(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 653 008 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.05.2006 Bulletin 2006/18

(51) Int Cl.:
E02D 31/00 *(2006.01)* ***E04B 1/70*** *(2006.01)*
F24F 7/06 *(2006.01)*

(21) Application number: **05077509.7**

(22) Date of filing: **02.11.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **02.11.2004 NL 1027400**

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(54) Building with radon protection

(57) Building with living quarters, a roof (2) and a first floor structure (6) separating a first living quarter from a crawl space (11) situated underneath it, wherein the building is provided with an air discharge pipe (20) from the crawl space to above the roof, wherein at the roof end the air discharge pipe is provided with a draught promoting terminal (30). The first floor structure (6) may at the side of the first living quarter be provided with a radon barrier layer (15).

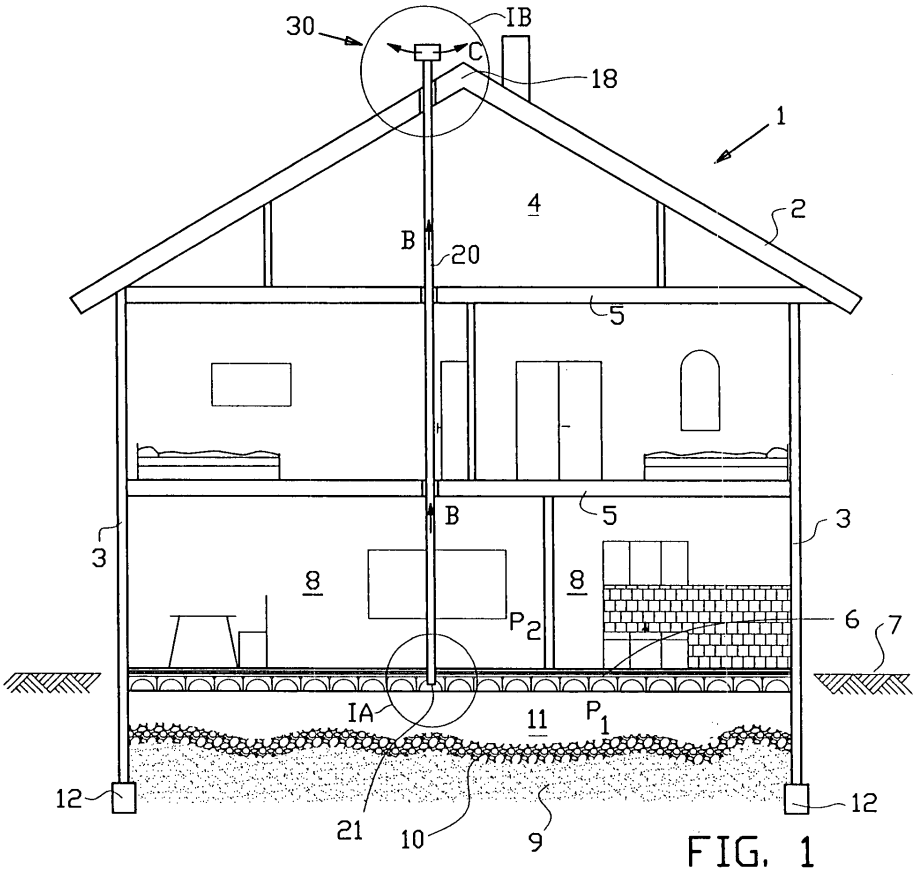

FIG. 1

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Description

[0001] The invention relates to a building with living quarters and provided with a crawl space.

[0002] The rock-containing construction materials used for buildings and the soil on which such buildings have been placed may release radon gases, which radon gases are radioactive. The persons staying in the living quarters need to be protected from contact with those radon gases as much as possible.

[0003] In case of buildings provided with a crawl space it is known to provide a radon barrier layer at the side of the floor that faces away from the crawl space. The crawl space is then ventilated by means of for instance floor ventilation ducts.

[0004] In a known, so-called active system intended for buildings without crawl space, a sump is placed into the ground, which sump is provided with holes for letting in radon gases from the soil material. The sump is connected to the outside air via a pipe extending horizontally to the outside and beyond the building to just above the roof edge. A driven ventilating fan is incorporated in the pipe.

[0005] In another known active system the discharge pipe extends through the house, through the attic and through the roof, and in the attic space a ventilating fan is incorporated in the pipe.

[0006] In both known active systems a radon barrier layer may be incorporated at the lower side of the floor.

[0007] The known systems may be expensive and/or insufficiently effective.

[0008] It is an object of the invention to provide a building provided with a simple system for effective discharge of radon gases.

[0009] From one aspect the invention provides a building with living quarters, a roof and a first floor structure separating a first living quarter from a crawl space situated underneath it, wherein the building is provided with an air discharge pipe from the crawl space, passing through the building, to above the roof, wherein at the roof end the air discharge pipe is provided with a draught promoting terminal.

[0010] Due to the draught promoting terminal a vacuum is effected in the crawl space via the air discharge pipe, independent from the wind direction, as a result of which gases present in the crawl space, such as radon gases and/or methane gases, are reliably discharged. The system under circumstances does not need driven parts, such as a ventilating fan, although, if so desired, it can be incorporated therein, optionally including pressure gauges and control unit, as described below.

[0011] Due to the vacuum in the crawl space an upward transportation flow through the floor is prevented, if anything a downward airflow to the crawl space will be effected in case of openings in the floor that may or may not be desired. Leakage from joints in the discharge pipe itself are also prevented due to the draught in the discharge pipe. A further additional advantage is that moisture can also be discharged downward.

[0012] Preferably the roof is a pitched roof having a ridge, wherein the terminal is situated near the ridge and preferably at least partially above the ridge, as a result of which the draught action is enhanced. Especially the Multivent®, which is available from Ubbink B.V., qualifies as draught promoting terminal that is active in all wind directions and wind angles. In this way a vacuum of some Pascal can be achieved, for instance -5 Pa.

[0013] In one embodiment the floor structure is built up from concrete elements, such as a system floor, wherein the first floor structure at the side of the first living quarter is provided with a radon barrier layer, wherein the radon barrier layer is placed on the concrete elements, optionally on a rough finishing layer applied thereon. In that way a large part of the construction material is kept at the shielded side of the radon barrier layer. The vacuum in the crawl space prevents that upward leakage of radon gases may yet occur, through chinks or cracks in the radon barrier layer. Preferably a final finishing layer is poured onto the radon barrier layer, as a result of which the radon barrier layer is protected.

[0014] The use of a radon barrier layer can be utilised for performing several functions. For instance pipes of a heating system can be placed on the radon barrier layer.

[0015] A damp barrier layer may furthermore have been provided at the radon barrier layer.

[0016] Alternatively or in addition a sound muffling layer may furthermore have been provided at the radon barrier layer.

[0017] Alternatively or in addition an airtight layer may furthermore have been provided at the radon barrier layer.

[0018] Alternatively or in addition a heat-insulating layer may furthermore have been provided at the radon barrier layer.

[0019] In an embodiment that is easy to place the radon barrier layer is part of a laminate having several functions.

[0020] In one embodiment the radon barrier layer comprises an HDPE-foil.

[0021] In one embodiment the radon barrier layer is furthermore provided with a layer of synthetic foam, such as polyethene foam.

[0022] In one embodiment the radon barrier layer is furthermore provided with an aluminium foil.

[0023] As indicated above, but this is unnecessary under normal conditions, a ventilating fan may have been placed in the discharge pipe, wherein the ventilating fan may then advantageously be a direct current ventilating fan.

[0024] For controlling the ventilating fan the building may furthermore have been provided with a control unit for the ventilating fan, wherein pressure gauges have been positioned for determining a pressure difference between the crawl space and at least the first living quarter, wherein the control unit is adapted for controlling the ventilating fan at a deviation from a predetermined value of the pressure difference. This is possible at a selected

deviation of for instance 0.1 Pa from a safety pressure difference of for instance 2 Pa (the pressure in the living quarter is 2 Pa higher than the pressure in the crawl space). The ventilating fan can be controlled from a standstill and/or from a rotating condition.

[0025] Several individual first living quarters may be present, wherein the pressure gauges are positioned for enabling to determine the pressure difference with the crawl space for each first living quarter, wherein the control unit is adapted for controlling the ventilating fan in case of said deviation in the pressure difference for one of the first living quarters.

[0026] The control unit can be adapted for regulating the number of revolutions of the ventilating fan depending on the time passed after the measurement in which too large a deviation was established, according to a relation between the number of revolutions alteration and the time that has been entered in the control unit. The number of revolutions is slowly raised in that way, until it is measured that the pressure difference is within the allowed deviation again. The ventilating fan is then controlled to remain rotating at the number of revolutions of that moment. In case the measured pressure difference goes beyond the allowed deviation again, the number of revolutions is raised again (in case the pressure difference has become too low) or lowered (in case the pressure difference has become too high), again according to the aforementioned relation (in which however the number of revolutions at the moment of establishing the too large a deviation is now started from. Lowering the number of revolutions may for instance be desirable if the natural draught is very high at that moment). Thus the used capacity of the ventilating fan can be optimally adjusted to the actual conditions. In this way the noise production and energy consumption of the ventilating fan is limited where possible.

[0027] The invention will be elucidated on the basis of a number of exemplary embodiments shown in the attached drawings, in which:

Figure 1 shows a schematic cross-section of a building, in this case a house, according to a preferred embodiment of the invention;

Figure 1A shows a detail according to IA in figure 1;

Figure 1B shows a detail according to IB in figure 1;

Figure 1C shows an alternative embodiment of the detail of figure 1B;

Figure 2 shows a diagram of a pressure regulation in the building of figure 1; and

Figure 3 shows a cross-section of a radon barrier layer suitable for the arrangement of figure 1.

[0028] The house in figure 1 comprises a pitched, gable roof 2 with ridge 18 and walls 3 that have been placed on foundation strips 12 that are situated below ground level 7. The building comprises storey floor structures 5 and a ground floor structure 6, wherein below the pitched roof 2 an attic space 4 has been formed.

[0029] Above the ground floor structure 6 there are living quarters 8. Below the ground floor structure 6 a crawl space 11 has been formed that is limited downward by a cover layer 10 on bottom 9, and sideward by the foundation walls.

[0030] As schematically shown in figure 1 A the floor structure 6 is a concrete system floor, built up from series of concrete elements 13, which are supported in manner known per se by concrete longitudinal girders that are not shown. The upper side of the concrete parts 13 is provided with a first poured finishing layer 14. On top of that a radon barrier layer 15, also see figure 2, has been arranged. On top of the radon barrier layer 15 a final finishing layer 16 of for instance screed is poured.

[0031] As can be seen in figure 1A in detail, the air discharge pipe 20, which with the lower end 21 a extends in the area of the crawl space 11, extends vertically upward, in order to, as can be seen in figure 1, go through the roof in the vicinity of the ridge 18. Said construction is further shown in figure 1B.

[0032] Figure 1B shows the draught promoting terminal combination 30, available under the name Multivent® from Ubbink B.V. The upper end 22 of pipe 20 extends through a passage 23 made in the (tile) roof 2. At the outside a so-called adjustment knob 29 is placed, which surrounds the pipe section 22, and has a hinging upper section 29a, for adjusting to the actual roof pitch, in the manner known per se. Around and on pipe section 22 an end pipe 24 is placed, which debouches at the location of 27 and at that location is surrounded by a wind band 28. A series of radial partitions 25 has been arranged around the wind band 28. Said radial partitions 25 extend between a lower plate 27a and an upper plate 27b. The air supplied through pipe 20/24 escapes through there between the bars 25.

[0033] The Multivent® is highly suitable for natural ventilation and has a low own resistance for instance at an airflow of 225 m^3/u only 0.2 Pa, for Multivent type 131.

[0034] The cross-section of the pipe 20, 21, 24 may be 125 cm^2 internally. As can be seen in figure 1 B the actual terminal, formed by parts 25-28, extends at least partially above the ridge 18. Said arrangement is advantageous to the draught, independent from the wind direction and wind angle. Because of the arrangement given, a vacuum P1 will be created in the crawl space 11 via the pipe 20, which vacuum may even reach values of -5 Pa.

[0035] As a result thereof air in the crawl space 11 will flow in the direction A into the lower end 21 of the vertical pipe 20 (figure 1 A), in order to flow upward from there in the direction B to the terminal 30, and escape from there in the direction C. Along with the air from crawl space 11 harmful gases, such as radon gases and meth-

ane gases, are also removed from the crawl space 11. Also radon gases formed by parts of the floor structure 6 that are situated below the radon barrier layer 15 are thus discharged, in which way diffusion of radon to the living quarters is prevented.

[0036] As a result of the vacuum P1 prevailing in the crawl space 11 a negative pressure difference will also be present over the floor structure 6, between pressure P2 in the ground floor quarters and pressure P1 in the crawl space 11. As a result transportation in the direction D (figure 1 A) can take place through chinks, slits and optionally cracks and imperfect overlaps in the layers 14, 15 and 16 of the floor structure 6.

[0037] The arrangement shown in figure 1 is mainly suitable for newly built houses/buildings. In case of renovation providing a radon barrier layer could be dispensed with due to the effective vacuum in the crawl space 11.

[0038] In case a much higher radon gas quantity is generated in the crawl space 11, using an arrangement as shown in figure 1C can be considered, wherein below the draught promoting terminal 30, at the upper section of the vertical pipe 20 a direct current ventilating fan 40 is provided, which when switched off has a low air resistance.

[0039] As schematically shown in figure 2 the ventilating fan 40 may be connected to a control unit 50 placed in the building, which unit controls the ventilating fan 40 on the basis of a pressure difference measurement between P1 and P2. For that purpose use can be made of one or more pressure difference gauges 60 which have pressure measurement inlets in the spaces 8 and 11. If the gauge 60 measures that P1 exceeds P2 (P1 is for instance 0 Pa and P2 -5 Pa) the control unit will give an activation signal to the ventilating fan 40, when it is switched off. When after a while the gauge 60 measures that the pressures P1 and P2 are almost equal or that P2 exceeds P1 (P2-P1 > = 0 Pa: for instance a safety pressure difference of at least 1 Pa, such as 2 Pa, such as with P1 =-7 Pa and P2 = -5 Pa), the control unit 50 will stop the activation signal. An overpressure P2 with respect to P1 results in a safety margin.

[0040] Optionally the measurement inlets may be placed in each of the spaces 8. In that case several respective pressure difference gauges may be present, wherein the control unit 50 gives an activation signal to the ventilating fan 40 if for at least one of the measurements it applies that P1 exceeds P2 (optionally with said safety margin).

[0041] If after the pressure difference has been brought at the desired value, it is established after some time that a deviation has arisen in an undesirable direction, for instance a deviation of 0.1 Pa, the control unit can then control the ventilating fan again until the desired pressure difference is realised again. If the ventilating fan was rotating at a number of revolutions to maintain the desired pressure difference, then said number of revolutions will be adjusted according to a time-number of revolutions alteration-relation that has been entered into the control unit beforehand, for instance on the basis of an RC-curve for the motor of the ventilator.

[0042] In the example of figure 2 the control unit 50 is shown with such a regulation for the number of revolutions of the ventilating fan 40. One would prefer the ventilating fan 40 to rotate at an as low as possible number of revolutions. In case of a desired increase of the pressure difference the number of revolutions will slowly be raised. In case of a desired decrease of the pressure difference the number of revolutions will slowly be lowered.

[0043] In figure 3 an exemplary embodiment is shown of a combined radon barrier layer according to the invention, used in the building according to figure 1. The radon barrier layer 15 comprises a number of layers, namely a bottom layer of synthetic foam, for instance polyethene foam 31, optionally having open cells, wherein the upper and lower surfaces 31 a,b thereof are melted up. The foam layer serves to accommodate irregularities in the first finishing layer 14 and for the protection of the layers situated on top of it. Moreover the foam layer 31 provides contact-sound insulation as well as heat insulation.

[0044] The layer 32 situated on top of that is made of aluminium foil, and forms a gasproof layer, against radon, methane etcetera and also a damp barrier layer.

[0045] The layer 33 situated on top of that forms a reinforcement and provides the combined layer 15 with strength in the longitudinal and the latitudinal direction. The top layer is a polyethene foil layer 34, preferably of HDPE, and provides the combines layer 15 with strength and protects the aluminium foil layer 32 against corrosion. Moreover said layer contributes to sealing against gases.

[0046] The combined layer, or laminate, may be provided with an overlap and adhesive strip for during placement ensuring a liquid and natural gas proof connection.

[0047] By way of example the foam layer 31 may be 3 mm thick, the layer of aluminium foil 32 may be of 55 grams having a thickness of 28 μm, the reinforcement net 33 may be of 13 grams flat and the HDPE-layer 34 may be of 80 grams having a thickness of 80 μm.

Claims

1. Building with living quarters, a roof and a first floor structure separating a first living quarter from a crawl space situated underneath it, wherein the building is provided with an air discharge pipe from the crawl space, passing through the building, to above the roof, wherein at the roof end the air discharge pipe is provided with a draught promoting terminal.

2. Building according to claim 1, wherein the roof is a pitched roof having a ridge, wherein the terminal is situated near the ridge and preferably at least partially above the ridge, as a result of which the draught

action is enhanced.

3. Building according to claim 1 or 2, wherein the floor structure is built up from concrete elements, such as a system floor, wherein the first floor structure at the side of the first living quarter is provided with a radon barrier layer, wherein the radon barrier layer is placed on the concrete elements, optionally on a rough finishing layer applied thereon, wherein preferably a final finishing layer is poured onto the radon barrier layer, wherein pipes of a heating system preferably are placed on the radon barrier layer.

4. Building according to claim 3, wherein furthermore a damp barrier layer has been provided at the radon barrier layer.

5. Building according to claim 3 or 4, wherein furthermore a sound muffling layer has been provided at the radon barrier layer.

6. Building according to claim 3, 4 or 5, wherein furthermore an airtight layer has been provided at the radon barrier layer.

7. Building according to any one of the claims 3-6, wherein furthermore a heat-insulating layer has been provided at the radon barrier layer.

8. Building according to any one of the claims 3-7, wherein the radon barrier layer is part of a laminate having several functions, as described.

9. Building according to any one of the claims 3-8, wherein the radon barrier layer comprises an HDPE-foil.

10. Building according to any one of the claims 3-9, wherein the radon barrier layer is furthermore provided with a layer of synthetic foam, such as polyethene foam.

11. Building according to any one of the claims 3-10, wherein the radon barrier layer is furthermore provided with an aluminium foil.

12. Building according to any one of the preceding claims, wherein a ventilating fan, preferably a direct current ventilating fan, has been placed in the air discharge pipe.

13. Building according to claim 12, wherein the building has furthermore been provided with a control unit for the ventilating fan, wherein pressure gauges have been positioned for determining a pressure difference between the crawl space and at least the first living quarter, wherein the control unit is adapted for controlling the ventilating fan at a preferably selected deviation (for instance 0.1 Pa) from a predetermined value of the pressure difference, wherein preferably the value of the pressure difference is predetermined at more than 1 Pa, preferably approximately 2 Pa (pressure in living quarter is more than 1 Pa or 2Pa, respectively, higher than the pressure in crawl space).

14. Building according to claim 13, wherein the ventilating fan can be controlled from a standstill and/or from a rotating condition.

15. Building according to claim 13 or 14, wherein several individual first living quarters are present, wherein the pressure gauges are positioned for enabling to determine the pressure difference with the crawl space for each first living quarter, wherein the control unit is adapted for controlling the ventilating fan in case of said deviation in the pressure difference for one of the first living quarters.

16. Building according to claim 13, 14 or 15, wherein the control unit is adapted for regulating the number of revolutions of the ventilating fan according to a time-number of revolutions alteration-relation that has been entered beforehand in the control unit, after establishing that the allowed deviation from the pressure difference has been exceeded.

17. Radon barrier layer suitable and intended for use in a building according to any one of the claims 3-12.

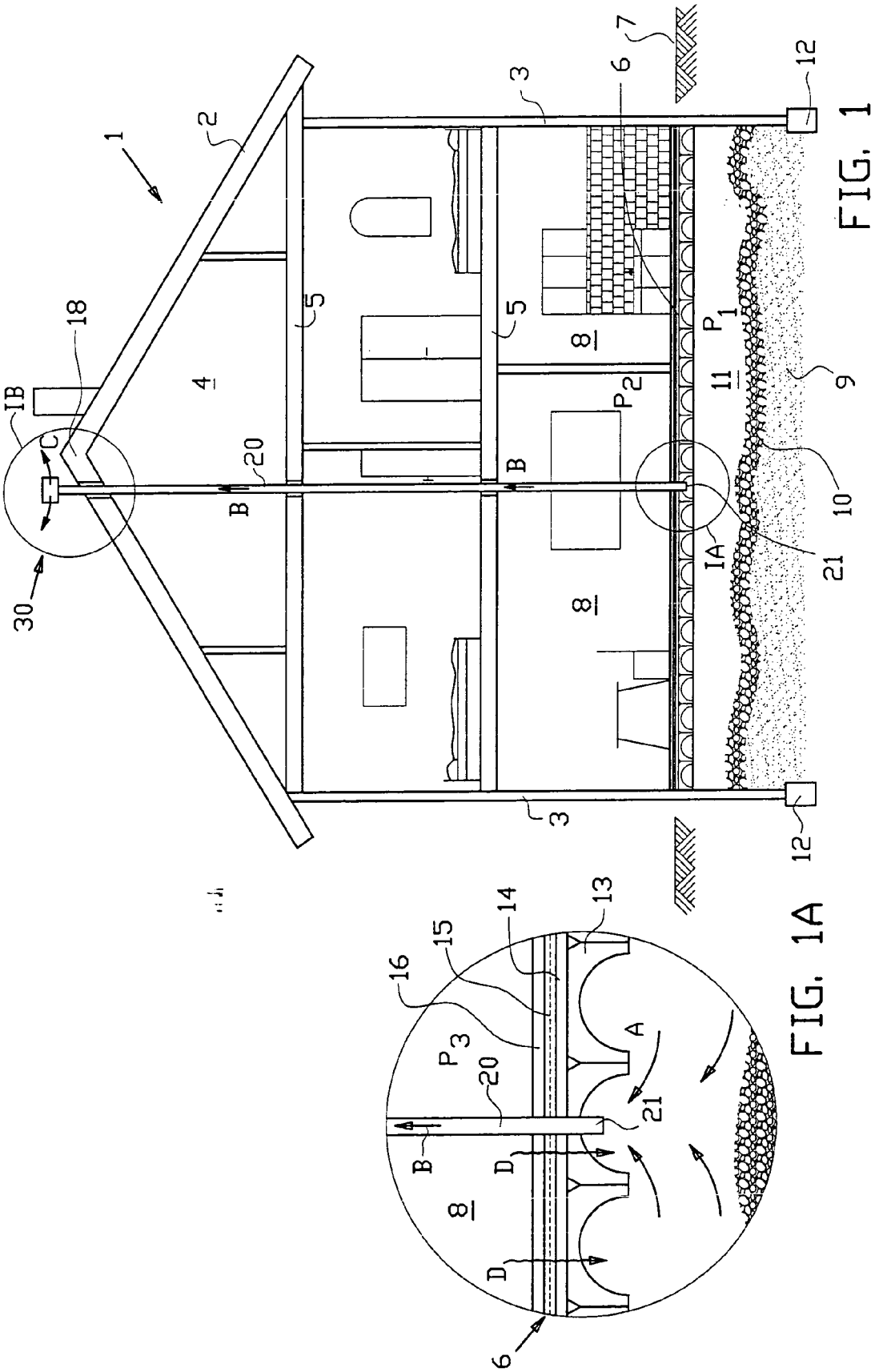
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FIG. 1

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FIG. 1A

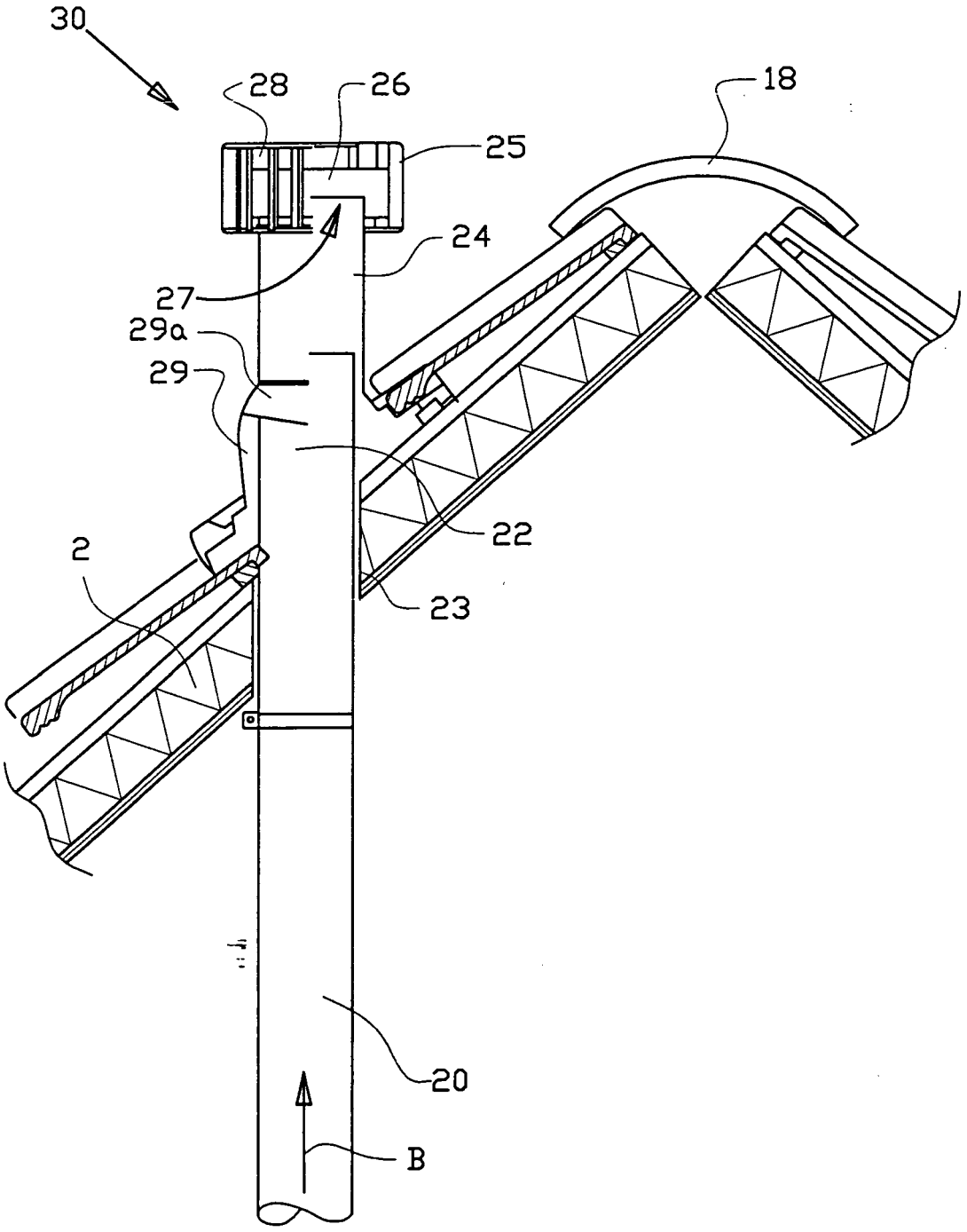

FIG. 1B

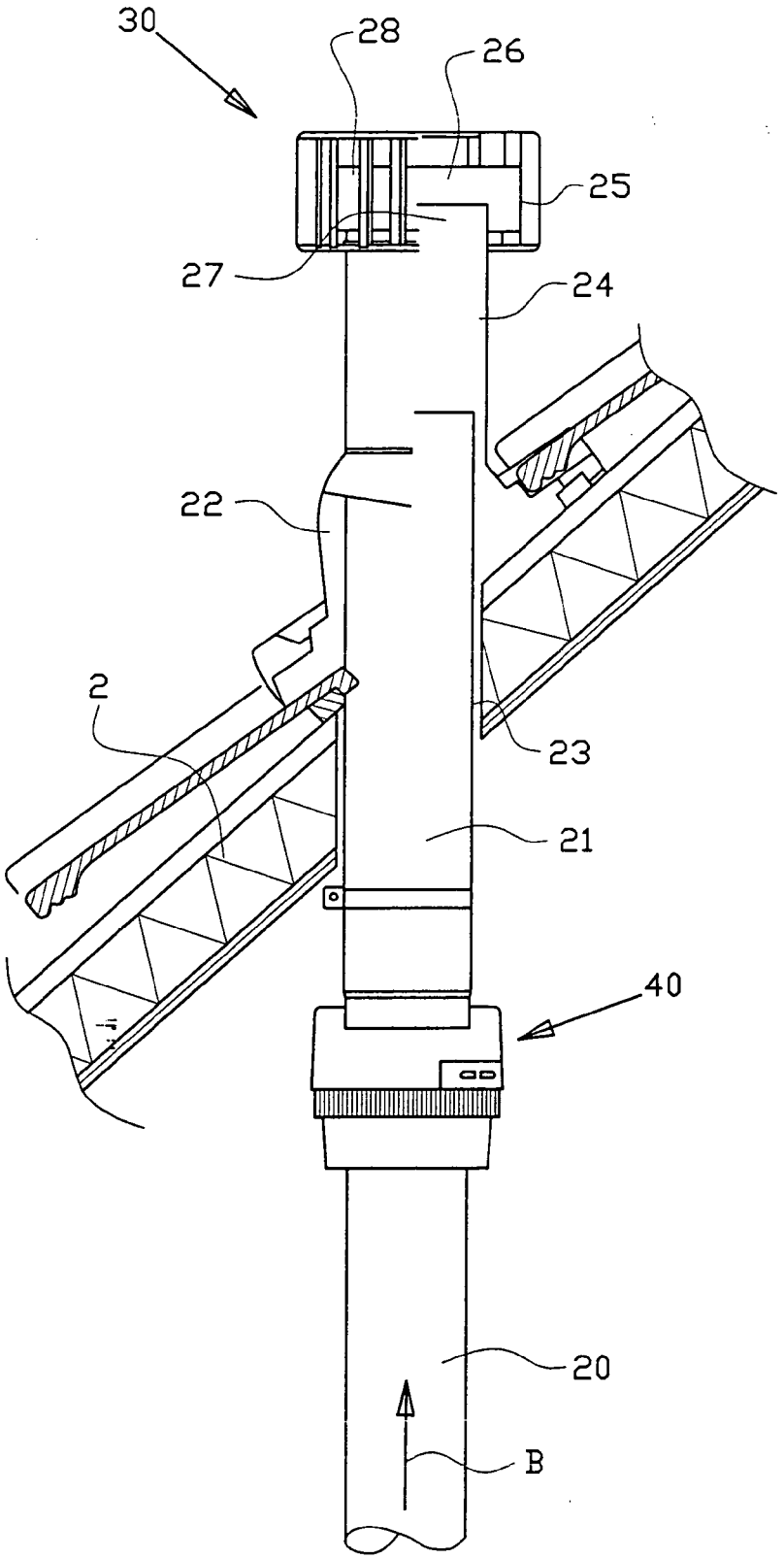

FIG. 1C

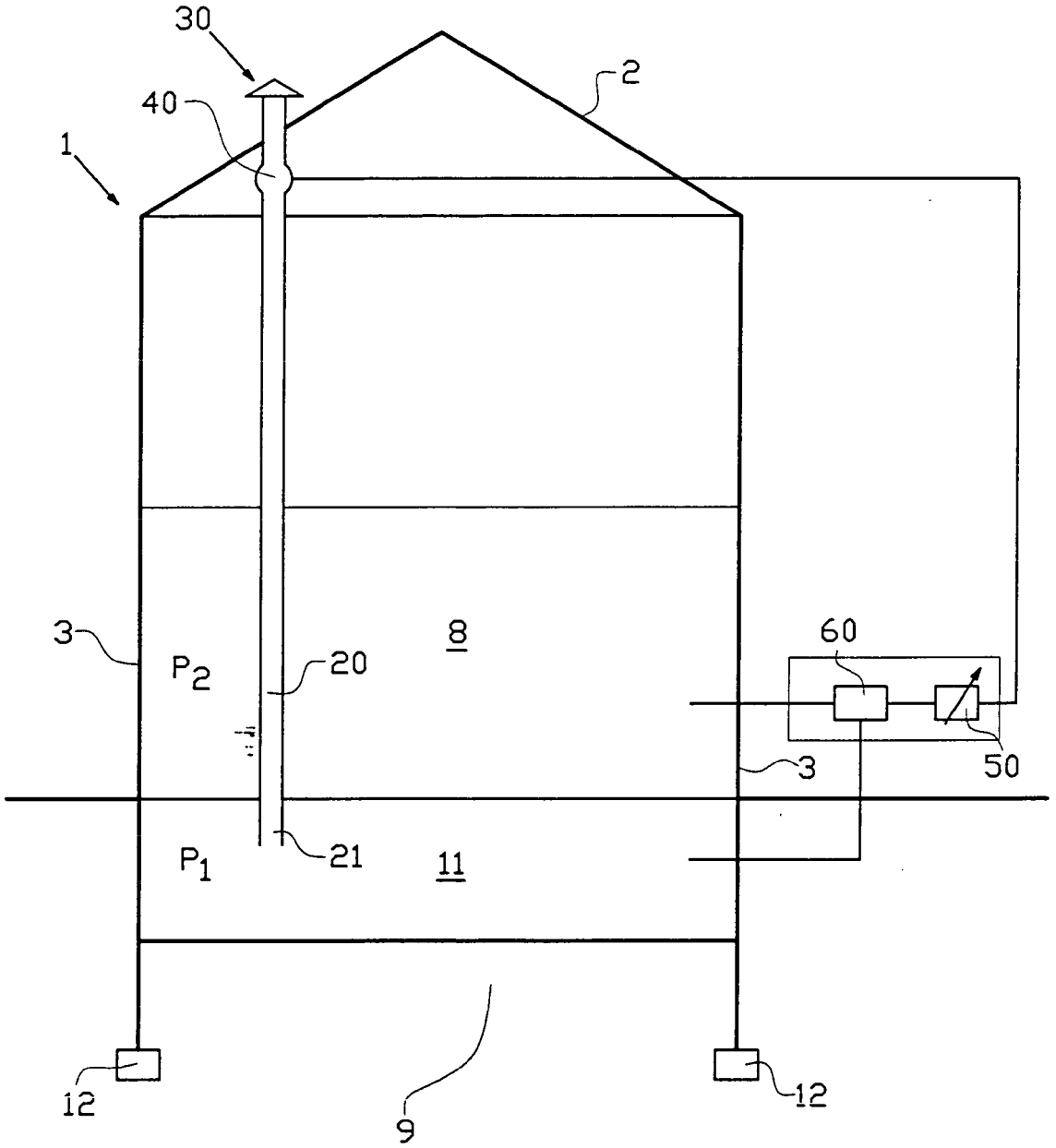

FIG. 2

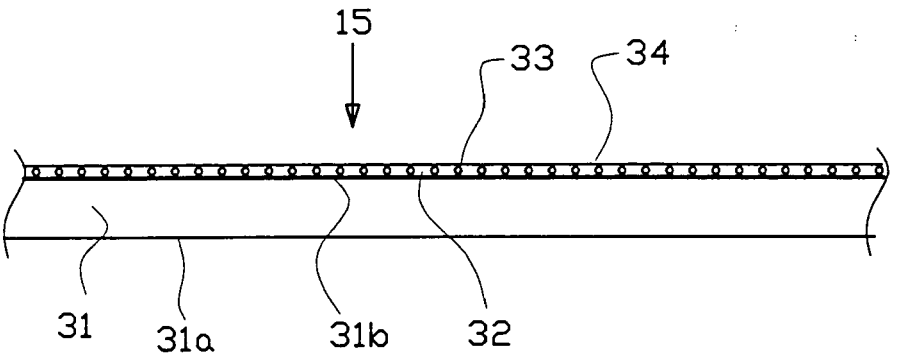

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 05 07 7509

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 January 2006	Rosborough, J

CATEGORY OF CITED DOCUMENTS

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