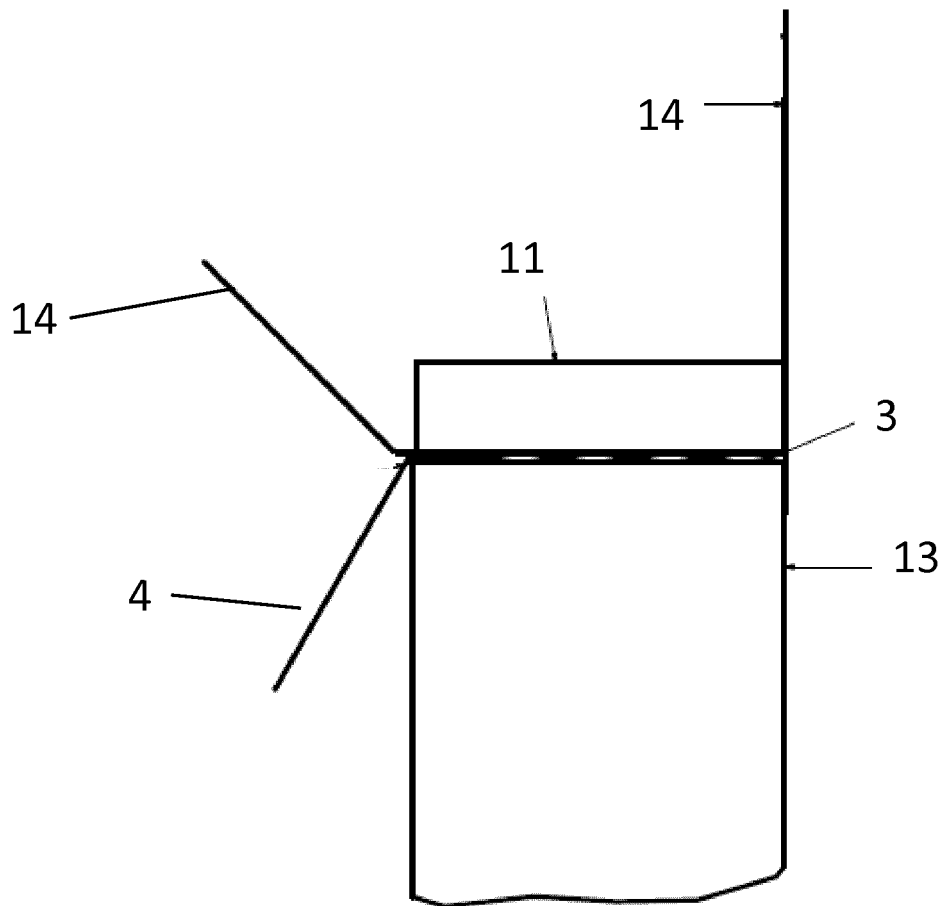


Fig. 4

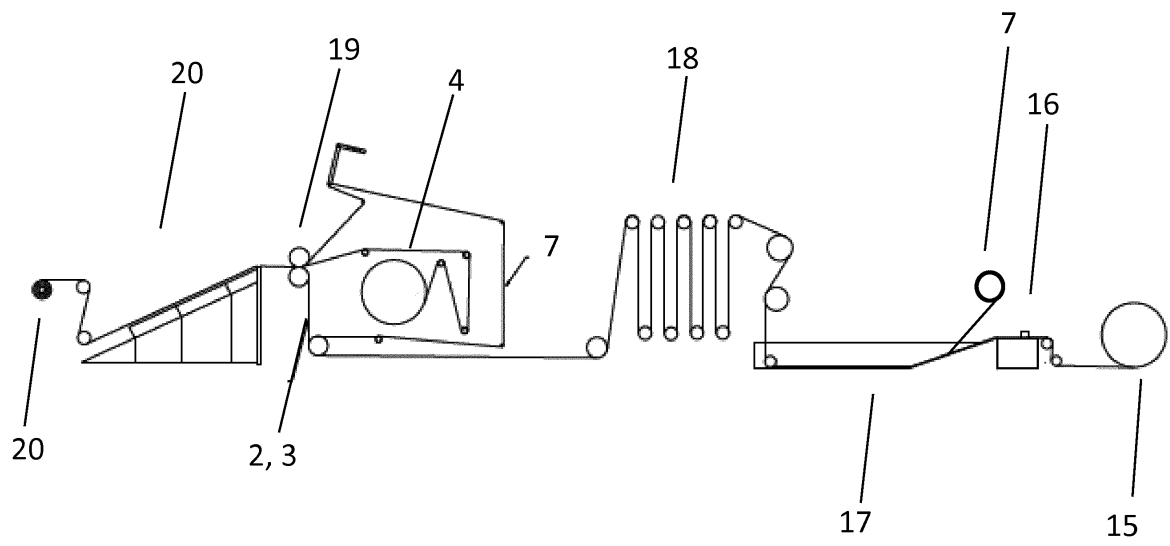


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 13 16 8056

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A	* column 5, line 30 - column 14, line 24; figures 1-13 *	1-7,9-11	TECHNICAL FIELDS SEARCHED (IPC) E04B E02D E04F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 3 February 2014	Examiner Ayiter, Johan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82