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(54) Gas-venting apparatus for a building and a method for its installation.

(57) Gas-venting apparatus comprises a precast concrete chamber (11) with separate base (12), cover (13) and annular wall (14) which are sunk into the ground beneath a building to collect gases therefrom. The gas permeates into the chamber through peripheral inlet apertures (16) and is vented through a vent duct connected to a peripheral outlet aperture (15). The vent duct opens to the exterior of the building or into the roof void and an impermeable membrane layed beneath the floor of the building prevents gases from rising into the building itself.

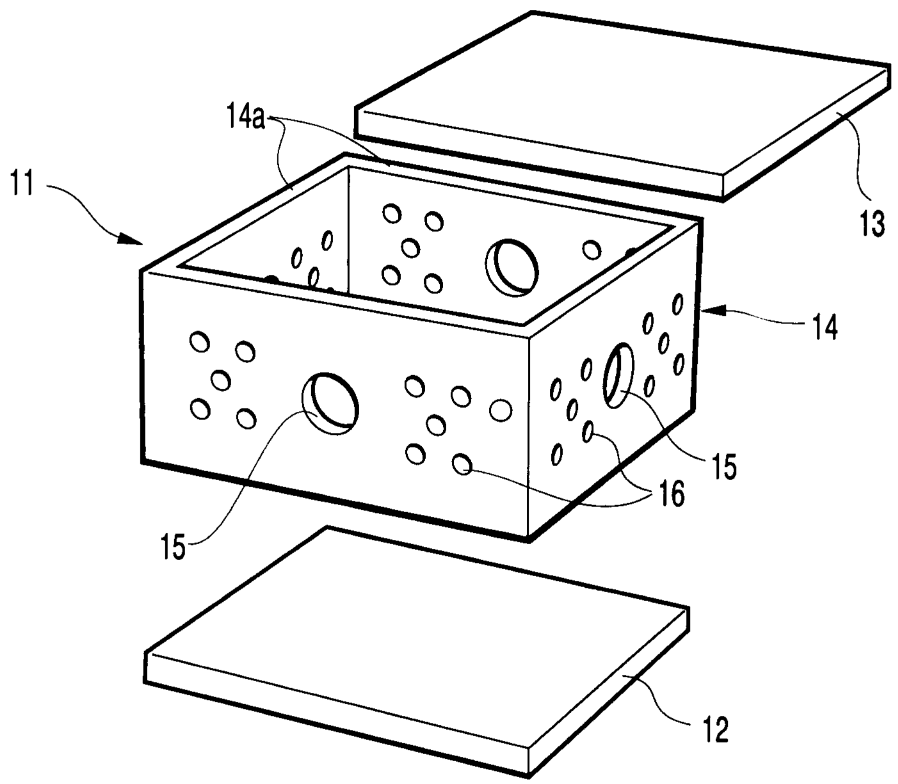

FIG 1

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The present invention relates to a suction-balance chamber particularly for location beneath the floor of a building to collect gases permeating from the underlying ground and for connection to a duct for venting the gases to the exterior of the building. The invention is particularly concerned with the venting of radon-containing gases to the exterior of a building but is also applicable to the venting of other noxious gases, such as methane, from underlying strata.

In recent years it has been realised that the problem of radioactive radon gas seeping up from the ground into buildings is quite widespread and is exacerbated by modern building techniques that reduce natural ventilation and cause the radon concentration to build up gradually over the years. Several methods have been developed to combat this problem and one is to build a chamber or sump beneath the building and to duct the gases which it collects to the exterior while an impermeable membrane located over the chamber prevents gases from seeping up through the floor into the building itself.

At present such chambers are usually built from brick, possibly with a cast-concrete floor and cover. Gaps are left between the bricks to allow gas to percolate into the chamber while a vent pipe leads from the chamber to the exterior or into the roof void to vent gas to the atmosphere. The chamber vent duct and inlets are so-dimensioned as to create a suction-balanced system which enables gas to flow freely through the chamber, possibly assisted by a fan or impeller in the vent duct.

A problem with the current brick-built chambers is that they are expensive to construct not only in terms of the actual material and labour costs for the building work itself but also because it is necessary to allow time for the mortar to set before the cover and impermeable barrier layer can be laid on top. This can mean that half a day's labour is lost, with the work force idle and unable to continue their subsequent work. A solution which has been proposed to this problem is to prefabricate the sump by moulding it from plastics materials. This reduces the installation time, and hence the installation costs, but the sump is itself expensive and also requires a separate, load-bearing cover to be placed over it during installation to prevent its deformation by overlying material, in use.

The object of the present invention is to provide a cheaper and more convenient chamber for such uses.

Accordingly, the present invention provides a prefabricated chamber for sinking in the ground beneath a building, comprising an annular wall having at least one aperture for connection to a vent duct and a plurality of gas-inlet apertures and a load bearing cover engaged with an open end of the annulus to close it. In use, the annular wall is intended to be sunk into the ground with its axis vertical and with the cover placed over it. A base on which the annulus will seat is preferably also included. The cover and base preferably comprise reinforced-concrete slabs of suitable thickness and of substantially the same peripheral dimensions as the external dimensions of the annular wall which is preferably also cast from concrete with suitable reinforcement. The slabs and annular wall may simply be rested one on top of another without any fixing means.

The annular wall may be of any sectional shape, such as circular, but conveniently is square. It may have only one aperture for connection to a vent pipe but, conveniently, has an aperture in each face so that, when placed in the ground in any one of four orientations, the face facing the vent pipe will present an aperture for connection thereto. The apertures not used for the vent may then constitute inlet apertures for the chamber and may simply be left open or may be connected to ducts which extend beneath the floor of the building to collect gases from areas remote from the chamber itself.

In addition to the above apertures, the annular wall preferably has a plurality of smaller apertures in each face for allowing gases into the chamber in use. In order to ensure a free flow of gas into the chamber through the inlet apertures and out through the single vent aperture, the total cross-sectional area of the inlets is preferably at least nine times the cross-section of the vent outlet. The annular wall is preferably formed so that it can be used with either open end uppermost.

The vent apertures are preferably spaced from that edge of the annular wall which will rest on the base, in use, in order to prevent any water which may collect in the chamber, for example due to condensation or seepage, from collecting in the vent duct.

In use of the chamber of the invention, a hole is first dug in the ground beneath the building which is to be protected from radon or other gas seepage. The concrete base is then simply placed in the bottom of the hole, the annular wall is placed on it, any pipework that it requires is laid and connected to the various apertures and the cover slab is placed on top.

The annulus may be of such a size and weight that it can be rested on the base without any need for attachment or location members although such members, for example in the form of projections on the base which engage in the corners of the square annulus, may be provided if desired. Similarly, the cover is preferably in the form of a simple square slab of concrete although locating means may be provided.

Once the annulus is in place and the pipes connected, the hole may be back-filled around the chamber with clean rubble. It will immediately be seen that the chamber of the invention may be installed very quickly and easily. No mortar is required to hold the annulus and/or cover in place and, indeed, would be disadvantageous not only because of the setting time involved but also because the slight gaps which would normally exist between the slabs and the edges of the annular wall provide further entry points for gases into the chamber. A further advantage in the use of concrete over plastics material is that the concrete itself may be permeable to gas, thus increasing the cross-sectional area open to the inflow of gas even further.

To enable a structure of suitable size for protecting a building against radon entry to be handled conveniently by a single person, at least the annular wall is preferably manufactured from a lightweight concrete. A concrete reinforced with silica fibres is found to be particularly convenient as it can be cast simply and quickly: galvanized steel reinforcements, which are also suitable, are more time-consuming to lay up.

The invention further comprehends a gas-venting system comprising: a suction-balance chamber as described above installed beneath the floor of a building; a vent duct connected at one end to a vent aperture in the annular wall of the chamber and opening at its other end to the exterior of the building or into the roof void, the vent duct optionally including a fan or impeller for drawing gas from the chamber and exhausting it through said other end; and a gas-impermeable membrane covering the chamber and extending beneath the floor of the building to prevent gas seepage from the underlying ground into the building. The vent duct may be sectional, the joints preferably being sealed to prevent the escape of gas therefrom. The system may further include one or more inlet ducts each connected at one end to an inlet aperture to the chamber and extending beneath the floor of the building to duct gas therefrom into the chamber.

A vent pipe which terminates in the roof void may rely on the pressure difference between the chamber and the roof of the building to ensure a flow of gases from the chamber up into the roof void from where they can escape to the atmosphere. Preferably, however, a fan or impeller is provided in the duct for drawing air from the chamber and expelling it into the roof void.

The invention further comprehends a kit comprising a suction-balance chamber and vent pipe, a gas-impermeable membrane and optional accessories as described above for use in the installation of the system described and a method of installing such a kit to protect a building from the percolation of gases from the underlying ground into the building.

One embodiment of the invention will now be more particularly described by way of example, with reference to the accompanying drawings, in which;

Figure 1 is a perspective view of a chamber according to the invention with the part separated; and

Figure 2 is an axial sectional view of the chamber of Figure 1 in its position of use, and

With reference to the drawings, a suction balance chamber is shown generally indicated 11. The chamber 11 includes two square reinforced concrete slabs 12 and 13, each measuring 600mm along each side and being 40mm thick. The slab 12 constitutes the base of the chamber whilst the slab 13 constitutes the cover. The peripheral wall of the chamber is constituted by a pre-cast, square annulus 14 also having external dimensions of 600mm along each side 14a but having a wall thickness of 75mm. The annulus 14 is 225mm high.

The annulus 14 has a central circular through-aperture 15 in each side 14a and a plurality of smaller apertures 16 grouped around each central aperture 15. The apertures 16 are also circular, for convenience of manufacture, but could be of any shape and arranged in any convenient manner. What is important is the cross-sectional area of the apertures 15 and 16 which will be explained further below.

As shown in Figure 2, in use, the chamber 11 is placed in a hole indicated 17 in the ground 18 beneath the floor of a building (not shown). The hole 17 may be dug in the floor of an existing building or may be dug during the erection of a new building. The chamber 11 is constructed simply by the placing of the base slab 12 on the flat bottom of the hole 17, the location of the annulus 14 on the base 12 and the subsequent placing of the cover 13 on the top of the annulus 14. Before the cover 13 is put in place, however, at least one of the central apertures 15 in the annulus is connected to a vent pipe indicated 20. The connection is effected simply by the fitting of one end of the pipe 20 into the selected aperture 15, the pipe being a fairly close fit but there being no need to seal the pipe in the aperture. From the chamber 11 the pipe 20 extends through a channel 21 in the ground 18 to a suitable point at which it can be connected at an elbow joint, not shown, to a vertical pipe which extends up into the roof void of the building.

The vent pipe may be formed in various sections which can be interconnected by sealed joints to form a required configuration to extend from the chamber to any selected outlet point, whether in the roof void or outside the building. A fan, also not shown, can be provided in the vent pipe to draw air through it from the chamber 11 and to exhaust it into the roof void or to the exterior of the building.

The other three larger apertures 15 in the sides 14a of the annulus 14 which are not connected to the vent pipe 20 may be left free or, as shown in Figure 2, may receive the ends of inlet pipes indicated 22. These inlet pipes may extend only a short distance from the chamber 11 as shown in Figure 2 or extend in suitable channels for a considerable distance beneath the floor of the building. The inlet pipes 22 may be of a porous material and/or may be perforated to allow any gas in the ground 18 beneath the building to seep into them and from there into the chamber 11. Gas will also seep into the chamber through the smaller apertures 16 in its walls.

In this embodiment the larger apertures 15 have a diameter of 100mm while the smaller apertures 16 have a diameter of 40mm, there being ten smaller apertures 16 in each side 14a of the annulus 14. The cross-sectional area of the outlet aperture 15 connected to the vent pipe 20 is thus approximately 8,000sq mm while the total cross-sectional area of the three inlet apertures 15 plus the apertures 16 is approximately 74,000sq mm, with a ratio of the inlet cross-sectional area to the outlet cross-sectional area of approximately 9.4:1. This is greater than the minimum ratio of 9:1 which is required to create a suction balance and ensure a free flow of air into the chamber 11 through the various inlets and out through the vent pipe 20. It will also be appreciated that the gaps between the annular wall 14 and the base 12 and cover 13 provide a further inlet for gases while the concrete constituting the three members 12, 13, 14 of the chamber is also gas-permeable.

The preferred concrete for the annular wall 14 is a lightweight concrete reinforced with silica fibre. An annulus 14 made from this concrete is sufficiently light to be handled by one person. The slabs 12 and 13 may be made from the same concrete. Alternatively the slabs 12, 13 and/or for the wall 14 may be made from concrete reinforced with galvanised steel rods.

Once the chamber 11 has been installed in the hole 17 and the ducts 20, 22 connected, the area around the chamber 11 is back-filled with clean rubble indicated 23 and a gas-impervious membrane 24 of known type is laid over the chamber so as to cover the entire ground area within the building. In use, radon permeating up through the ground will seep through the inlet apertures 16 and through any inlet ducts connected to the apertures 15 into the chamber 11 from where it will be exhausted through the vent pipe 20 by means of the fan. This prevents a build-up of gas beneath the impervious membrane 24 which itself prevents the gas from leaking into the building.

A chamber of the size described above is suitable for protecting a building with a floor area of up to about 250sq m. The chamber 11 would preferably be sunk in the centre of such a building and would operate over a radius of about 9m. If it were necessary to locate the chamber near one side or corner of the building, apertures in the sides 14a of the chamber facing out of the building could be blanked off: it might, in addition, be necessary to provide one or more additional chambers under other parts of the building.

Naturally, the dimensions of the chamber 11 may be altered at will to suit a particular use, but chambers of the following dimensions have been found suitable in practice:

Thickness of cover and base slabs	: 50mm
Height of annular wall	: 225mm
External dimension of each side of cover, base and annular wall	: 600mm, 407mm or 305mm.

In practice it is also found convenient to cast the annular wall 14 with a very slight taper from top to bottom, to facilitate release from the mould and also to form the apertures 15, 16 therein with a slight taper, from the exterior to the interior of the chamber, for the same reason.

In addition, apertured plugs (not shown) are provided for insertion in any of the four central apertures 15 in the annulus 14 which are not connected to a vent pipe 20 or to an inlet pipe 22. The plugs are a close fit in these apertures and themselves have apertures of substantially the same diameter as the apertures 16. The plugs prevent any smaller pieces of the backfill rubble 23 from entering the chamber 11, in use, while providing additional inlet apertures.

Example

Sumps as described above have been installed in various buildings and have been found to reduce the radon level therein. The results of tests with various numbers of sumps of different sizes are summarised in the table below.

Building Type	Floor area (m^2)	Sumps Installed No	Sump dimensions (mm)	Fan Operating Rate (Vol. through put m^3/min)	Radon level before Installation (Bq/m^3)	Radon level after Installation (Bq/m^3)
Bungalow with 2 separate floor areas	40	2	407 x 407 x 225	3.63	880	18
Bungalow	35	1	407 x 407 x 225	3.63	650	20
Split-Level House	55	3	2 x 407 x 407 1 x 600 x 600	7.26 (2 Fans)	1500	17
Split-Level House	58	3	2 x 407 x 407 1 x 305 x 305	7.26 (2 Fans)	2300	15
Bungalow	38	1	407 x 407 x 225	3.63	600	21
Bungalow		2	407 x 407	3.63	780	14

Claims

1. A prefabricated chamber for sinking in the ground beneath a building, comprising an annular wall open at at least one end and having at least one peripheral gas-outlet aperture for connection to a vent duct and a plurality of peripheral gas-inlet apertures and a load-bearing cover engaged with the open end of the annular wall to close it.

2. A prefabricated chamber as claimed in Claim 1, further including a base for supporting the annular wall and closing the end opposite the end closed by the cover.

3. A prefabricated chamber as claimed in Claim 2, in which the annular wall comprises an open-ended pre-cast reinforced concrete member of substantially uniform internal and external cross-section and the base and cover comprise precast reinforced concrete slabs of substantially the same peripheral dimensions as those of that end of the annular wall they are to close.

4. A prefabricated chamber as claimed in any one of the preceding claims, in which the total cross-sectional area of the gas-inlet apertures is at least nine times the total cross-sectional area of the outlet aperture or apertures.

5. A gas-venting system comprising: a prefabricated chamber as claimed in any one of the preceding claims installed beneath the floor of a building with the annular wall located with its axis substantially vertical and the cover closing its upper end; a vent duct connected at one end to the at least one outlet aperture in the annular wall of the chamber and opening at its other end to the exterior of the building or into the roof void; and a gas-impermeable membrane covering the chamber and extending beneath the floor of the building to prevent gas seepage from the underlying ground into the building.

6. A kit for forming a gas-venting system, comprising an annular chamber wall open at at least one end and having at least one peripheral gas outlet aperture and a plurality of gas inlet apertures, a load-bearing cover engageable with the open end of the annular wall to close it, a gas-impermeable membrane for location over the chamber beneath the floor of a building and a vent duct connectible to the outlet aperture to vent gases from the chamber.

7. A kit as claimed in Claim 6, further including a base for supporting the annular wall and closing that end opposite the end closed by the cover.

8. A kit as claimed in Claim 6 or Claim 7, further including a fan or impeller for location in the vent duct to draw air from the chamber and expel it through the vent duct.

9. A kit as claimed in any one of Claims 6 to 8, further including at least one inlet duct for connection to an inlet aperture of the chamber.

10. A kit as claimed in any one of Claims 6 to 9 in which the annular wall has a plurality of identical outlet apertures and the kit includes at least one plug which is a cooperating fit in an outlet aperture.

11. A method of installing a venting system for a building with the use of a kit according to Claim 6, including the steps of; forming a hole in the ground beneath the floor, or intended floor, of the building sufficient to accommodate a chamber comprising the annular wall and its cover; placing the annular wall in the hole with its axis substantially vertical and its open end uppermost; placing the load-bearing cover on the annular wall to close its open upper end; connecting the inlet end of the vent duct to the outlet aperture of the chamber wall; laying the impermeable membrane over the chamber and beneath the entire floor area of the building; and arranging the vent duct such that an outlet end opens to the exterior of the building or into a roof void.

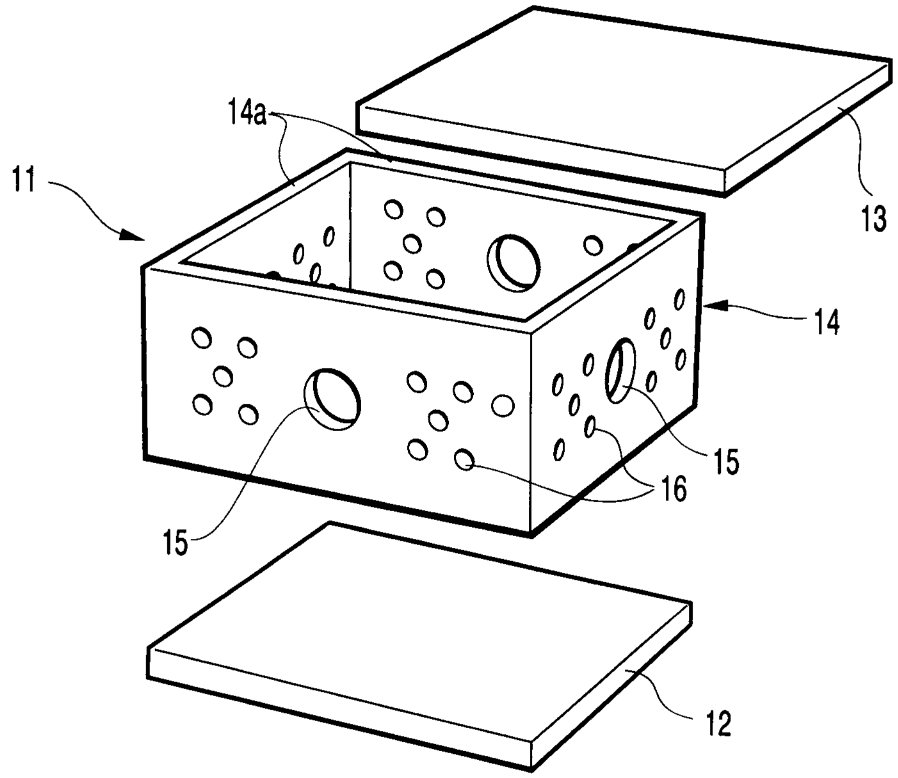

FIG 1

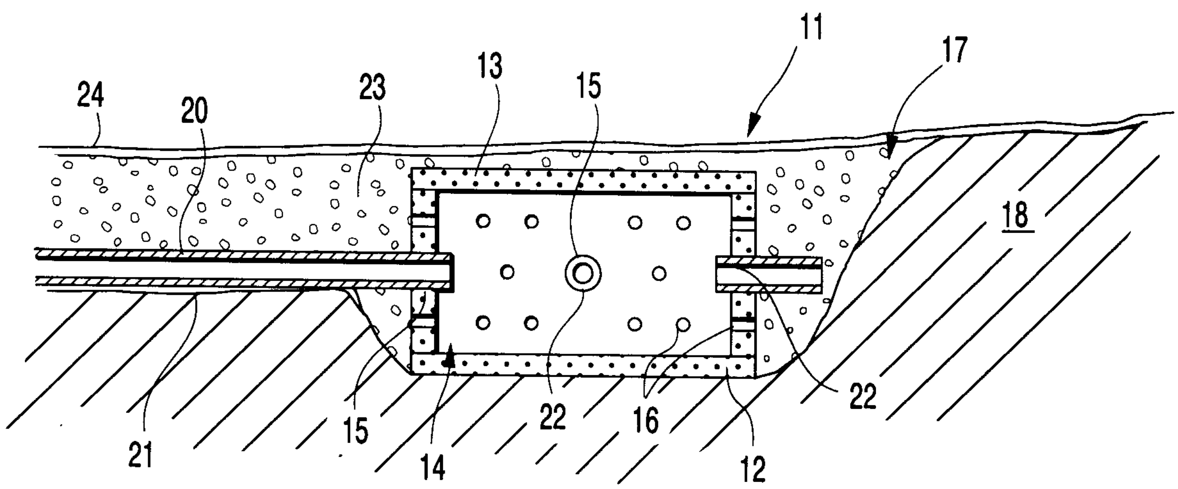

FIG 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 92 31 1362

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8 905 890 (ERIKSSON & CLAVENSJÖ)	1,5,6,8, 11	E02D31/00 E04H9/16
A	* page 2, line 23 - page 4, line 6; figure *	2,3,7,10	
A	US-A-4 957 394 (JARNAGIN) * column 2, line 40 - column 3, line 51; figure 1 *	1,2,5,6, 8	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E02D
E04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	04 MARCH 1993	BLOMMAERT S.

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
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