Radon piping arrangement

A radon piping arrangement (2) that comprises a radon piping package formed as a unit to be sold to consumers and comprising a quantity of at least perforated piping (4) for a suction channel system (3) and solid-walled piping (7) for an exhaust channel (6) used in the radon piping of a normal one-family house. At least part of the perforated piping (4) for the suction channel system (3) and/or at least part of the solid-walled piping (7) for the exhaust channel (6) is made of flexible pipe, whereby the radon piping package is suitable for use in several different construction sites.
Description

Background of the invention

[0001] The invention relates to a radon piping arrangement that comprises a radon piping package formed as a unit to be sold to consumers and comprising a quantity of at least perforated piping for a suction channel system and solid-walled piping for an exhaust channel used in the radon piping of a normal one-family house.

[0002] Radon is a radioactive, that is, radiative, gas that is generated when uranium and radium in the soil, in particular, decay. The radon concentration in the soil air is very high. Construction materials, filler layers below buildings, and household water also bring radon into indoor air. All construction materials containing minerals, such as concrete, emit radon. However, construction materials in accordance with regulations do not cause a radon concentration that would exceed the maximum value in indoor air, if the ventilation in the building meets the set requirements. Instead, soil air is the most significant radon concentration source of indoor air in Finland, for example.

[0003] Long-term exposure to radon increases the risk of lung cancer. Therefore, different authorities have provided guidelines and regulations on the maximum values of radon concentration in indoor air. Guideline values of radon are exceeded at several sites so easily that it is always justifiable to take radon into consideration in building. If a too high radon concentration is found in a building, it is quite arduous and difficult to lower the radon concentration afterwards, if the matter has not been considered during the construction stage.

[0004] Radon enters buildings in air flows either directly through structural components or through joints and cracks in them. Air flows are caused by wind, air pressure variations, temperature differences, and ventilation equipment, for example. The amount of air flow through the construction materials depends essentially on the air permeability of the material, which is a property specific to the material and has a great range of variation. However, the most significant air flows are those entering through the joints and cracks in the structural components.

[0005] The entry of radon indoors is prevented by sealing the structural components. The object of sealing is to provide an air barrier in the base floor structure of the building to cut off flows from the foundations to the room space. Sealing the base floor structure is especially important in ground-supported buildings.

[0006] By means of effective ventilation, it is possible to reduce the amount of impurities in indoor air. In terms of the radon concentration of indoor air, it is also important to pay attention to the control of negative pressure in the dwelling. The difference in indoor and outdoor temperatures, the density of the building, and the adjustment of ventilation air flows in forced ventilation, among other things, affect negative pressure.

[0007] Negative pressure is better controlled by a forced supply air and exhaust air ventilation system than by just a forced exhaust air ventilation. In a forced supply air and exhaust air ventilation system, supply air enters in a controlled manner and is not sucked in through structures and joints from the soil or outdoor air.

[0008] Forced exhaust air ventilation always increases the pressure difference and significantly adds to the radon concentration in the dwelling, if there are cracks and gaps in the structures. Correctly designed and used outdoor air valves lower negative pressure, but only to a limited extent. The situation becomes particularly problematic on rough gravel soil, where even an increase in radon concentration has been detected in densely constructed houses, when forced exhaust ventilation is intensified. By sealing the structures and implementing the ventilation correctly, it is thus possible to reduce the radon concentration in the indoor air of a building. However, these solutions do not always provide a sufficiently good end result, which is why it is recommended that new buildings be furnished with radon piping below their ground-supported space. The purpose of the radon piping is to ventilate the soil air in the layer below the building and to provide negative pressure to the foundations. For the system to work, the sealing solutions of the base floor structure and the foundation structures must be correctly implemented. Ventilating the layer below the building reduces the radon concentration in the soil air. By providing negative pressure to the building ground, the direction of flow is changed in such a manner that it is possible to prevent the radon-containing air from entering from the soil to the room space.

[0009] Radon piping comprises a suction channel system installed below the base floor structure of the building and connected to an exhaust channel.

[0010] Radon piping is a reserve system that is only taken into use when necessary. After the building is finished, a radon-concentration measurement is made in winter. If the measurement shows that the radon concentration in the indoor air is too high, the radon piping is taken into use. This is done by connecting an exhaust fan to the top end of the exhaust channel above the roof. The exhaust fan then sucks radon-containing air from the building ground through the suction channel system as evenly as possible. For radon control, it is essential that the exhaust fan is kept on continuously.

[0011] FI Patent Application 20031755 discloses a radon piping arrangement with radon piping comprising perforated pipes to form the suction channel system, a solid-walled exhaust channel and a solid-walled transfer channel for connecting the suction channel system to the exhaust channel in such a manner that the radon piping arrangement forms a radon piping package intended to be sold as a unit to consumers and comprising a quantity of suction channel system and exhaust channel and transfer pipe connecting the suction channel system and exhaust channel as well as joints for connecting the pipes and channels used in the radon piping of a normal one-
family house.

**Brief description of the invention**

[0012] It is an object of the present invention to provide a new type of radon piping arrangement.

[0013] The radon piping arrangement of the invention is characterised in that at least part of the perforated piping for a suction channel system and/or at least part of the solid-walled piping for an exhaust channel is made of flexible pipe, whereby the radon piping package is suitable for use in several different construction sites.

[0014] In the radon piping arrangement that comprises a radon piping package formed as a unit to be sold to consumers and comprising a quantity of at least perforated piping for a suction channel system and solid-walled piping for an exhaust channel used in the radon piping of a normal one-family house, at least part of the perforated piping and/or at least part of the solid-walled piping is made of flexible pipe, whereby the radon piping package is suitable for use in several different construction sites.

[0015] If at least part of the piping used in the suction channel system is flexible, the bends in the suction channel system may easily be formed by using the flexible piping. The number of pipe joints can then be reduced, and at its simplest, the entire suction channel system is formed of one continuous flexible pipe, in which case there is no need to make any pipe joints in the suction channel system, with the possible exception of joining the exhaust channel to the suction channel system. When at least part of the exhaust channel is made of a flexible solid-walled pipe, it is easy to form bends in the exhaust channel to circumvent various obstacles, such as roof trusses or ventilation pipes. In addition, it is easy to avoid pipe joints in the room space, for instance inside the partition walls.

[0016] Different embodiments and additional features of the solution are disclosed in the dependent claims.

**Brief description of the figures**

[0017] Some embodiments of the invention are described in greater detail in the attached drawings, in which

- Figure 1 is a schematic view of a radon piping arrangement;
- Figure 2 is a schematic view of a detail related to the radon piping arrangement; and
- Figure 3 is a schematic view of another detail related to the radon piping arrangement.

[0018] In the figures, some embodiments of the invention are shown simplified for the sake of clarity. Like reference numerals refer to like parts in the figures.

**Detailed description of the invention**

[0019] Figure 1 is a schematic view of a building 1, a one-family house in the case of Figure 1, with a radon piping arrangement 2 arranged thereto. The radon piping arrangement 2 of Figure 1 comprises a suction channel system 3 formed of a single-measure or continuous flexible pipe 4 with a perforated wall. The suction channel system 3 may thus be formed of a flexible pipe with a perforated wall and stored in a coil or roll by cutting a section of pipe 4 needed for the length of the suction channel system 3 on the basis of a radon plan, or, if there is no specific radon plan, on the basis of the shape and size of the ground floor of the building.

[0020] In a new building, the suction channel system 3 is installed in a manner known per se in the gravel layer below the base floor of the building. The gravel layer may, for instance, be made of underdrain gravel or, depending on the conditions of the construction site, of expanded clay aggregate that then also serves as thermal insulation. If the radon piping arrangement 2 is taken into use, radon-containing air is sucked from the bottom gravel under the building through the pipe 4 forming the suction channel system 3 and, at the same time, the formation of overpressure is prevented under the building.

[0021] The pipe 4 forming the suction channel system 3 is preferably corrugated or ribbed on its outer surface. The ring stiffness of the pipe 4 can then be made sufficiently high for the pipe 4 to be strong enough for installation underground. The strength of the pipe 4 can be further improved by making the pipe double-layered. Owing to its structure, the pipe 4 will remain intact underground and keep its roundness during the post-installation construction phases, such as bottom gravel compaction, base floor insulation and reinforcement and moulding of the base floor slab.

[0022] In Figure 1, the suction channel system 3 forms an annular structure, in which the ends 4’ and 4” of the pipe 4 of the suction channel system 3 are connected to each other with a joint or branch tube 5.

[0023] The radon piping arrangement 2 of Figure 1 further comprises an exhaust channel 6 formed of a single-measure or continuous flexible pipe 7 with a solid wall. The exhaust channel 6 can then be formed of a flexible, solid-walled pipe stored in a coil or roll by cutting a length of pipe 7 needed for the exhaust channel 6. The exhaust channel 6 is installed with a branch tube 5 to the suction channel system 4, whereby the exhaust channel 6 connects the suction channel system 3 to the top of the roof 8 of the building 1 so as to discharge the radon-containing air from the suction channel system 3 to the environment outside the building 1.

[0024] The outer surface of the exhaust channel 6 may be smooth and it may be of single-layer pipe, because load from soil, for instance, is not directed to the exhaust channel 6. However, the pipe 7 of the exhaust channel 6 is preferably corrugated on its outer surface as shown in Figure 1, which means that it is easily bendable. In
rooms, the exhaust channel 6 is located out of sight, for instance inside cupboards or enclosed or inside a partition wall.

[0025] In the radon piping arrangement 2 of Figure 1, the radon piping consists of a suction channel system 3 and exhaust channel 6 that are in their entirety made of flexible piping. However, it is possible that only the suction channel system 3 or part of it is made of a flexible pipe, and the exhaust channel 6 is made of a rigid pipe in a known manner. It is also possible that only the exhaust channel 6 or part of it is made of a flexible pipe, and the suction channel system 3 is made of a rigid pipe in a known manner.

[0026] When the suction channel system 3 or at least part of it is made of a continuous flexible pipe 4, it is very fast and easy to install the suction channel system 3 in place in comparison with the solution used earlier, in which cut-to-size pipes were connected to each other with joints permitting different direct or angular pipe joints and, if necessary, cutting the pipes into the desired length. The suction channel system 3 can be very simply made by just uncoiling a continuous pipe from a coil or roll along the installation line of the suction channel system 3. After the entire suction channel system 3 has been installed, the pipe 4 is cut and its ends 4', 4" are attached to each other with a branch tube 5. In the shown manner, the work load used in making the pipe joints and cutting the pipes as necessary is minimized. No waste pieces of the pipe 4 are formed, either. With a single-measure or continuous flexible pipe, it is also possible to easily make bends in the suction channel system to conform to the shape of the projections formed in the building, if the radon piping regulations on the shape and dimensions of the piping allow or require it on the site in question.

[0027] Should the versatility of the foundation of the building so require, it is also possible to connect with pipe joints to the annular suction channel system 3 shown in Figure 1 branch pipes made of either a flexible or rigid pipe having a perforated wall or transfer channels made of either a flexible or rigid pipe having a solid wall in such a manner that the regulations on radon piping are implemented.

[0028] When the exhaust channel 6 or at least part of it is made of a continuous flexible pipe 7, it is very fast and easy to install the exhaust channel 6 in place in comparison with the solution used earlier, in which cut-to-size pipes were connected to each other with joints permitting different direct or angular pipe joints and, if necessary, cutting the pipes into the desired length. The exhaust channel 6 can be very simply made with reference to Figure 1 by just uncoiling a continuous pipe from a coil or roll and fastening it at required intervals to suitable points of support. When the entire exhaust channel 6 has been drawn to the attic space 22 above the roof 21 or ceiling 21 of the building 1, the pipe 7 is cut. The work load used in making the pipe joints of the exhaust channel 6 and cutting the pipes as necessary is also minimized. No waste pieces of the pipe 7 are formed, either. In addition, since the exhaust channel no longer has joints inside the building, for instance inside the partition walls, the risk of radon-containing air leaking inside the building through joints of the exhaust channel also disappears.

When using a flexible pipe 7, it is easy to form various shapes in the exhaust channel 6 to circumvent roof-trusses, their supports or ventilation channels, for example, as shown schematically in Figure 1. Using a flexible pipe 7 in forming the exhaust channel 6 also permits the alternative in installing the exhaust channel 6, in which the exhaust channel 6 runs in its initial section after the branch tube 5 along the base floor of the building 1 for a distance and is only then bent upward. Possible obstacles in the structures above the base floor of the building can then be circumvented by running the exhaust channel 6 initially below the base floor essentially horizontally for a distance or at a somewhat ascending angle.

[0029] The pipe 4 of the suction channel system 3 and the pipe 7 of the exhaust channel 6 are preferably made of plastic, such as polyethylene PE, polypropylene PP or some other plastic suitable for the purpose. For instance, pipes made of polyethylene or polypropylene are entirely non-corroding. Because a flexible pipe is used in the suction channel system 3 and/or exhaust channel 6, a joint equipped with fixed joint branches 5', 5", 5" can be used as the branch tube 5.

[0030] A radon piping arrangement similar to that of Figure 1 can also be implemented without any branch tubes 5 by using just one continuous flexible pipe. The beginning of the pipe is then formed of a flexible pipe section having a perforated wall and the end of the pipe is formed of a flexible pipe having a solid wall fastened seamlessly to the beginning of the pipe. This type of pipe can be made by stopping the perforations on the wall of the pipe after a predefined length of perforated pipe has been made. The beginning of the pipe can then be arranged to form the suction channel system 3 and the end of the pipe can be arranged to form the exhaust channel 6.

[0031] The radon piping arrangement 2 of Figure 1 further comprises an insulator 9 arranged around the exhaust channel 6, of which Figure 1 only shows a part for the sake of clarity. The insulator 9 can be made of many different materials and arranged in many different ways around the exhaust channel 6. Preferably, the insulator 9 is made of expanded polyethylene PE and formed without seams into the form of sock or pipe, whereby the insulator 9 can be wound in a roll for storage and transport. When the exhaust channel 6 is installed, the insulator 9 is unwound from the roll and pulled around the exhaust channel 6. The thickness of the insulator 9 may be 10 mm, for example.

[0032] Figure 1 further shows an exhaust fan 10 positioned on the roof 8 of the building 1 and which in the case of Figure 1 is a roof exhaust fan, such as a specific radon suction fan that is installed at the end of the exhaust channel 6. Usually, a control unit 11 or power controller 11 for controlling the suction effect of the exhaust fan 10 is connected to the exhaust fan 10. Wiring 20 connected
from the control unit 11 to the fan 10 for controlling the operation of the fan 10 and for supplying current to the fan 10 is shown schematically by a dashed line. A lead-in through the roof structure of the building 1 is made ready by a suitable lead-in piece 12 of the roof 8 and a lead-in piece of the roof covering sheeting not shown in Figure 1 for the sake of clarity, and these lead-in pieces are selected on the basis of the materials and colour of the used roof covering sheeting and roof.

[0033] During construction the exhaust channel 6 is usually ended at the attic space 22 above the ceiling 21. If the radon measurement made after the building has been taken into use shows that target values set for the radon concentration are exceeded, the radon piping is taken into use by extending it above the roof and connecting the exhaust fan to it.

[0034] Figure 2 shows schematically the sealing of the base floor lead-in of the exhaust channel 6 in cross-section. The exhaust channel 6 extends from the bottom gravel 14 upward through the insulator 15 and concrete slab 16. Before making the concrete slab 16, a rubber lead-in seal 17 is arranged around the exhaust channel 6 on the top surface of the insulator 15 to tighten against the outer circumference of the exhaust channel 6.

[0035] Figure 3 shows schematically the sealing of the roof 21 or ceiling 21 lead-in of the exhaust channel 6 in cross-section. For the sake of clarity, Figure 3 only shows the vapour barrier 18 of the roof 21 structure. Assuming that the vapour barrier plastic is used as the vapour barrier 18, the exhaust channel 6 is taken through the vapour barrier 18 by making a cross-slit in it and arranging the exhaust channel 6 through it. To seal the lead-in around the exhaust channel 6, preferably on the top surface of the vapour barrier 18, a roof lead-in seal 19 is arranged which may be a lead-in sheet made of expanded polyethylene PE, for example, and has for the exhaust channel 6 a prefabricated opening, the edges of which settle tightly against the outer circumference of the exhaust channel 6. The exhaust channel 6 is preferably arranged through the opening in the lead-in seal 19 at the same time as the exhaust channel 6 is taken through the slit made in the vapour barrier 18. Alternatively, the lead-in seal 19 may also be arranged around the exhaust channel 6 later, in which case the lead-in seal 19 may also have a cut, through which the lead-in seal may be drawn around the exhaust channel 6. The surface of the lead-in seal 19 against the vapour barrier 18 preferably has an adhesive layer, whereby the lead-in seal 19 may easily be fastened tightly to the vapour barrier 18.

[0036] The radon piping package is assembled on a transport pallet as a unit to be sold to the consumers. The consumer may be a private person who builds or has a building built, a construction firm or some other builder or building developer. A radon piping package assembled on a transport pallet may for instance consist of approximately 50 m of non-perforated piping 4 stored in a coil for the suction channel system 3 and approximately 20 m of solid-walled piping 7 stored in a coil for the exhaust channel 6. The diameter of the pipes 4 and 7 may be 110 mm, for example. The quantity of piping 4 for the suction channel system 3 belonging to the radon piping package is then sufficient for a suction channel system 3 of a building having a ground-supported surface area of approximately 150 to 250 m² depending on the shape of the foundation of the building. Further, the quantity of pipe 7 for the exhaust channel 6 belonging to the radon piping package is easily sufficient for forming the exhaust channel 6 of a three- or four-storey building. The pipe 4 for the suction channel system 3 and the pipe 7 for the exhaust channel 6 are preferably pipes stored separately on their own coils on the transport pallet, in which case to the finished radon piping package at least one joint, such as a branch tube 5, is added, by means of which the exhaust channel 6 is connected to the suction channel system 3. To simplify the acquisition of a radon piping system, a lead-in seal 19 for sealing the lead-in of the exhaust channel 6 through the roof 21 or ceiling 21 and a lead-in seal 17 for sealing the lead-in of the exhaust channel 6 through the base floor and a quantity of insulator 9 sufficient for insulating the exhaust channel 6 are preferably added to the same transport pallet in rolls. It is also possible to add to at least some radon piping packages assembled on transport pallets a control unit 11 required for controlling the exhaust fan 10 to be connected to the exhaust channel 6 and the necessary wiring between the control unit 11 and fan 10.

[0037] In some cases, the features described in this specification may be used as such, regardless of other features. On the other hand, the features described in this specification may also be combined to provide various combinations as necessary.

[0038] The drawings and the related description are only intended to illustrate the idea of the invention. Details of the invention may vary within the scope of the claims.

[0039] In the embodiment of Figure 1, the ends 4", 4" of the pipe 4 forming the suction channel system 3 are connected to each other with a branch tube 5. However, the suction channel system 3 can also be formed by not connecting the ends 4" and 4" of the pipe 4 to each other, in which case for instance the end 4" of the pipe 4 is closed and a bend or angle piece is arranged at the end 4" of the pipe 4 to form a joint for connecting the exhaust channel 6 to the suction channel system 3.

Claims

1. A radon piping arrangement (2) that comprises a radon piping package formed as a unit to be sold to consumers and comprising a quantity of at least perforated piping (4) for a suction channel system (3) and solid-walled piping (7) for an exhaust channel (6) used in the radon piping of a normal one-family house, characterised in that at least part of the perforated piping (4) for the suction channel system (3) and/or at least part of the solid-walled piping (7) for
the exhaust channel (6) is made of flexible pipe, whereby the radon piping package is suitable for use in several different construction sites.

2. A radon piping arrangement as claimed in claim 1, characterised in that the radon piping package comprises at least one joint for connecting the exhaust channel (6) to the suction channel system (3).

3. A radon piping arrangement as claimed in claim 2, characterised in that the joint is a branch tube (5) equipped with branches (5', 5", 5") having a fixed angle.

4. A radon piping arrangement as claimed in any one of the preceding claims, characterised in that the radon piping package comprises at least one lead-in seal (17) for sealing the exhaust channel (6) lead-in in the base floor.

5. A radon piping arrangement as claimed in any one of the preceding claims, characterised in that the radon piping package comprises at least one lead-in seal (19) for sealing the exhaust channel (6) lead-in in the roof (21) or ceiling (21).

6. A radon piping arrangement as claimed in any one of the preceding claims, characterised in that the radon piping package comprises an insulator sock (9) or pipe (9) made of expanded polyethylene and made into a roll for insulating the exhaust channel (6).

7. A radon piping arrangement as claimed in any one of the preceding claims, characterised in that the radon piping package comprises a control unit (11) for controlling a fan (10) to be connected to the exhaust channel (6).

8. A radon piping arrangement as claimed in any one of the preceding claims, characterised in that the radon piping package includes, positioned on the same transport pallet, approximately 50 m of perforated piping (4) wound in a coil for the suction channel system (3), approximately 20 m of solid-walled piping (7) wound in a coil for the exhaust channel (6), and at least one joint for connecting the exhaust channel (6) to the suction channel system (3).

9. A radon piping arrangement as claimed in claim 8, characterised in that the radon piping arrangement further has, positioned on the same transport pallet, a sufficient quantity of insulation material (9) required to insulate the exhaust channel (6) wound in a roll, a lead-in seal (19) for sealing the roof lead-in of the exhaust channel (6), and a lead-in seal (17) for sealing the base floor lead-in of the exhaust channel (6).
REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

• FI 20031755 [0011]