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## Description

### TECHNICAL FIELD

**[0001]** The invention relates to a device intended to produce a pressure difference in and/or a flow of a gas between an accumulation of the gas beneath a foundation of a house and a surrounding in order to remove the gas from the accumulation of the gas beneath the foundation of the house. The device comprises a fan house and a fan unit arranged within the fan house, the fan unit comprising at least one fan arranged to produce the pressure difference in and/or the flow of the gas. The invention also relates to a use of such a device.

### PRIOR ART

**[0002]** Beneath foundations of houses, gases, such as radon or moisture saturated air, may accumulate. These gases may defuse through the foundation of the house, which in the case of radon creates health hazards due to radioactive radiation, and in the case of damp air creates problems with mould and/or fungus growth destroying the house.

**[0003]** These problems are solved by removing the gas from the space beneath the foundation of the house. One device for removal of gas from beneath a foundation of a house according to the prior art comprises a piping drilled through the foundation, such that the piping makes contact with the accumulation of gas beneath the foundation of the house. The device further comprises a suction apparatus, wherein the gas is sucked off through the piping by the suction apparatus. One problem with such devices is that they make much noise, therefore inhabitants, in a residential property for example, may have difficulties sleeping due to the level of noise.

**[0004]** One device intended to solve this problem is described, for example, in the document SE 9802299-9. The document describes a suction apparatus comprising two fans mounted together in a cassette and coupled in series, wherein the suction abilities of the fans are added. Thus, the size and the power generation of the fans can be halved which decreases the noise generated by the fans. One problem with this device is that the cassettes are difficult and expensive to manufacture. Another problem with this device is that the fans still generate too much noise when a powerful suction efficiency is demanded.

### SUMMARY OF THE INVENTION

**[0005]** The object of the present invention is to indicate a device for removal of a gas from beneath a foundation of a house, the device being simple and inexpensive and swift to manufacture and repair. Another object is to indicate a device generating less noise.

**[0006]** This object is achieved with the device described in the introduction being **characterised in that** the fan unit comprises a block made in a porous material,

the block comprising at least a first hollow space with a first hollow space opening mouthing on the outside of the block, said fan being insertable into and removable from the hollow space through the hollow space opening, and the fan being arranged in the first hollow space to produce a flow of and/or a pressure difference in the gas.

**[0007]** By the fan being arranged in a hollow space in a block of a porous material, the vibrations generated by the fan are reduced by the material in the block. Thus, the noise from the fan is muffled, wherein the device becomes more silent, since the noise is absorbed within the block. Thus, the device becomes as silent that it can be positioned in a bedroom and used even during night, without disturbing sleepers in the bedroom. Since the fan is easily insertable into the hollow space, the manufacturing of the device is very fast, therefore the manufacturing costs become very low. Such an insertion operation is very fast and can be carried out automatically by, for example, a machine.

**[0008]** If much gas has been accumulated beneath the foundation of the house, the device produces a pressure difference in and a gas flow from the accumulation and out to the surroundings. If the amount of gas in the accumulation is small, the device at least produces a pressure difference between the accumulation and the surroundings, making the gas pressure in the accumulation much lower than the air pressure in the surroundings. Upon a possible increase in the amount of gas in the accumulation, for example, due to an inflow of gas from the ground, the surplus of gas thus arisen is immediately removed from the accumulation by the device, due to the device producing a flow off from the accumulation.

**[0009]** According to a preferred embodiment, the block comprises an inlet channel with an inlet opening mouthing on the outside of the block, which inlet channel is arranged to make an inflow of gas possible, wherein the hollow space communicates with the inlet channel. Preferably, the block also comprises an outlet channel with an outlet opening mouthing on the outside of the block, which outlet channel is arranged to make an outflow of the gas possible, wherein the hollow space communicates with the outlet channel. The device is thus arranged to achieve a flow from the inlet opening to the outlet opening. Due to the fact that the airflow generated by the fan passes through the inlet channel and the outlet channel and thus passes through the block, the noise that follows the air stream is also softened after the passage through the fan, wherein the device becomes even more silent.

**[0010]** According to one embodiment of the invention, said hollow space is at least partly limited by two opposite walls of said porous material, wherein the hollow space and/or the fan are shaped such that the fan tightly bears against both these walls and such that the fan is held firmly in the hollow space. Thus, no additional means for fastening are needed to hold the fan firmly in the hollow space after the fan has been inserted into the hollow space. Thus, the manufacturing of the device becomes fast and inexpensive, since no additional operation for

fastening the fan is needed. Furthermore, the costs of the device are decreased, since the cost for a fastening means can be omitted. By the fan tightly bearing against the walls, the leakage past the fan decreases. A possible reverse suction through the device, that is a flow in the direction from the outlet channel to the inlet channel, is eliminated. Thus, the efficiency of the device increases. Preferably, said walls are adapted to the fan in such a way that the fan tightly bears against the walls at least around the hollow space opening. Thus, no leakage takes place between the hollow space and the area outside the block through the hollow space opening. Thus, the entire airflow passes through the block and its communication channels in a direction from the inlet channel to the outlet channel and through the fan achieving the flow of and/or the pressure difference in the gas.

**[0011]** According to a further embodiment of the invention, the hollow space is essentially box shaped, the hollow space being limited by a cross wall and a long wall essentially perpendicular to each other and to the hollow space opening, the area of the cross-wall being smaller than the area of the long wall. The hollow space is thus essentially rectangular, which is a shape simple to achieve, lowering the manufacturing costs and the time for manufacturing. Preferably, the hollow space is substantially flat in such a way that the cross-wall is considerably shorter than the long wall.

**[0012]** According to a further embodiment of the invention, the inlet channel comprises an inflow opening, mouthed in said hollow space and being arranged to allow an inflow of gas to the hollow space, the inflow opening being arranged substantially in the middle of the long wall of the hollow space, the outlet channel comprising an outflow opening mouthed in said hollow space and being arranged to allow an outflow of gas from the hollow space, and the outflow opening being arranged in the cross-wall of the hollow space. Usually, the fans have a shape being something in between being circular cylindrical and rectangular. The fans have their inlet substantially in the middle on their end surface and their outlet on their mantle surface. By arranging the inflow opening and the outflow opening on the hollow space as described, the inflow opening ends up substantially in the vicinity of the inlet of the fan and the outflow opening ends up substantially in vicinity of the outlet of the fan, wherein losses due to the fall of pressure through the hollow space and the fan decrease.

**[0013]** According to a further embodiment of the invention, the block comprises a second hollow space separated from the first hollow space by a partition wall of said porous material, the device comprising a second fan arranged in the second hollow space. By the use of two fans, a greater suction performance is obtained. A larger suction performance can also be obtained by using a large fan, but a large fan generates more noise than two smaller fans with the same suction ability. The device thus becomes more silent by the use of two smaller fans. Preferably, the device comprises four fans, wherein the block

comprises four hollow spaces, each fan being arranged in one hollow space. Thus, the suction ability of the device can be further improved.

**[0014]** According to a further embodiment of the invention, the block comprises a communication channel arranged between the first and the second hollow space, the communication channel being arranged to allow a flow of gas between the hollow spaces. Preferably, the communication channel is formed by the outlet channel of the first hollow space and the inlet channel of the second hollow space. By a communication channel being arranged between the hollow spaces, a coupling of the suction abilities of the fans is made possible.

**[0015]** According to a further embodiment of the invention, the fans are connected in series with each other such that the gas first passes through the first fan and then passes through the second fan, wherein the pressure differences of the gas achieved by each fan are added. By two fans being connected in series, the joint pressure difference, which the fans may achieve, is doubled.

**[0016]** Preferably, the device comprises four fans and four hollow spaces, wherein the device also comprises three communication channels, one communication channel between each pair of hollow spaces. Preferably, the four fans are connected in series. Thus, the pressure difference, which the device can achieve, may be substantially quadrupled. Since the amount of gas beneath the foundation of a house normally is small, it is more important that the device may achieve a large pressure difference between the accumulation of the gas and the surroundings, than the device being able to remove large amounts of gas. Thus, it is very advantageous to connect the fans in series, since the pressure difference that the device can achieve increases.

**[0017]** According to a further embodiment of the invention, the block comprises a top plate comprising said hollow space openings, a bottom plate being substantially solid and a middle part comprising the inlet channel, the outlet channel, the hollow spaces and the communication channel between the hollow spaces. Thus, the block can easily be manufactured at a low cost by casting and/or punching each part and a subsequent attachment of the parts to each other. Preferably, the parts are attached to each other by gluing, but the top plate and the bottom plate can also be attached to the middle part in some other known way. By manufacturing the block in three parts, the parts can be cast or punched, which is considerably less expensive than by, for example, milling the hollow space from one single block. Preferably, the communication channels and the hollow spaces substantially pass straight through the middle part, wherein the floor and the ceiling of the communication channels and the hollow spaces are constituted by the floor plate and the top plate, respectively. It is also possible to manufacture a block with more than three parts.

**[0018]** According to a further embodiment of the invention, the block is self-supporting. With this is meant that

the block holds together by itself, such that no additional housing or other external equipment is needed to keep the block together. Thus, the manufacturing of the device becomes considerably simpler and faster.

**[0019]** According to a further embodiment of the invention said porous material is a polymer material. Polymers are in general inexpensive materials and also vibration and shock absorbing. A polymer material thus efficiently muffles the sound from the fans. Preferably, said polymer material is a plastic foam. Plastic foam has a very high noise insulating ability and thus the sound passing through the block becomes very low. Plastic foam is furthermore inexpensive and light, wherein the device weighs very little. Furthermore, a plastic foam is flexible, wherein the plastic foam easily is compressed when the fans are inserted into the hollow spaces and thus exerts a pressure against the fans. Thus, the fans bear against the block tighter, which gives a smaller leakage. Preferably, said porous material also has closed pores. With this is intended that the air cells in the material are separate and closed, wherein air cannot pass through the block (except for in the communication channels and the hollow spaces intended therefor). Thus, no leakage through the material of the block takes place. Preferably, the material of the block is constituted to at least 90% of said porous material, wherein the volume of the block, including the channels and the hollow spaces in the block, to at least 30% is constituted by the porous material. Thus, it is provided that the block comprises a sufficient amount of material to keep the block together and to sufficiently muffle the sound from the fans.

**[0020]** According to a further embodiment of the invention, said fan house comprises a first casing and a second casing arranged inside the first casing, the fan house comprising an insulating material arranged in between the first and the second casing, and the fan unit being arranged inside the second casing. In such a way, yet a further layer of sound insulation for reducing the sound from the fans is obtained. Further, the fan house gives a good protection against external influences, such as from blows or rapid temperature changes.

**[0021]** According to a further preferred embodiment of the invention, the device comprises a fluid conductor comprising a first and a second end, the first end communicating with the accumulation of gas beneath the foundation of the house and the second end communicates with said inlet opening, and the device being arranged to remove the gas from the accumulation beneath the foundation. By arranging such a fluid conductor, it is secured that the device communicates with the accumulation of gas, wherein the gas can be removed from the accumulation beneath the foundation of the house. Preferably, the fluid conductor is arranged to pass through a hole in the foundation of the house. Preferably, the fluid conductor is formed in accordance with the previously known thin-pipe method.

**[0022]** A further object of the invention is to indicate a use of the device described above.

**[0023]** This object is achieved with a use of a device according to any of the claims 1-17, wherein the device is used to remove gas from an accumulation of gas beneath a foundation of a house. The device is well suitable for such a use, since the device is very silent and thus can be positioned in places where a low level of sound is desirable, such as in bedrooms.

## DESCRIPTION OF THE FIGURES

**[0024]** The invention shall now be described in greater detail with embodiments shown as examples and with reference to the attached drawings.

- 15 Fig. 1 shows a house and a foundation of the house, beneath which gas is accumulated, which house comprises a device for removing the gas.
- 20 Fig. 2 shows a fan arrangement according to one embodiment of the invention.
- Fig.3A shows a cross section of the block in Fig. 3A from above according to one embodiment of the invention.
- 25 Fig. 3B shows a cross section of the block in Fig. 3A from the side.
- 30 Fig. 3C shows a cross section of the block in Fig. 3A from the side along another cut than the cut in Fig. 3B.

## DESCRIPTION OF EMBODIMENTS

- 35 **[0025]** In Fig. 1 a house 1 comprising walls 3, a roof 5, and a foundation 7 is shown. The foundation 7 is anchored in a ground 9, wherein the foundation 7 comprises a protruding runner 11 extending downwards into the ground 9 and running around the underside of the foundation 7. From the ground 9, radon gas and moisture rise upwards, wherein the radon gas and the moisture are accumulated beneath the foundation 7. In time, moisture may, as an example, make the foundation 7 wet, wherein the moisture may continue upwards into the walls 3.
- 40 When the house 1 has been damp during a period of time, there is a hazard for mould and fungus growth in the house 1, wherein the house 1 becomes ruined. In the same way, radon may accumulate beneath the foundation 7, wherein the radon penetrates the foundation 7 when the content of radon beneath the foundation becomes high and thereafter accumulates inside the house 1. Radon is radioactive and decays, wherein the radon emits radioactive radiation that may cause cancer in those inhabiting the house 1. In order to prevent both these problems the radon and/or the moisture beneath the foundation 7 must be removed.
- 50 **[0026]** In order to remove the gas beneath the foun-

dation 7, which gas usually is air comprising radon and/or moisture, a device for removing the gas is arranged in the house 1. The device comprises a fluid conductor system comprising a main conductor 13 and several thin fluid conductors 15a-b. The thin fluid conductors 15a-b are connected with the main conductor 13 and arranged to pass through the foundation 7, wherein the thin fluid conductors 15a-b are in contact with the zone beneath the foundation 7 and thus with the accumulation of gas beneath the foundation 7. The thin fluid conductors 15a-b are thus arranged to pass through a hole 13 through the foundation 7. Further the device comprises a fan arrangement 19 communicating with the main fluid conductor 13 wherein the fan arrangement 19 is arranged to achieve a flow of gas from the accumulation of gas beneath the foundation and out to the surroundings of the house 1. The fan arrangement 19 thus blows the gas through an outlet 21. If the pressure of the gas in the accumulation beneath the foundation is small, the fan arrangement at least achieve a pressure difference between the gas in the accumulation beneath the foundation 7 and the gas in the surroundings of the house 1.

**[0027]** A fluid conductor 15a-b communicating with the zone beneath the foundation 7 can only remove gas from a zone with a certain area. The area of the zone depends only insignificantly on the pressure difference between the zone beneath the foundation 7 and the surroundings of the house 1. Thus, there is in principle a limit on the size of the zone beneath the foundation, which a single thin fluid conductor 15a-b can cover. This problem is solved by the fluid conductor system comprising a plurality of thin fluid conductors 15a-b arranged at a distance from each other and evenly distributed across the foundation 7, wherein the whole area beneath the foundation 7 is covered.

**[0028]** For two different thin fluid conductors 15a-b the accumulation of gas beneath the foundation 7 may have different gas pressures and quantities of gas. Thus, it happens that a large flow passes through one thin fluid conductor 15a, while a small or no flow passes through the second thin fluid conductor 15b. In order to avoid that the suction ability through the thin fluid conductors are lost for some fluid conductors 15b, the thin fluid conductors 15a-b are formed such that the fall of pressure through the fluid conductor 15a-b increases substantially at a certain flow of gas through the same. Thus, the flow and the pressure difference respectively through the fluid conductors 15a-b may be maintained for all thin fluid conductors 15a-b even when a large amount of gas is accumulated beneath one of them. Thus, the suction ability is maintained beneath the entire foundation 7 despite differences in the amount of gas or inflow of gas beneath different parts of the house 1. The main fluid conductor 13 is thus arranged thick in relation to the thin fluid conductors 15a, 15b, such that the fall of pressure in the main fluid conductor 13 is small.

**[0029]** In Fig. 2, the fan arrangement 19 according to one embodiment of the invention is shown. The fan ar-

rangement 19 comprises a housing 23 and a fan unit 25 arranged within the housing 23. The fan unit comprises a block 27 of a porous material and four fans 29 a-d arranged in hollow spaces within the block 27. The block 27 is shown in Fig. 3A in a cross section from above and in Fig. 3B and 3C in a cross section from the side.

**[0030]** The block 27 comprises an inlet channel 31 with an inlet opening 33 mouthed on the outside of the block 27. In this example, the inlet opening 33 mouths on the upper side of the block 27. The inlet channel 31 is arranged to allow an inflow of the gas. Furthermore, the block 27 comprises an outlet channel 35 with an outlet opening 37 mouthed on the outside of the block 27. In this example the outlet opening 37 mouths on the upper side of the block 27. The outlet channel 35 is arranged to allow an outflow of the gas. Furthermore, the block 27 comprises four hollow spaces 39a-b each with one hollow space opening 41a-d, mouthed on the outside of the block 27. In this example, the hollow space openings 41a-d mouth on the upper side of the block 27. The hollow spaces 39a-d communicate with the inlet channel 31 and with the outlet channel 35. The fans 29a-d are each inserted into a hollow spacing 39a-d through the hollow space openings 41a-d in Fig. 2. The fans 29a-d are arranged to achieve a pressure difference in the gas or a flow of the gas between the inlet channel 31 and the outlet channel 35.

**[0031]** In Fig. 3A are also shown communication channels 42a-c arranged between the hollow spaces 39a-d to allow a flow of gas between the hollow spaces 39a-d in a direction from the inlet channel 31 to the outlet channel 35. The communication channels 42a-c are in this example constituted by an outlet channel of one hollow space 39a-c and an inlet channel of another hollow space 39b-d. The fans 29a-d are thus connected in series. With this is intended that the gas passes through all the fans 29a-d on its journey from the inlet channel 31 to the outlet channel 35. Thus, the effects from the single fans 29a-d are added together, wherein the pressure differences from the fans 29a-d substantially are added, the fan unit 25 achieves a common pressure difference in the gas which is substantially four times the pressure difference from a single fan 29a-d.

**[0032]** During use of the fan arrangement 19, the gas is led into the block 27 via the inlet opening 33 and the inlet channel 31 to the first hollow space 39a, in which the first fan 29a is arranged. The fan 29a pushes the gas further towards the first communication channel 42a arranged in connection with and between the first 39a and the second hollow space 39b. In the second hollow space 39b a second fan 29b is arranged. In the same way, the block 27 comprises a second communication channel 42b arranged in connection with and between the second 39b and the third 39c hollow space and a third communication channel 42c arranged in connection with and between the third 39c and the fourth 39d hollow space. In the third 39c and the fourth 39d hollow space, a third 29c and a fourth fan 29d are arranged respectively, which

fans 29c-d push the gas further towards the outlet channel 35. The outlet channel 35 is arranged to communicate with the fourth hollow space 39d, wherein the gas is pushed out from the hollow space 39d and into the outlet channel 35. The outlet channel 35 comprises an outlet opening 37, wherein the gas is led out from the block 27. The gas thus passes through all four fans 29a-d, wherein the pressure difference between the inlet channel 31 and the outlet channel 35 is substantially four times as large as compared to if only one single fan had achieved the pressure difference.

**[0033]** The hollow spaces 39a-d are substantially box shaped, wherein the hollow spaces 39a-d in this example are limited by four walls and a floor of said porous material, in which the block 27 is manufactured. Two of the walls are cross-walls 43 and two of the walls are long walls 45. The cross-walls 43 are essentially perpendicular to the long walls 45 and both the cross-walls 43 and the long walls 45 are essentially perpendicular to the hollow space opening 41. The hollow spaces 39a-d are in this example shaped such that the fan 29a-b tightly bears against the two walls that are the long walls 45, such that the fan 29a-b is held firmly in the hollow space 39a-d by the friction between the fan 29a-d and the long walls 45 of the hollow spaces 39a-d. Further, the hollow space 39a-d is shaped such that the fan 29a-d bears tightly against the walls, at least around the hollow space opening 41 a-d, wherein the leakage between the fan 29a-d and the walls decreases. In this example, the area of the cross-walls 43 is less than the area of the long walls 45. Further, the width of the cross-walls 43 and the length of the long walls 45 define the size of the hollow space opening 41. The hollow space openings 41 are further arranged at a distance from the outer edges of the block 27.

**[0034]** The inlet channel 31 and the communication channels 42a-c each further comprising an inflow opening 47 mouthed in said hollow space 39a-d and being arranged to allow an inflow of gas to the hollow space 39a-d. The inflow opening 47 is arranged substantially in the middle of one long wall 45 of the hollow space 39a-d. Further, the outlet channel and the communication channels 42a-c each comprises an outflow opening 49a-d arranged to allow an outflow of gas from the hollow spaces 39a-d. The outflow opening 49 is arranged in a cross-wall 43 of the hollow space 39a-d. In this example, the outflow opening 49 completely covers one of the cross-walls 43. The inflow opening 47 next to the first hollow space 39a constitutes the end of the inlet channel 31. The outflow opening 49 next to the last hollow space 39d constitutes an opening to the outlet channel 35. The inflow openings 47 and outflow openings 49, respectively, of the other hollow spaces 39a-d constitute openings to the communication channels 42a-c. Further, the hollow spaces 39a-d are positioned displaced in relation to each other in the block 27. The hollow spaces 39a-d are thus positioned in a zig-zag pattern. Thus, it becomes easier to arrange the communication channels 42a-c between the hollow spaces 39a-b with a small fall of the pressure.

In this example, the hollow spaces 39a-b are displaced such that the outflow opening 49 of the first hollow space 39a is in level with the inflow opening 47 of the second hollow space 39b.

**[0035]** The hollow spaces 39a-d are further arranged at a distance from each other, wherein at least a part of said porous material is arranged between the fans 29a-d. Thus, resonance between the vibrations of the fans 29a-d is prevented. Further, the communication channels 42a-c, the inlet channel 31 and the outlet channel 35 are rounded, wherein the fall of pressure when the gas passes through the channels decreases.

**[0036]** The fans 29a-d each comprises an intake and an exhaust. The intakes are arranged on the sides of the fans 29a-d and the exhausts are arranged on the mantle surfaces of the fans 29a-d, wherein the intakes come to be placed in the vicinity of the inflow openings 47 and the exhausts come to be placed in the vicinity of the outflow openings 49 in the hollow spaces 39 when the fans 29a-d are inserted into the hollow spaces 39a-d.

**[0037]** In Figs. 3B and 3C, the block 27 is seen in a cross section from the side. From the figures, it is apparent that the block 27 is constructed from three parts: a bottom plate 51 being substantially homogeneous, that is, it does not comprise any communications channels or hollow spaces, a middle part 53, and a top plate 55. The middle part 53 comprises said hollow spaces, communication channels 42, and inlet and outlet channels 31, 35. The communication channels 42 and the hollow spaces 39 are arranged straight through the middle part 53, wherein the bottom plate 51 constitutes the floor of the communication channels and the hollow spaces. The top plate 55 comprises a smaller part of the hollow spaces 39, the inlet channel 33, and the outlet channel 37. Further, the top plate comprises in this example the hollow space openings 41, the inlet opening 33, and the outlet opening 37. The top plate 55 is thus arranged to constitute the ceiling to the communication channels 42a-c and the hollow spaces 39a-d in the block 27.

**[0038]** The block 27 is manufactured in a porous material, by which is intended that the material comprises pores and/or air bubbles. In this example, the porous material comprises closed pores, with which is intended that the pores and/or the air bubbles in the material are not connected with each other. Thus, no flow of air can pass through the material in the block 27. In this example, the porous material is a polymer material. Further, the polymer material is, in this example, a plastic foam. In this example, the material of the block 27 is constituted by at least 90% of said porous material. Further, the volume of the block 27, including the communication channels 42a-c and hollow spaces 39a-d situated in the block 27, is to at least 30% constituted of the porous material. Thus, it is secured that the block 27 comprises sufficiently of the porous material in order to effectively muffle the vibrations and sounds from the fans 29a-d. Further, it is secured that the block 27 is self-supporting, that is, that the block 27 holds together by itself. Thus, no additional

casing to force the block together is needed.

**[0039]** The three parts 51, 53, 55 in the block 27 are in this example glued to each other. In another example of the invention, the three parts 51, 53, 55, or the block 27, may instead be joined by screws or attached to each other in some other way. The figures 3B-C also show a moisture absorbing mat 57 arranged in the bottom of the hollow spaces 39 and between the bottom plate 51 and the middle part 53. Further, the mat 57 is arranged to protrude into the outlet 35. The air beneath the foundation 7 is usually saturated with moisture, wherein the hazard for depositing condensate is great when the gas is led into the block 27. The water thus condensates inside the block 27, wherein the condensate is absorbed by the moisture absorbing mat 57. The moisture is led through the mat 57, for example, with the help of capillary action, wherein the moisture is transported upwards to the protruding part of the mat 59. The protruding part 59 of the mat is arranged within the outlet 35, where the air has been somewhat heated by the heat generated by the fans 29a-b. The air is thus no longer saturated by moisture when the air passes the outlet 35, wherein the air dries the protruding part 59 of the mat 57. Thus, condensed moisture in the block 27 is removed from the block 27 with the help of the mat 57.

**[0040]** In the following the manufacturing of the fan unit 25 will be described. The first step in the manufacturing of the fan unit 25 is the manufacturing of the block 27. The block 27 is manufactured by casting the three parts, the bottom plate 51, the middle part 53, and the top plate 55, in a porous material, in this example plastic foam with closed pores. In another example of the invention, the channels 31, 35, 42, and the hollow spaces 39 are punched out from three homogeneous blocks of the porous material wherein the three parts 51, 53, 55 are obtained. Thereafter, the three parts 51, 53, 55 are attached to each other, which, in this example, takes place through gluing the parts 51, 53, 55 to each other. During the gluing of the parts 51, 53, 55, said mat 57 is also placed in the hollow spaces 39 and between the bottom plate 51 and the middle part 53. The parts can also be attached to each other in some other way than through gluing, for example by screwing, riveting or curing. Since the block 27 is manufactured in three separate parts, which are thereafter joined, the parts may be cast or punched. Casting is preferable compared to, for example, milling and removal of material from a homogeneous slab of material in order to create the communication channels 42 and the hollow spaces 39a-d, since no material then has to be removed from the block 27, producing no waste material during the manufacturing. Punching is preferable, since it is a very fast method. Of course, a block can also be manufactured from a single homogeneous slab of material by removal of material, but it is then much more difficult to remove the material through punching. Thereafter, the fans 29a-d are inserted into the hollow spaces 39 through the hollow space openings 41. Since the walls of the hollow spaces 39a-d bear against the fans 29a-d,

no fastening devices are needed to keep the fans 29a-b in place in the hollow spaces 39. Thus, it is sufficient to insert the fans 29a-b and no further operations for fastening are needed during the manufacturing. Further, the fans 29a-d are removable from the hollow spaces 39a-d, wherein a broken fan 29 simply can be changed during a reparation of the fan arrangement 19. The fan unit 25 is thereafter arranged into the housing 23. In another example, the fans 29a-d are inserted into the hollow spaces after the block 27 has been mounted into the fan house 23.

**[0041]** In Fig. 2 is shown the fan arrangement 19 comprising the fan house 23 and the fan unit 25 as described in the figures 3a-c. The fan house 23 comprises a first outer casing 61 of, for example, a sheet metal, arranged to protect the fan arrangement 19 from for example blows and impacts. The fan house 23 further comprises an inner casing 63 arranged within the first casing 61. Between the first outer casing 61 and the second inner casing 63 a layer of insulating material 65 is arranged. The layer 65 of insulating material is arranged to decrease the sound from the fans 29 further. The fan house 23 further comprises two fluid conductor openings 67. Only one fluid conductor opening 67 is visible in the figure, since part of the fan house 23 is cut off in the figure 2. The fluid conductor opening 67 is arranged to be connected to the main fluid conductor 13. The fan house 23 comprises two such main fluid conductor openings 67 partly to give the possibility to connect the main fluid conductor 13 to the fan arrangement 19 from different directions and partly to allow connection of two main fluid conductors 13 to the fan arrangement 19. Further, the fan house 23 comprises two outlet openings 69 arranged to allow a connection to an outlet valve 21 for exhaustion of the gas to the surroundings of the house 1. On the inside of the fan house 23 an inner outlet fluid conductor 71 is arranged to connect the outlet opening 69 to the outlet opening 37 of the block 27. The device further comprises a second inner fluid conductor 73 arranged to connect the inlet opening 33 to the main fluid conductor opening 67.

**[0042]** The invention is not limited to the embodiment shown herewith but can be varied freely within a framework of the following claims.

**[0043]** For example, the shape of the hollow spaces can be varied as well as the shape and the route through the block of the communication channels, the inlet channel and the outlet channel. For example, the hollow spaces can be shaped circular cylindrical or with some other shape in order to fit the fans. The number of fans, hollow spaces, communication channels, inlet channels, and outlet channels may be varied freely. The fans need not to be connected in series but can also be connected in parallel to each other or be connected as several parallel series or connected in some other way. The fan house may comprise several layers of insulation of different kinds and more or fewer casings. The fan house and the block can be shaped in another form than the one shown herein, such as, for example, circular cylindrical. Several

fans can also be arranged within the same hollow space. The hollow space openings, the inlet channel opening, and the outlet channel opening can be located on some other surface of the block than the upper side of the block.

## Claims

1. A device intended to achieve a pressure difference in and/or a flow of a gas between an accumulation of the gas beneath a foundation of a house and a surrounding in order to remove the gas from the accumulation of the gas beneath the foundations of the house, wherein the device comprises a fan house (23) and a fan unit (25) arranged within the fan house (23), wherein the fan unit (25) comprises at least one fan (29a-d) arranged to achieve the pressure difference in and/or the flow of the gas, **characterised in that** the fan unit (25) comprises a block (27) manufactured in a porous material, wherein the block (27) comprises at least a first hollow spacing (39a) having a first hollow space opening (41a) mouthed on the outside of the block (27), wherein said fan (29) is insertable into the hollow space through the hollow space opening, wherein the fan (29) is arranged in the first hollow space (39a) to achieve a flow and/or a pressure difference in the gas.
2. A device according to claim 1, **characterised in that** the block (27) comprises an inlet channel (31) with an inlet opening mouthed on the outside of the block, which inlet channel is arranged to make an inflow of the gas possible, wherein the hollow space (39) communicates with the inlet channel.
3. A device according to claim 1 or 2, **characterised in that** the block (27) comprises an outlet channel (35) with an outlet opening (37) mouthed on the outside of the block, which outlet channel is arranged to make an outflow of the gas possible, wherein the hollow space communicates with the outlet channel.
4. A device according to claim 1, 2, or 3, **characterised in that** said hollow space (39) is at least partially limited by two opposite walls of said porous material, wherein the hollow space and/or the fan (29) are shaped such that the fan tightly bears against both these walls and such that the fan is held firmly in the hollow space.
5. A device according to any of the previous claims, **characterised in that** said walls are adapted to the fan such that the fan tightly bears against the walls at least around the hollow space opening (41).
6. A device according to any of the previous claims, **characterised in that** the hollow space is substantially box shaped, the hollow space being limited by a cross-wall (43) and a long wall (45), which are substantially perpendicular to each other and to the hollow space opening (41), and the area of the cross-wall being smaller than the area of the long wall.
7. A device according to claim 6, **characterised in that** the inlet channel (31) comprises an inflow opening (47) mouthed in said hollow space (39) and being arranged to allow an inflow of gas to the hollow space, the inflow opening (47) being arranged substantially in the middle of the long wall (45) of the hollow space, the outlet channel comprising an outflow opening (49) mouthed in said hollow space and being arranged to allow an outflow of gas from the hollow space, and the outflow opening (49) being arranged in the cross-wall (43) of the hollow space.
8. A device according to any of the previous claims, **characterised in that** the block (27) comprises a second hollow space (39b) separate from the first hollow space (39a) by a partition wall of said porous material, wherein the device comprises a second fan (29b) arranged in the second hollow space (39b).
9. A device according to any of the previous claims, **characterised in that** the block (27) comprises a communication channel (42) arranged between the first (39a) and the second hollow space (39b), the communication channel being arranged to allow a flow of gas between the hollow spaces.
10. A device according to claim 9, **characterised in that** the communication channel is formed by the outlet channel of the first hollow space and the inlet channel of the second hollow space.
11. A device according to claim 9 or 10, **characterised in that** the fans (29a-b) are connected in series with each other such that the gas first passes through the first fan (29a) and then passes through the second fan (29b), wherein the pressure differences achieved by each fan (29a, 29b), respectively, are substantially added together.
12. A device according to any of the previous claims, **characterised in that** the block (27) comprises a top plate (55) comprising said hollow space opening (41), a bottom plate (51) being substantially solid, and a middle part (53) comprising the inlet channel, the outlet channel, the hollow spaces and the communication channels between the hollow spaces.
13. A device according to any of the previous claims, **characterised in that** the block (27) is self-supporting.
14. A device according to claim 13, **characterised in that** said porous material is a polymer material.



15. A device according to claim 14, **characterised in that** said polymer material is a foam plastic.

16. A device according to any of the previous claims, **characterised in that** said porous material has closed pores.

17. A device according to any of the previous claims, **characterised in that** the material of the block (27) at least to 90% is constituted by said porous material, and that the volume of the block (27), including the channels (31, 35, 42) and the hollow spaces (39) situated in the block, is at least to 30% constituted by the porous material.

18. A device according to any of the previous claims, **characterised in that** said fan house comprises a first casing (61) and a second casing (63) arranged inside the first casing, the house (23) comprising an insulating material (65) arranged between the first (61) and the second casing (63), and the fan unit (25) being arranged inside the second casing (63).

19. A device according to any of the previous claims, **characterised in that** the device comprises a fluid conductor (13, 15) comprising a first and a second end, the first end communicating with the accumulation of gas beneath the foundation of the house and the second end communicating with said inlet opening, and the device being arranged to remove the gas from the accumulation beneath the foundation.

20. A use of a device according to any of the claims 1-19, **characterised in that** the device is used to remove gas from an accumulation of gas beneath a foundation of a house.

#### Patentansprüche

1. Vorrichtung zur Erzeugung einer Druckdifferenz im Gas und/oder einer Gasströmung zwischen einem unter einem Gebäudefundament angeordneten Gasspeicher und einer Konstruktionsumgebung, mit dem Ziel, das Gas aus dem unter dem Gebäudefundament angeordneten Gasspeicher zu transportieren, wobei die Vorrichtung aus einem Gebläsegehäuse (23) und einer in dem Gebläsegehäuse (23) angeordneten Gebläseeinheit (25) besteht und wobei die Gebläseeinheit (25) aus mindestens einem Gebläse (29a-d) besteht, das so ausgelegt ist, dass die Druckdifferenz im Gas und/oder die Gasströmung erzeugt wird,  
**dadurch gekennzeichnet, dass**  
die Gebläseeinheit (25) aus einem Block (27) besteht, der aus porösem Material gefertigt ist, wobei der Block (27) mindestens eine erste Kammer (39a)

mit einer ersten Öffnung (41a) aus dem Block (27) aufweist, wobei sich vorgenanntes Gebläse (29) durch die Öffnung in die Kammer einsetzen lässt und wobei das Gebläse (29) so in der Kammer (39a) angeordnet ist, dass eine Gasströmung und/oder eine Druckdifferenz im Gas erzeugt wird.

2. Vorrichtung nach Anspruch 1,  
**dadurch gekennzeichnet, dass**  
der Block (27) einen Eintrittskanal (31) mit einer Eintrittsöffnung außen am Block aufweist, der so ausgelegt ist, dass der Gaseintritt ermöglicht wird und wobei die Kammer (39) mit dem Eintrittskanal verbunden ist.

3. Vorrichtung nach einem der Ansprüche 1 oder 2,  
**dadurch gekennzeichnet, dass**  
der Block (27) einen Austrittskanal (35) mit einer Austrittsöffnung außen am Block aufweist, der so ausgelegt ist, dass der Gasaustritt ermöglicht wird und wobei die Kammer mit dem Austrittskanal verbunden ist.

4. Vorrichtung nach einem der Ansprüche 1, 2 oder 3,  
**dadurch gekennzeichnet, dass**  
vorgenannte Kammer (39) mindestens teilweise durch zwei gegenüberliegende Wände aus dem porösen Material begrenzt wird, wobei die Kammer und/oder das Gebläse (29) so ausgebildet sind, dass das Gebläse fest an beiden Wänden anliegt und ortsfest in der Kammer gehalten ist.

5. Vorrichtung nach einem der vorgenannten Ansprüche,  
**dadurch gekennzeichnet, dass**  
vorgenannte Wände so auf das Gebläse abgestimmt sind, dass das Gebläse zumindest im Bereich der Kammer (41) fest an den Wänden anliegt.

6. Vorrichtung nach einem der vorgenannten Ansprüche,  
**dadurch gekennzeichnet, dass**  
vorgenannte Kammer (41) vorzugsweise kastenförmig ausgebildet ist und von einer Querwand (43) sowie von einer Längswand (45) begrenzt wird, die vorzugsweise senkrecht zueinander sowie zur Kammer (41) verlaufen und wobei die Fläche der Querwand kleiner ist als die Fläche der Längswand.

7. Vorrichtung nach Anspruch 6,  
**dadurch gekennzeichnet, dass**  
der Eintrittskanal (31) eine Eintrittsöffnung (47) in die Kammer (39) aufweist und so ausgebildet ist, dass der Gaseintritt in die Kammer ermöglicht wird, wobei die Eintrittsöffnung (47) vorzugsweise in der Mitte der Längswand (45) der Kammer angeordnet ist, wobei der Austrittskanal eine Austrittsöffnung (49) aus vorgenannter Kammer aufweist und so ausgebildet

ist, dass der Gasaustritt aus der Kammer ermöglicht wird und wobei die Austrittsöffnung (49) in der Querwand (43) der Kammer vorgesehen ist.

8. Vorrichtung nach einem der vorgenannten Ansprüche, 5  
**dadurch gekennzeichnet, dass**  
 der Block (27) eine zweite Kammer (39b) aufweist, die durch eine Trennwand aus vorgenanntem porösem Material von der ersten Kammer (39a) getrennt ist und wobei die Vorrichtung ein zweites Gebläse (29b) aufweist, das in der zweiten Kammer (39b) angeordnet ist. 10
9. Vorrichtung nach einem der vorgenannten Ansprüche, 15  
**dadurch gekennzeichnet, dass**  
 der Block (27) zwischen der ersten Kammer (39a) und der zweiten Kammer (39b) einen Verbindungskanal (42) aufweist, der so ausgebildet ist, dass die Gasströmung zwischen den beiden Kammern ermöglicht wird. 20
10. Vorrichtung nach Anspruch 9, 25  
**dadurch gekennzeichnet, dass**  
 sich der Verbindungskanal aus dem Austrittskanal aus der ersten Kammer und dem Eintrittskanal in die zweite Kammer zusammensetzt.
11. Vorrichtung nach Anspruch 9 oder 10, 30  
**dadurch gekennzeichnet, dass**  
 die Gebläse (29a-b) hintereinander geschaltet sind, so dass das Gas zuerst durch das erste Gebläse (29a) und dann durch das zweite Gebläse (29b) tritt, wobei die von jedem Gebläse (29a, 20b) erzeugten Druckdifferenzen vorzugsweise zusammen addiert werden. 35
12. Vorrichtung nach einem der vorgenannten Ansprüche, 40  
**dadurch gekennzeichnet, dass**  
 der Block (27) eine Deckplatte (55) mit vorgenannter Öffnung (41), eine vorzugsweise feste Bodenplatte (51) sowie einen zentralen Teil (53) mit dem Eintrittskanal, dem Austrittskanal, den Kammern sowie den Verbindungskanälen zwischen den Kammern aufweist. 45
13. Vorrichtung nach einem der vorgenannten Ansprüche, 50  
**dadurch gekennzeichnet, dass**  
 der Block (27) selbst tragend ausgebildet ist.
14. Vorrichtung nach Anspruch 13, 55  
**dadurch gekennzeichnet, dass**  
 das vorgenannte poröse Material ein Polymermaterial ist.

15. Vorrichtung nach Anspruch 14, 5  
**dadurch gekennzeichnet, dass**  
 das vorgenannte Polymermaterial ein Schaumkunststoff ist.
16. Vorrichtung nach einem der vorgenannten Ansprüche, 10  
**dadurch gekennzeichnet, dass**  
 das vorgenannte Schaumstoffmaterial geschlossene Poren aufweist.
17. Vorrichtung nach einem der vorgenannten Ansprüche, 15  
**dadurch gekennzeichnet, dass**  
 das der Block (27) zu mindestens 90 % aus vorgenanntem, porösen Material besteht und das die Gesamtheit von Block (27) einschl. den Kanälen (31, 35, 42) und den im Block vorgesehenen Kammern (39) zu mindestens 30 % aus dem porösen Material besteht.
18. Vorrichtung nach einem der vorgenannten Ansprüche, 20  
**dadurch gekennzeichnet, dass**  
 vorgenanntes Gebläsegehäuse aus einem ersten Gehäuse (61) und einem zweiten Gehäuse (63) besteht, das in dem ersten Gehäuse angeordnet ist, wobei das Gehäuse (23) ein Isoliermaterial (65) aufweist, das zwischen das erste Gehäuse (61) und das zweite Gehäuse (63) eingelagert ist und wobei die Gebläseeinheit (25) innerhalb des zweiten Gehäuses (63) angeordnet ist.
19. Vorrichtung nach einem der vorgenannten Ansprüche, 25  
**dadurch gekennzeichnet, dass**  
 die Vorrichtung eine Flüssigkeitsleitung (13, 15) mit einem ersten und zweiten Ende aufweist, wobei das erste Ende mit dem unter dem Gebäudefundament angeordneten Gasspeicher des Gebäudes in Verbindung steht und das zweite Ende mit vorgenannter Eintrittsöffnung und wobei die Vorrichtung so ausgebildet ist, dass das Gas aus dem unter dem Gebäudefundament angeordneten Gasspeicher transportiert wird.
20. Einsatz einer Vorrichtung nach einem der Ansprüche 1 bis 19, 30  
**dadurch gekennzeichnet, dass**  
 die Vorrichtung dazu dient, Gas aus einem unter einem Gebäudefundament angeordneten Gasspeicher zu transportieren.

## Revendications

1. Dispositif destiné à réaliser une différence de pression interne et/ou un flux de gaz entre une accumu-

- lation du gaz en dessous d'une fondation d'une maison et un environnement afin de retirer le gaz de l'accumulation de gaz en dessous des fondations de la maison, dans lequel le dispositif comprend un logement de ventilation (23) et une unité de ventilation (25), disposée dans le logement de ventilation (23), dans lequel l'unité de ventilation (25) comprend au moins un ventilateur (29a-d) disposé pour réaliser la différence de pression interne et/ou le flux de gaz, **caractérisé en ce que** l'unité de ventilation (25) comprend un bloc (27) fabriqué dans un matériau poreux, dans lequel le bloc (27) comprend au moins un premier espace creux (39a) ayant une première ouverture d'espace creux (41a) débouchant à l'extérieur du bloc (27), dans lequel ledit ventilateur (29) est insérable dans l'espace creux au travers de l'ouverture d'espace creux, dans lequel le ventilateur (29) est disposé dans le premier espace creux (39a) pour réaliser un flux et/ou une différence de pression dans le gaz.
2. Dispositif selon la revendication 1, **caractérisé en ce que** le bloc (27) comprend un canal d'arrivée (31) avec une ouverture d'arrivée débouchant à l'extérieur du bloc, lequel canal d'arrivée est disposé pour rendre possible un afflux du gaz, dans lequel l'espace creux (39) communique avec le canal d'arrivée.
  3. Dispositif selon la revendication 1 ou 2, **caractérisé en ce que** le bloc (27) comprend un canal de sortie (35) avec une ouverture de sortie (37) débouchant à l'extérieur du bloc, lequel canal de sortie est disposé pour rendre possible un flux de sortie de gaz, dans lequel l'espace creux communique avec le canal de sortie.
  4. Dispositif selon la revendication 1, 2 ou 3, **caractérisé en ce que** l'espace creux (39) est au moins partiellement limité par deux parois opposées dudit matériau poreux, dans lequel l'espace creux et/ou le ventilateur (29) est formé de sorte que le ventilateur s'appuie fermement contre ces parois et de sorte que le ventilateur est tenue fermement dans l'espace creux.
  5. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lesdites parois sont adaptées au ventilateur de sorte que le ventilateur s'appuie fermement contre les parois au moins autour de l'ouverture (41) de l'espace creux.
  6. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** l'espace creux forme sensiblement une boîte, l'espace creux étant limité par un paroi transversale (43) et une paroi longitudinale (45), qui sont sensiblement perpendiculaire entre elles et à l'ouverture (41) de l'espace creux, et l'aire de la paroi transversale étant plus petite que l'aire de la paroi longitudinale.
  7. Dispositif selon la revendication 6, **caractérisé en ce que** le canal d'arrivée (31) comprend une ouverture de flux d'arrivée (47) débouchant sur l'espace creux (39) et étant disposée pour permettre un flux d'arrivée de gaz dans l'espace creux, l'ouverture de flux d'arrivée (47) étant disposée sensiblement au milieu de la paroi longitudinale (45) de l'espace creux, le canal de sortie comprenant une ouverture de flux de sortie (49) débouchant dans ledit espace creux et étant disposé pour permettre un flux de sortie de gaz depuis l'espace creux, et une ouverture de sortie de flux (49) étant disposée dans la paroi transversale (43) de l'espace creux.
  8. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le bloc (27) comprend un second espace creux (39b) séparé du premier espace creux (39a) par une paroi formant cloison dudit matériau poreux, dans lequel le dispositif comprend un second ventilateur (29b) disposé dans le second espace creux (39b).
  9. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le bloc (27) comprend un canal de communication (42) disposé entre le premier (39a) et le second espace creux (39b), le canal de communication étant disposé pour permettre un flux de gaz entre les espaces creux.
  10. Dispositif selon la revendication 9, **caractérisé en ce que** le canal de communication est formé par le canal de sortie du premier espace creux et le canal d'entrée du second espace creux.
  11. Dispositif selon la revendication 9 ou 10, **caractérisé en ce que** les ventilateurs (29a-b) sont reliés en séries entre eux, de sorte que le gaz passe en premier au travers du premier ventilateur (29a) et passe ensuite au travers du second ventilateur (29b), dans lequel les différences de pression obtenues par chaque ventilateur (29a, 29b), respectivement, sont sensiblement ajoutée l'une à l'autre.
  12. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le bloc (27) comprend une plaque supérieure (55) comprenant ladite ouverture d'espace creux (41), une plaque inférieure (51) étant sensiblement pleine, et une partie médiane (53) comprenant le canal d'entrée, le canal de sortie, les espaces creux et les canaux de communication entre les espaces creux.
  13. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le bloc (27) est autoportant.

14. Dispositif selon la revendication 13, **caractérisé en ce que** le matériau poreux est un matériau polymère.
15. Dispositif selon la revendication 14, **caractérisé en ce que** le matériau polymère est une mousse plastique. 5
16. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit matériau poreux a des pores fermés. 10
17. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le matériau du bloc (27) est au moins à 90% constitué par ledit matériau poreux, et **en ce que** le volume du bloc (27), incluant les canaux (31, 35, 42) et les espaces creux (39) situés dans le bloc, est au moins à 30% constitué par le matériau poreux. 15
18. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit logement de ventilation comprend un premier coffrage (61) et un second coffrage (63) disposés à l'intérieur du premier coffrage, le logement (23) comprenant un matériau isolant (65) disposé entre le premier (61) et le second coffrage (63), et l'unité de ventilation (25) étant disposé à l'intérieur du second coffrage (63). 20 25
19. Dispositif selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le dispositif comprend un conducteur de fluide (13, 15) comprenant une première et une seconde extrémité, la première extrémité communiquant avec l'accumulation de gaz en dessous de la fondation de la maison, et la seconde extrémité communiquant avec ladite ouverture d'entrée, et le dispositif étant disposé pour retirer le gaz de l'accumulation en dessous de la fondation. 30 35
20. Utilisation d'un dispositif selon l'une quelconque des revendications 1-19, **caractérisé en ce que** le dispositif est utilisé pour retirer du gaz de l'accumulation de gaz en dessous de la fondation d'une maison. 40

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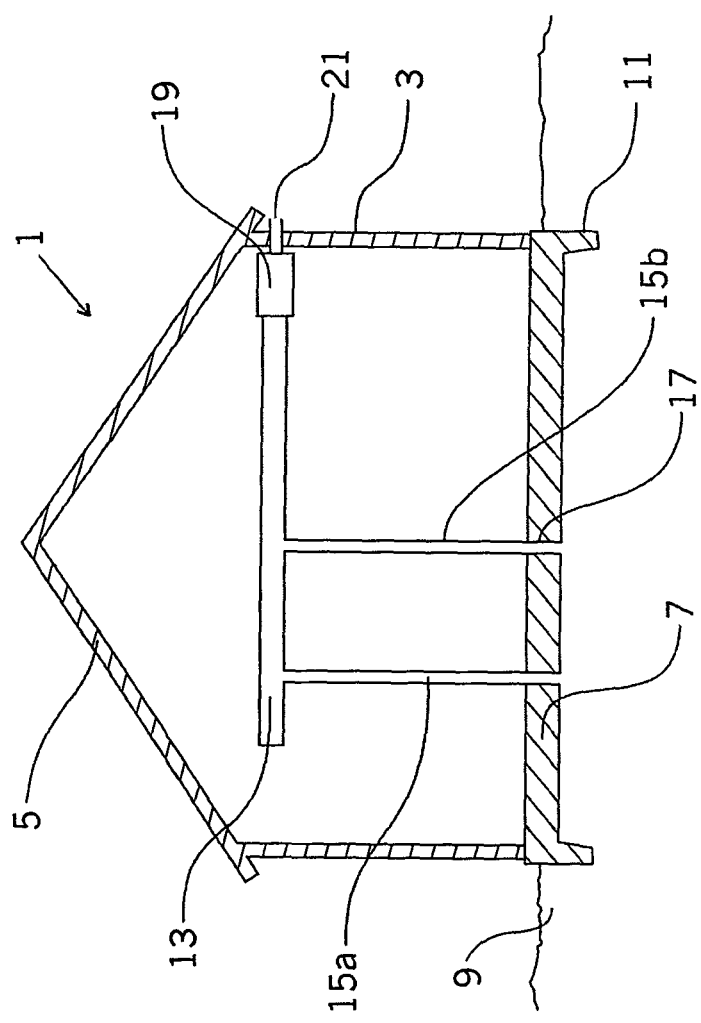


Fig 1

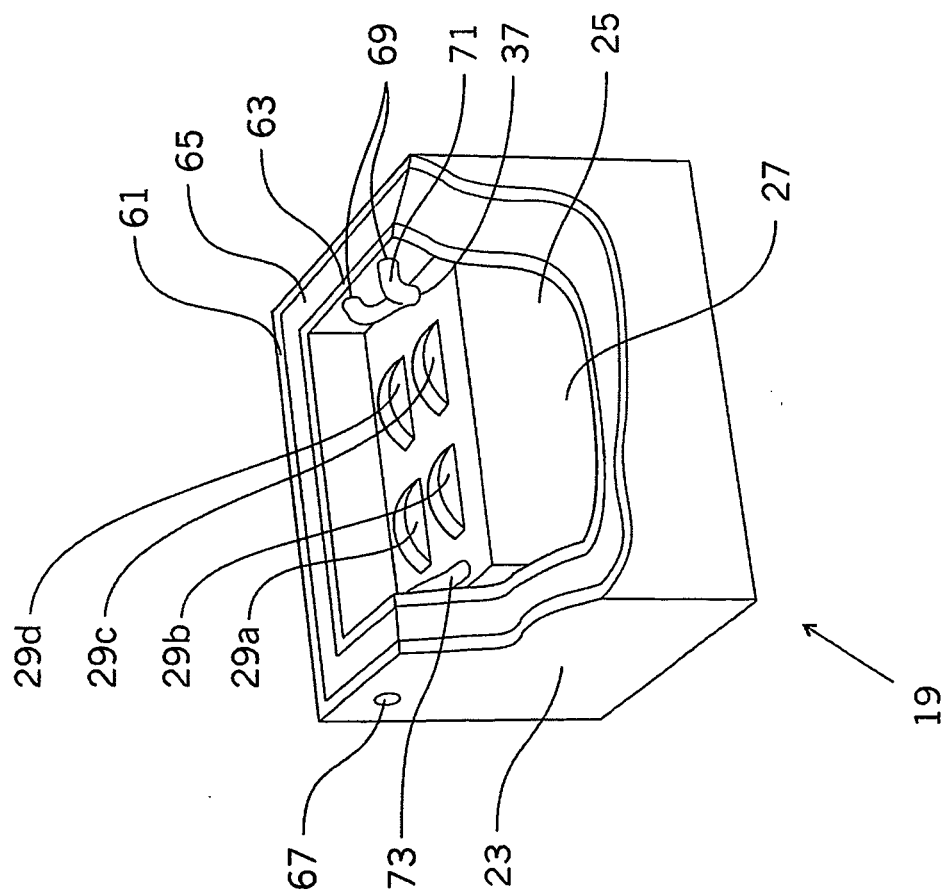


Fig 2

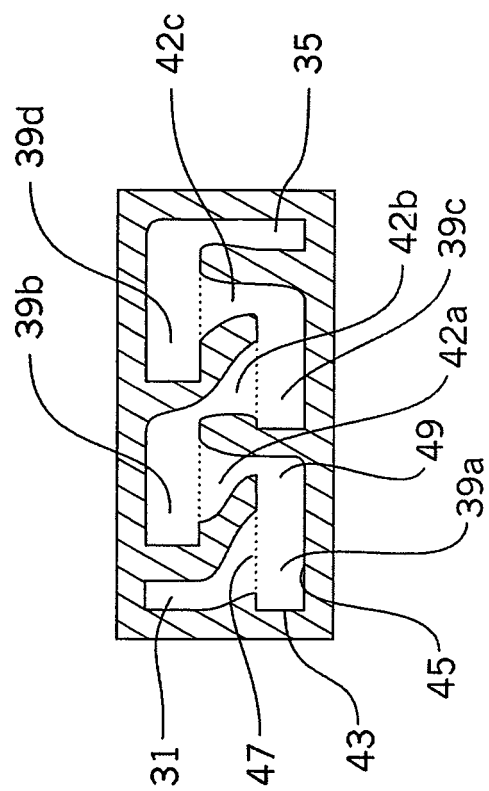


Fig 3A

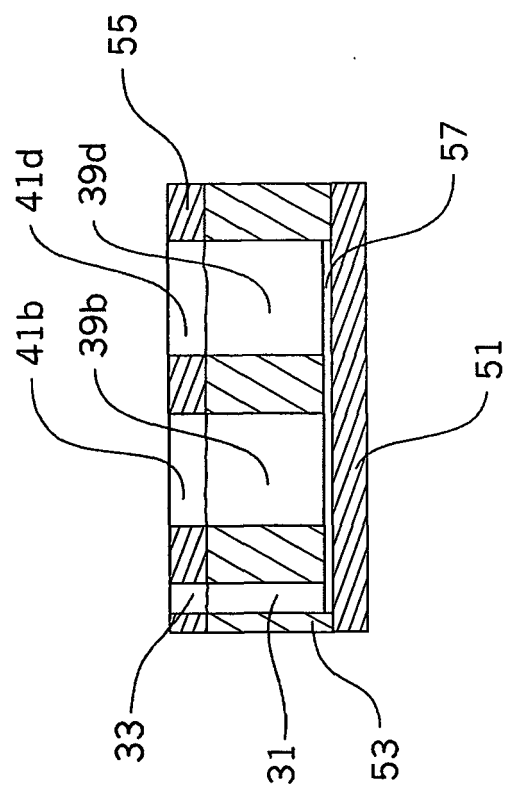


Fig 3B



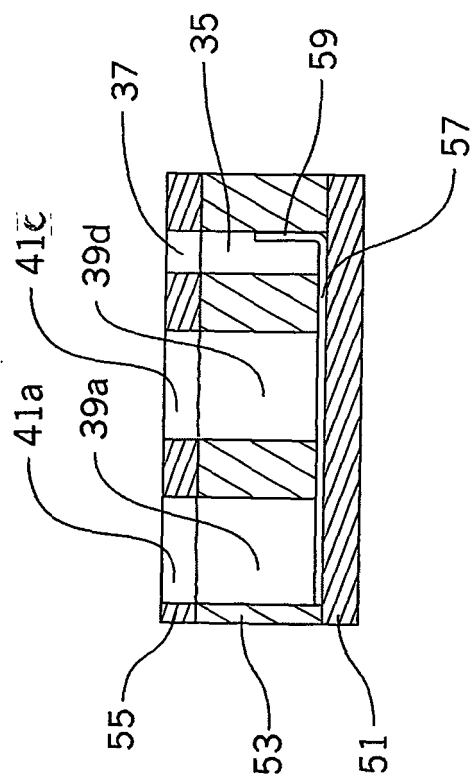


Fig 3C

**REFERENCES CITED IN THE DESCRIPTION**

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