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(54) **METHOD AND SYSTEM FOR REMOVING MOISTURE AND IMPURITIES FROM THE STRUCTURE**

VERFAHREN UND SYSTEM ZUM ENTFERNEN VON FEUCHTIGKEIT UND VERUNREINIGUNGEN VON DER STRUKTUR

PROCÉDÉ ET SYSTÈME POUR ÉLIMINER L'HUMIDITÉ ET LES IMPURETÉS DE LA STRUCTURE

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Description

Background of the invention

[0001] The invention relates to a method and system for removing moisture and/or impurities from a structure.

[0002] Construction defects and water damages cause moisture and mould problems both in new and old buildings. Particularly problematic are a ground slab, foundation wall and wall structure, which, if built in a wrong way and with wrong materials, as well as the formation of gaps due to the drying shrinkage of concrete and through holes, make it possible for humidity and impurities from the structures and the ground below to pass on to the indoor air and result in odour and health hazards. Problems are also caused by the erroneous adjusting of ventilation to be a negative pressure ventilation, in which case the make-up air is taken from the base floor, which increases the migration of impurities into the indoor air.

[0003] Fixing humidity problems is a difficult and time consuming activity, because all the damaged structures need to be dried or torn down. A concrete structure dries as a result of natural diffusion and evaporation, aiming to achieve an equilibrium moisture content with its surroundings. In diffusion, water vapour molecules move randomly in the pores of a porous material. Diffusion aims to balance vapour pressure differences of water vapour, whereby water vapour molecules move towards the lower partial pressure. The humidity rising from the ground as a result of diffusion or capillary force may cause moisture damages on a surface of a structure and odour and health problems for a user of the structure, if the moisture cannot evaporate quickly enough from the structure.

[0004] Publication EP 1760223 discloses a wooden plank floor beneath which plastic sheets resembling a waterstop sheet have been installed to circulate air in the space between a concrete slab and wooden plank floor. The humidity created by the drying of concrete is led to the room space from under the wooden plank floor. A problem with such a system is that as the concrete structure is drying, the moisture and impurities are transferred to the indoor air, which may cause health problems. There are also systems in use in which air is sucked from between mold-ings in the room to between the floor structures to dry the floor. The circulated air is finally led out. Leading air from the room space to between floor structures makes ventilation more difficult to adjust and gathers additional dust and impurities under the floor structure, possibly causing odour and health hazards.

[0005] Publication WO 2005047792 discloses a system for drying building structures such as floors, underfloor layers, and the like, in which a channeling arrangement having a plurality of channels is sealingly overlaid over the structure and a suction is applied to the channels by an external source to reduce the pressure in channels. Air, water, and water vapor are extracted from the structure and the low pressure conditions maintained by virture of the channels provide rapid drying of the structure.

[0006] In publication US 5155924 a dryer system for concentrated drying of water-damaged building surfaces in typical residential and commercial constructions is temporarily attached during the drying process and is removed after the damaged area is dried. The dryer system comprises a high-volume, forced air blower attached to an air diverter selected from a variety of different diverters configured to attach to various flat surfaces or corners in a room. The system forces dry air between partitioning studs in walls, through flutes typically found in tongue-in-groove flooring, and similarly behind ceilings.

[0007] Publication WO 2005047792 discloses a wall system for use on a vertical wall, such as a basement wall. A drain conduit is positioned adjacent the wall footer and a collection member is mounted along the bottom of the wall. A plurality of connector conduits extend between the collection member and the drain conduit. In one embodiment a vertical support column is mounted adjacent the wall.

[0008] Publication US 4 757 651 A1, which is considered to form the closest prior art, discloses a ventilation duct permanently fixed to the lower edge of a wall and connected to a drainage network. Holes in the upper part of the ventilation duct assure an air inlet to remove moisture from the wall structure to the drainage network.

Brief description of the invention

[0009] An object of the invention is thus to provide a method and a system so as to enable the aforementioned problems to be solved. The object of the invention is achieved by a method and system, which are characterized by what is disclosed in the independent claims. Some preferred embodiments of the invention are disclosed in the dependent claims.

[0010] The invention comprises a method for removing moisture and/or impurities from a structure by means of a system, which comprises an air circulation system for circulating air in a ventilation duct network. The ventilation duct network comprises at least one ventilation duct. The ventilation duct comprises a casing structure open at both ends and at least partly open on one side. In the method, at least one hole is drilled in the structure at the installation position of the ventilation duct, and the structure is partly or entirely roughened. After this, the ventilation duct is fixed air-tightly to the surface of the structure so that the roughened and perforated installation position in the structure is disposed inside the at least partly open side of the ventilation duct. Dry air is circulated in the ventilation duct network, whereby the moisture and/or impurities absorbed in the structure can proceed to the air circulated in the ventilation duct network.

[0011] An advantage of the method and system according to the invention is that the drying of the concrete structure may be enhanced and accelerated, whereby the structure dries faster dry enough for coating during repair and construction. In addition, the moisture caused

by a potential water damage or other sources of moisture may be easily removed without the moisture causing a health hazard. The system may also be used for removing impurities, such as detrimental volatile organic compounds (VOC), unpleasant odours, and radon.

[0012] Furthermore, the inventive method and system allow condition data of the structure in the ventilation duct network and/or inside the structure to be determined on the basis of the air circulated in the pipe system of the ventilation system. By means of the pipe system and the ventilation duct network of the air circulation system it is possible to detect moisture damages and/or increased impurities all over the structure. By means of the condition data measured by means of the system, possible leakage damages may be detected and repaired before they cause more serious damage to a building and health hazards to the people staying of living in the building. By means of sensors placed in the air circulation system, the location of a moisture damage in the building may be located fast and restricted to a particular area. Furthermore, by means of the system the structure may be dried at the same time as real-time information is obtained of the drying of the structures. In addition, a system that defines condition data of a structure is a good tool for monitoring the moisture in the structures of a building during the entire life cycle of the building.

Brief description of the figures

[0013] The invention will now be described in more detail in connection with preferred embodiments and with reference to the accompanying drawings, in which:

Figure 1 shows a system for removing moisture and/or impurities from a structure;
Figure 2 shows a system used in defining condition data of a structure;
Figure 3 shows a second system used in defining condition data of a structure; and
Figures 4a to 4d show different embodiments of a cross section of a ventilation duct;
Figure 5 shows a cross section of a concrete structure, comprising both a pipe system and a heating system of an air circulation system; and
Figure 6 show a method for removing moisture and/or impurities from a structure.

Detailed description of the invention

[0014] Figure 1 shows a system for removing moisture and/or impurities from a structure. The structure is advantageously a concrete structure or another porous structure in which moisture can move from one place to the next within the structure as a result of the capillary force, diffusion, or similar. Figure 1 shows a concrete wall structure rising up from a footing and is in contact with moisture rising from the ground. A capillary cut-off 17 may be formed in the wall structure to prevent the rise of moisture higher in the structure. The capillary cut-off 17 may be made, for example, by drilling at least one hole in the wall and by treating the hole thus formed by a substance preventing the rise of moisture. The position of the capillary cut-off 17 is determined on a case by case basis. In Figure 1, the capillary cut-off is formed at the level of the lower surface of a heat insulator. To prevent radon from accessing indoor areas of a building, a radon cut-off 15 is formed by a foil-like material, the bottom part of which is fixed to a wall by glueing, for example, and the top part is turned over the insulator, placing it under the cast floor. Although Figure 1 shows an interior wall, the wall structure may also be an external wall or another structure.

[0015] On the left side of the wall there is a ventilation duct 1, installed air-tightly on the surface of the wall structure. For fixing, at least one of the following may be used: screws, nails, glue, sealing compound, or other ways or substances suitable for fixing. In addition, at least one hole 16 has been drilled in the wall. The surface of the wall structure has been roughened for the part on which the ventilation duct 1 is to be installed, because there may be paint or other coating material on the wall surface, which prevents the passing of moisture to the outside of the wall structure. At the holes 16 and roughened surface, moisture and/or impurities may move on to the ventilation duct 1 to be taken away. The radon cut-off 15 at the ventilation duct 1 is fixed by its lower part to the wall structure, and by its end part air-tightly to the bottom part of the ventilation duct 1 and side and on the heat insulator. The floor cast to be provided on the ventilation duct 1 and heat insulator will permanently fix the ventilation duct 1 and radon cut-off 15 in place.

[0016] Figures 4a to 4d show different embodiments of a cross section of a ventilation duct 1 of the air circulation system. Plastic, metal or other suitable materials may be used as the material for the ventilation duct 1. The ventilation duct 1 comprises a casing structure open at both ends, and at least partly open on one long side. The cross section of the ventilation duct 1 shown in Figure 4a shows that the casing-like structure consists of a square casing 18 and wings 19 bent outside of the casing edges. A purpose of the wings 19 is to make possible air-tight fixing of the casing 18 to the structure by means of screws and/or sealing compound, for example. Other fixing methods may also be used. Figure 4b illustrates a square casing 18 according to Figure 4a, but with the wings 19 bent inwards in relation to the edges of the casing 18. In such a case, glue or sealing compound, for example, are well suited to fixing. Figure 4c shows a ventilation duct 1 similar to Figure 4a, but the casing 20 is of the shape of a semi-circle. The wings 19 are adapted to be bent outward from the casing 20. Figure 4d shows a semi-circle casing 20 with the wings 19 bending inward in relation to the casing 20 edges. The cross sections of the ventilation duct 1 are not limited to the shape in the above examples, but other applicable cross sections may be used. The ventilation duct 1 may be formed as a skirt-

ing board or another structure shaped esthetically suitable for use in an interior space of a building. A goal is to make as wide as possible a drying area of the structure in contact with the circulation of dry air.

[0017] The system may also comprise a pipe system 1a of the air circulation system, which may be used for drying and/or heating of a concrete slab. In said system, at least part of the pipe system 1a of the air circulation system is arranged to be permeable at least to moisture. In the system, the pipe system 1a of the air circulation system is arranged to circulate dry air in the pipe system 1a in question, and arranged to transfer moisture possibly absorbed by the structure through the pipe system 1a of the air circulation system to the air circulated in the pipe system 1a of the air circulation system. The pipe system 1a of the air circulation system may, in a not claimed embodiment, be used for drying and/or heating of any structure, such as a concrete slab. The pipe system 1a of the air circulation system may be installed in at least one structure, advantageously within the structure.

[0018] The structure is a wall structure. The air circulation structure is an air circulation, heating, and/or drying system which comprises an air circulation apparatus, air circulation channel network, as well as heating, drying, and/or cooling apparatus. In addition, the air circulation system comprises the pipe system 1a. In the pipe system 1a of the air circulation apparatus and ventilation duct network in the structure, air is circulated at high speed. Heating, and/or cooling apparatuses may be missing from the air circulation system, in which case room temperature air is circulated in the pipe system 1a and ventilation duct network. The system in the pipe system 1a and the channel network of the air circulation apparatus may be interconnected, whereby the same air is circulating in both of them, or a separate system may be formed of both, with different air circulating in them. Even though air is circulated in the air circulation system in the embodiments to be described below, other, not claimed, embodiments are not restricted to these embodiments, but instead of air, another gaseous medium suitable for the purpose may be used. Advantageously, the circulation speed of air is 5 to 10 m/s, but other speed may be used depending on the structure and system.

[0019] The air circulation system may comprise a drying feature, whereby the moisture in the structure may be transferred to the dry air circulated in the pipe system and led out of the structure. As a heat source of the air circulation system, heat sources of different kind may be used, such as direct electric heating, a fire-place, district heating, or a heat pump. Air may be circulated in heat distribution pipe systems 1a, ventilation duct networks, or other similar structures that are open casing structures, perforated structures, or otherwise so porous that they let moisture, air, or other gases through them. In such a case, they are moisture, air or other gases, and impurities, such as volatile organic compound (VOC), permeable. Moisture, air and/or impurities in the structure may pass from the structure to the air circulated in the air circulation system. The open casing structure of the ventilation duct network of the air circulation system and the holes and porous structure of the pipe system 1a enable direct contact for the circulated air to the surrounding structure, such as a concrete structure, whereby it is possible for the moisture in it to move to the circulated air through the holes or roughened structure. At the same time also the possible heat in the circulated air may transfer to the structure around the ventilation duct network and/or pipe system. The air exiting to the structure through the holes or porous structure of the ventilation duct network or pipe system 1a is insignificant. Before concrete pouring, the pipe system 1a may be wrapped in air-penetrating protective fabric to prevent the flowing of fresh concrete through the holes and clogging up the holes. If there is moisture and/or impurities present in the structure, according to an embodiment all or part of the circulated air may be removed outside and new air taken from the outside to replace it.

[0020] In addition to the air circulation system, the system may comprise a heating system which may be installed in the structure external to the pipe system of the air circulation system. The heating system may comprise an electric heating resistor wire, electric heating resistor network, water-circulation heating, warm air pipe system or another system suitable for heating. The heating system is advantageously installed between the pipes of the pipe system of the heating system but depending on the heating system, the heating system may also be installed elsewhere in the concrete structure such as in the concrete structure around the pipe.

[0021] According to an embodiment, the system in addition comprises the heating system described above, which is adapted to heat at least part of the structure outside the ventilation duct network. In such a case, the heating system, which is an electric cable, for example, may be installed to a wall, above the ventilation duct 1 shown in Figure 1, in which case it will be provided inside the floor cast. In such a case, the heating system transfers moisture and/or impurities to move towards the ventilation duct 1. If the wall in question is an internal wall, the heating system may be installed in the wall structure on the opposite side of the ventilation duct 1, whereby the moisture in the wall migrates, as a result of heating, towards the ventilation duct 1.

[0022] The air circulation system of a building may comprise one or more air circulation circuits whereby, for example, the ceiling, and floor may have one or more air circulation circuits as well. Thus, the entire floor of an apartment may be an air circulation circuits of its own, or each room or part of room of the apartment may have an air circulation circuit of its own. Likewise, the heating system may comprise one or more heating circuits, whereby a ceiling, walls, or floor may have one or more heating circuits installed in the structure around or between the pipe system 1a of the air circulation system or to a structure outside the ventilation duct network. The heating system may be installed in the immediate vicinity of the

pipe system, but elsewhere, too, if it is desired to dry moisture in different locations of the structure and/or it is otherwise desired to control the migration of moisture.

[0023] Figure 5 shows a cross section of a concrete structure, comprising a pipe system 1a and heating system 1b of an air circulation system, where at least part of the pipe system 1a of the air circulation system is arranged to be permeable at least to moisture. The heating system 1b is arranged to heat the concrete structures outside the pipe system 1a, and the pipe system 1a of the air circulation system is arranged to circulate dry air in the pipe system 1a. The pipe system 1a of the air circulation system is additionally arranged to transfer moisture and/or impurities possibly absorbed by the concrete structure through the pipe system 1a to the air circulated in the pipe system 1a of the air circulation system.

[0024] For the drying and/or heating of a moist concrete structure, at least part of the concrete structures outside the pipe system 1a and/or the structure outside of the ventilation duct network but in a fixed connection with the ventilation duct network, is heated by the heating system to increase the vapour pressure in the concrete structure. The molecules in the concrete structure move according to random thermal radiation. When a concrete structure is heated, the vapour pressure in the concrete structure increases and the movement of the concrete molecules picks up. At the same time as the concrete structure is heated, dry air is led to the pipe system 1a of the air circulation system and/or ventilation duct network, the partial pressure of the water vapour of which is lower than the partial pressure of the concrete structure. In such a case the moisture possibly absorbed by the concrete structure by the effect of the partial pressure difference in the concrete structure and pipe system 1a and/or in the ventilation duct network is able to migrate through the pipe system 1a and/or to the ventilation duct network from the concrete structure having a higher vapour pressure to the air having a lower vapour pressure, circulated in the air circulation system. As a result of diffusion, the molecules in the concrete move in such a manner that they move from their place to such a place where there are fewer molecules, that is, through the pipe system 1a and/or to the ventilation duct network to the air having a lower vapour pressure, circulated in the air circulation system. In Figure 5, the arrows 1c indicate the migration of moisture from the concrete structure to the pipe system 1a.

[0025] Dry air, which may be heated or cooled, is led to the air circulation system. The force driving diffusion in moisture migration is the absolute humidity of air, resulting in that concrete usually dries faster in winter time when there is less water vapour in the air. By heating cold winter air, its moisture absorption ability may be improved and drying accelerated. Usually, room-temperature dry air may be used as the air circulated in the pipe system 1a and/or ventilation duct network. Dry air refers to air whose relative humidity RH is advantageously ≤ 20 %, more advantageously $\leq$ 10 % and most advantageously RH is 0 %. If air has to be cooled, it is advantageously cooled down to the room temperature or below it. The temperature of the circulated air is advantageously 21 °C or less. The lower the temperature of the air is, the less water vapour it contains. Advantageously the humidity of the air circulated in the pipe system 1a is lower than the moisture of the concrete structure, in which case the moisture absorbed by the concrete structure by the effect of the partial pressure difference in the pipe system 1a and/or in the ventilation duct network is able to migrate from the concrete structure having a higher vapour pressure to the air having a lower vapour pressure, circulated in the pipe system 1a and/or the ventilation duct network. If there is no moisture in the concrete structure or there is no longer any need to dry it, the system may be merely used to heat the structure and the space outside of it. In this case, the air led to the air circulation system is heated and at the same time the structure may be also heated with the heating system 1b, if needed.

[0026] Moisture and/or impurities possibly gathered in the air circulated in the air circulation system may be removed from it by drying the circulated air with the drying system and/or by removing part of or all the circulated air from the air circulation system and taking in new air to replace it.

[0027] Figure 5 shows that the circulated air is led in the concrete structure at point A of the pipe system 1a of the air circulation system. The warm air circulates in the pipe system 1a inside the structure and dries the structure, also heating the structure if so desired, whereby the moisture and/or organic compounds in the structure are able to migrate to the circulated air from the perforated or porous pipe system 1a. The circulated air exits from within the structure at point B. The condition of the concrete structure may be monitored in real time by placing sensors measuring the condition of the structure inside, for example, a fan unit that blows air into the pipe system 1a, whereby their replacement and calibration is easy during use. The sensors may also be positioned in the air stream at different air distribution circuits. In Figure 5, at least one starting value of the air going into the structure may be measured at point A, for example, and at least one resulting value of the air coming from the inside of the structure may be measured at point B, for example. The condition data of the structure may be determined based on at least one measured starting and resulting value. When a starting and resulting value are measured, at least one of the following is measured: temperature, relative humidity of air, absolute humidity or air, amount of radon, and at least one content of volatile organic compound. For example, when the resulting value of the absolute humidity or air is measured for a longer time period, a change in the drying of the concrete structure may be deduced.

[0028] The system for removing moisture and/or impurities from a structure, described in the above, may additionally comprise a system for determining a condition data of the structure from the air circulating in the

pipe system 1a or ventilation duct network of the air circulation system. The air circulation system additionally comprises at least two sensors adapted in the air circulation system, in which system at least one sensor is adapted to measure at least one starting value from the air going to the air circulation system within the structure, and at least one sensor is adapted to measure at least one resulting value from the air coming from the air circulation system within the structure. Finally, to determine the condition data of the structure, the system is adapted to determine the condition data of the structure on the basis of at least one starting and resulting value.

[0029] Figure 2 shows a system that may be used to determine condition data of a structure. The system comprises four sensors 2 adapted in the air circulation system to gather information, a data collection system 3 adapted to receive and forward the information, and three servers 4, at least one server 4 of which is adapted to determine the condition data. The sensors 2 may be placed in the air stream at different air distribution circuits. In such a case, the condition data of each air distribution circuit may be separately determined by adapting at least two sensors 2 in each air distribution circuit. At least one sensor 2 may be adapted to measure at least one starting value from the air going inside the pipe system 1a and/or the ventilation duct network of the air circulation system, and at least one sensor 2 may be adapted to measure at least one resulting value from the air coming from inside the pipe system 1a and/or ventilation duct network of the air circulation system. For example, two sensors 2 may be placed in the floor structure in the pipe system 1a, and two sensors 2 in the wall structure in the ventilation duct network. The sensors 2 may be adapted to send the measured starting and resulting values to the data collection system 3. The data collection system 3 may be adapted to send at least one starting and resulting value received from at least one sensor 2 to at least one server 4. At least one sensor 2 may comprise a memory for storing the measurement data, and a processor for computing the condition data. In addition, at least one sensor 2 may send or receive data on a wired or wireless connection, whereby the sensor may send the condition data it computed directly to the data collection system.

[0030] The data collection system 3 may comprise at least one data logger 5, at least one data compiler 6, and at least one data conveyor 7 adapted to receive and send data, such as starting and resulting values or other data. The data logger 5 (DL) may be adapted to receive data from at least one sensor 2. The data compiler 6 (TK) may be adapted to compile the data received from at least one data logger 5, and the data conveyor 7 (TVL) may be adapted to convey data received from at least one data compiler 6 for at least one server 4. The data conveyor 7, data compiler 6, and/or data logger 5 may comprise a communication interface, which comprises an apparatus or software to communicate by means of at least one communications protocol. The communications interface makes it possible for the data conveyor 7, data compiler 6, and/or data logger 5 to access a wireless radio network, for example. The sensor 2, data logger 5, data compiler 6, and data conveyor 7 may both receive and send data, and they may be separate devices or at least two of them may be combined into one device. The devices may be interconnected with a fixed or wireless connection, such as Bluetooth or WLAN. Separate pieces of equipment may also be used for the connections, such as radio transmitters or receivers. In addition, the local area network of the measurement site may be utilized. The data conveyors 7, data compilers 6, data loggers 5, and/or sensors 2 of the data collection system 3 may be connected to a local area network (LAN), a radio network, such as a telephone network, a cloud service or the Internet for forwarding the data to at least one server 4, or for receiving data from at least one server 4. In Figure 2, the starting and resulting values have been sent to a server 4 in a cloud service.

[0031] In an embodiment, the data collection system 3 may also comprise a counter, a memory for storing starting and resulting values, data collection software, and processor for forming the condition data. If a change is detected in the condition data of the structure, it is possible to send an alarm message to a customer's device from the data collection system 3 by means of, for example, the data conveyor 7 through the phone network or the Internet as a text message or an e-mail. In an embodiment, the alarm caused by a change in the condition data of the structure may be seen in the data collection system 3 or in another way, for example, as an indicator light flashing on the device, or an alarm sound inside the building.

[0032] In an embodiment, the server 4 may be adapted to determine the condition data of the structure on the basis of at least one starting and at least one resulting value received from at least one data collection system 3. The server 4 may comprise a memory for storing starting and resulting values, server software, and processor for forming the condition data. There may be a plurality of servers 4, in which case different function may be carried out on different servers 4.

[0033] The condition data of the structure may be determined as a difference between at least one starting and at least one resulting value. A second option is to determine the condition data as a change rate, which may be formed by means of at least one difference between a starting value and a resulting value and the difference between at least one previously measured and computed starting and resulting value. In such a case, the change rate is determined by comparing the change with the behavioural history data. The previously measured starting and resulting values and the change rates of the condition data may be stored in the memory of the server 4, from which they may be retrieved when needed. In addition, a predetermined threshold value for the difference between the starting and resulting value as well as the change rate threshold value may be stored in the memory of the server 4, by means of which it is deter-

mined when to send an alarm message on a changed condition to a customer's device. By means of calculating the change rate, the aim is to disregard momentary changes in the condition, which may cause unnecessary alarms. Momentary changes in the condition may be caused by natural changes in the air humidity or temperature, for example.

[0034] The server 4 may be adapted to compare the obtained at least one difference between the starting and resulting value with a predetermined threshold value of the difference between the starting and resulting value, or to compare the change rate with a predetermined threshold value of the change rate. If said difference between the starting and resulting value deviates from the predetermined threshold value for the starting and resulting value, or if said change rate deviates from the predetermined threshold value for the change rate, the change is noted in the condition data of the structure and an alarm message is sent. It is possible to send an alarm message to a customer's device by means of, for example, the phone network or the Internet as a text message or an e-mail. The customer's device may be a phone 8, tablet 9, computer 10, or another applicable device. By the use of a separate application in the browser, on the phone 8 or tablet 9, the condition data may be monitored and alarms received and acknowledged.

[0035] Figure 3 shows a second system used for determining condition data of a structure, comprising four controllers 11 operationally connected to the data collection system 3 and adapted to receive and send data. A controller 11 may be adapted to receive control data sent from a user's device from the data collection system 3. The user's device may send control data either directly to the data collection system 3 or through a server 4 to the data collection system 3, which forwards the control data further to the controller 11. The controllers 11 may send a confirmation on the received control data to the server 4 in a return message. There may be one or more controllers 11. The control data may comprise different kinds of adjustment values relating to the air circulation system, such as temperature, humidity of the circulated air, or speed adjustment for air circulation. The control data may further comprise the adjustment of at least one heating system temperature. The controllers 11 may be connected through a fixed or wireless connection to at least one data logger 5, data compiler 6, or data conveyor 7 in the data collection system 3. The data collection system 3 forwards the messages received from the server 4 to the controller 11 and the messages received from the controller 11 to the server 4. The data collection system 3 may forward messages relating to adjustments to the sensors 2 or a unit controlling the sensors 2, and to the control system of the heating system to adjust temperature, air humidity, and air circulation speed. Other devices or heating systems associated with the air circulation system may also be controlled from the server software on a server 4. Control data may also be sent when the sensors are connected to a NAT local area network, in which a device, such as a router, at the boundary of a private network has a public address towards the public network and converts all the packets from the private network into public, and vice versa. The system according to Figure 3 may also comprise sensors 2 of Figure 2, connected to the data collection system 3 and measuring the condition data of a structure. The sensors 2 may send and receive data in accordance with the embodiments disclosed in the above.

[0036] All the measurement and adjustment details may be stored in a memory of the server 4 or another device, from which they may later be examined. Measurement and adjustment details may also be stored in the memory in the data collection system 3, if needed. The users themselves may manage where and how alarms are sent by providing, for example, a phone number for the text messages or an e-mail address. Measurements made from structures provide much information on the conditions of the structures during the life cycle of a building, and this information may be used when an apartment is sold, for example.

[0037] In the following, a method for removing moisture and/or impurities from a structure by means of a system is illustrated with reference to Figure 6. As the system, systems shown in Figures 1 to 5 or their parts combined in various ways may be used.

[0038] The system may be used both at new and repair sites. In renovation work, it is usually necessary to chisel the floor structures open, whereby the system disclosed in the above is easy to install before the floor structure is cast. The system is in the same way simple to install in new buildings. If there is no need to pull down the floor structure, the inventive system may be installed on the floor, on the wall surface right at the floor, like a skirting board. This way the heating system of the type referred to in the above may also be used, installed on the surface of the wall structure, for example, close to a ventilation duct. The system according to the invention is suitable for building and renovation work of all kind, and may be used both in building single-family houses and larger sites. The system is particularly well suited for repair work of schools, daycare centres and similar buildings.

[0039] The method for removing moisture and/or impurities from a structure by means of a system comprises an air circulation system for circulating air in a ventilation duct network, which ventilation duct network comprises at least one ventilation duct 1, and which comprises a casing structure open at both ends and at least partly open on one side.

[0040] Before the ventilation duct 1 is installed on the surface of a structure, at least one hole 16 is drilled 600 in the installation point of the ventilation duct 1 in the structure, and the structure is partly or entirely roughened. Holes are drilled in the structure advantageously every 10 to 30 cm. The surface of the structure may be roughened by sanding, for example, or by another suitable method. By means of the roughening and holes, the moisture and/or impurities from the structure are able to

find their way out of the structure through the ventilation duct 1. After this, the ventilation duct 1 is fixed 602 air-tightly to the surface of the structure so that the roughened installation position in the structure is disposed inside the at least partly open side of the ventilation duct 1.

[0041] In an embodiment, wherein the ventilation duct network 1 will remain inside concrete in connection with casting the floor, a capillary cut-off 17 to prevent moisture from rising, and/or a radon cut-off 15 to prevent radon from accessing the indoor space of the building may also be formed in the structure.

[0042] In an embodiment, the ventilation duct network may be installed above the original floor in a wall structure at the skirting board position, at the bottom part of the wall.

[0043] When the ventilation duct network is tightly connected to the structure, dry air is circulated 604 in the ventilation duct network, whereby the moisture and/or impurities possibly absorbed in the structure are able to transfer from the roughened installation position to the air circulated in the ventilation duct network.

[0044] The air circulated in the ventilation duct network may be negatively pressurized in relation to the air inside the building, which prevents possible gas streams from the base floor to the room space. The negative pressurization increases the migration of moisture and/or impurities from the structure to the air circulated in the ventilation duct network. If it is desired to remove impurities and leakage air from the structure, the negative pressure may be small. A large negative pressure is used in moisture removal from the structure. Moisture and/or impurities possibly gathered in the air circulated in the air circulation system may be removed by drying the circulated air and/or by removing part of or all the circulated air from the air circulation system and taking in new air to replace it. Air may be removed and make-up air taken in from the outside or, for example, from the exhaust air system of the house. It is also possible to connect a sensor to the system, which measures the humidity content of the outside air, and if the humidity outside is lower that the humidity of the indoor air in the pipe system and/or ventilation duct network, the circulated air is led straight out and make-up air is taken in from the outside. Sub-zero air in the wintertime is particularly dry. If radon from the ground enters buildings, the system may be used as a radon extractor.

[0045] A person skilled in the art will find it obvious that, as technology advances, the basic idea of the invention may be implemented in many different ways. The invention and its embodiments are thus not restricted to the above-described examples but may vary within the scope of the claims.

Claims

1. A method for removing moisture and/or impurities from a structure by means of a system which system comprises a ventilation duct network and an air circulation system for circulating air in the ventilation duct network, which ventilation duct network comprises at least one ventilation duct (1), and which ventilation duct (1) comprises a casing structure open at both ends and at least partly open on one side, **characterized in that** the structure is a wall structure, in which method

   at least one hole (16) is drilled in the wall structure where moisture and/or impurities are removed at an installation position of the casing structure of the ventilation duct (1), and the wall structure is partly or entirely roughened, wherein the at least one hole (16) is not through hole;
   the ventilation duct (1) is fixed with the at least partly open side permanently and air-tightly to a surface of the wall structure so that the installation position of the wall, which is roughened and perforated by the at least one hole (16), and the at least one hole (16) are disposed inside the at least partly open side of the casing structure of the ventilation duct (1); and
   dry air is circulated in the ventilation duct network, whereby moisture and/or impurities possibly absorbed in the wall structure are able to migrate through the roughened and perforated concrete wall structure, and the at least one hole (16) to the air circulated in the ventilation duct network through the at least partly open side of the casing structure.

2. A method as claimed claim 1, wherein a capillary cut-off (17) and/or radon cut-off (15) is/are additionally formed in the structure.

3. A method as claimed in claim 1 or 2, wherein the air circulated in the ventilation duct network is negatively pressurized in relation to the air inside the building.

4. A method as claimed in any one of the preceding claims, wherein the moisture and/or impurities possibly absorbed in the air circulated in the air circulation system are removed by drying the circulated air and/or by removing at least part of the circulated air from the air circulation system and taking in new air to replace it.

5. A system for removing moisture and/or impurities from a structure, which system comprises a ventilation duct network and an air circulation system for circulating air in the ventilation duct network, which ventilation duct network comprises at least one ventilation duct (1), and which ventilation duct (1) comprises a casing structure open at both ends and at least partly open on one side, **characterized in that** the structure is a wall structure, in which system

   the wall structure comprises at least one hole

(16), which is adapted to be drilled in the wall structure where moisture and/or impurities are removed at the installation position of the casing structure of the ventilation duct (1), and the structure is partly or entirely roughened wherein the at least one hole (16) is not through hole;
the ventilation duct, with the at least partly open side of the casing structure of the ventilation duct (1) is adapted to be fixed permanently and airtightly to the surface of the wall structure so that the installation position of the wall, which is roughened and perforated by the at least one hole (16), and the at least one hole (16) are disposed inside the at least partly open side of the casing structure of the ventilation duct (1); and
the ventilation duct network is adapted to circulate dry air, whereby the moisture and/or impurities possibly absorbed in the wall structure are able to migrate through the roughened and perforated wall structure, and the at least one hole (16) to the air circulated in the ventilation duct network through the at least partly open side of the casing structure.

6. A system as claimed in claim 5, which further comprises a heating system adapted to heat at least part of the structure outside the ventilation duct network.

7. A system as claimed in claim 5 or 6, which further comprises a pipe system (1a) of an air circulation system installable in at least one structure, wherein at least part of the pipe system (1a) of the air circulation system is arranged to be permeable at least to moisture, in which system

the pipe system (1a) of the air circulation system is arranged to circulate dry air in the pipe system (1a) of the air circulation system; and
the pipe system (1a) of the air circulation system is arranged to transfer moisture and/or impurities possibly absorbed by the structure through the pipe system (1a) to the air circulated in the pipe system (1a) of the air circulation system.

8. A system as claimed in claim 7, which further comprises a heating system (1b) installed in at least one structure, the heating system (1b) being arranged to heat structures outside the pipe system (1a) of the air circulation system.

9. A system as claimed in any one of the preceding claims 5 to 8, which further comprises a system for determining a condition data of the structure from the air circulating in the pipe system (1a) and/or ventilation duct network of the air circulation system, the air circulation system further comprising at least two sensors (2) adapted in the air circulation system, in which system

at least one sensor (2) is adapted to measure at least one starting value from the air going into the pipe system (1a) and/or ventilation duct network of the air circulation system;
at least one sensor (2) is adapted to measure at least one resulting value from the air coming from the pipe system (1a) and/or ventilation duct network of the air circulation system; and
the system for determining the condition data of the structure is adapted to determine the condition data of the structure on the basis of at least one starting and resulting value.

10. A system as claimed in any one of the preceding claims 5 to 9, wherein the ventilation duct (1) is adapted as a skirting board.

11. A system as claimed in any one of the preceding claims 5 to 10, wherein impurities comprise detrimental volatile organic compounds (VOC), unpleasant odours, and radon.

Patentansprüche

1. Verfahren zum Entfernen von Feuchtigkeit und/oder Verunreinigungen aus einer Struktur mittels eines Systems, wobei das System ein Lüftungskanalnetz und ein Luftzirkulationssystem zum Zirkulieren von Luft in dem Lüftungskanalnetz umfasst, wobei das Lüftungskanalnetz mindestens einen Lüftungskanal (1) umfasst, und wobei der Lüftungskanal (1) eine Gehäusestruktur umfasst, die an beiden Enden offen und zumindest teilweise an einer Seite offen ist, **dadurch gekennzeichnet, dass** die Struktur eine Wandstruktur ist, wobei das Verfahren

mindestens ein Loch (16) in die Wandstruktur gebohrt wird, wo Feuchtigkeit und/oder Verunreinigungen an einer Installationsposition der Gehäusestruktur des Lüftungskanals (1) entfernt werden, und die Wandstruktur teilweise oder vollständig aufgeraut wird, wobei das mindestens eine Loch (16) kein Durchgangsloch ist;
der Lüftungskanal (1) mit der zumindest teilweise offenen Seite dauerhaft und luftdicht an einer Oberfläche der Wandstruktur befestigt ist, so dass die Einbauposition der Wand, die durch das mindestens eine Loch (16) aufgeraut und perforiert ist, und das mindestens eine Loch (16) innerhalb der zumindest teilweise offenen Seite der Gehäusestruktur des Lüftungskanals (1) angeordnet sind; und
trockene Luft in dem Lüftungskanalnetz zirkuliert, wobei Feuchtigkeit und/oder Verunreinigungen, die möglicherweise in der Wandstruktur absorbiert werden, durch die aufgeraute und perforierte Betonwandstruktur und das mindes-

tens eine Loch (16) zu der in dem Lüftungskanalnetz zirkulierenden Luft durch die zumindest teilweise offene Seite der Gehäusestruktur wandern können.

2. Verfahren nach Anspruch 1, wobei in der Struktur zusätzlich eine Kapillarabsperrung (17) und/oder Radonabsperrung (15) ausgebildet ist/sind.

3. Verfahren nach Anspruch 1 oder 2, wobei die im Lüftungskanalnetz zirkulierende Luft im Verhältnis zur Luft im Inneren des Gebäudes unter Unterdruck steht.

4. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Feuchtigkeit und/oder Verunreinigungen, die möglicherweise in der in dem Luftumlaufsystem umgewälzten Luft absorbiert sind, durch Trocknen der umgewälzten Luft und/oder durch Entfernen zumindest eines Teils der umgewälzten Luft aus dem Luftumlaufsystem und Einführen neuer Luft als Ersatz entfernt werden.

5. System zum Entfernen von Feuchtigkeit und/oder Verunreinigungen aus einem Bauwerk, wobei das System ein Lüftungskanalnetz und ein Luftzirkulationssystem zum Zirkulieren von Luft in dem Lüftungskanalnetz umfasst, wobei das Lüftungskanalnetz mindestens einen Lüftungskanal (1) umfasst, und wobei der Lüftungskanal (1) eine Gehäusestruktur umfasst, die an beiden Enden offen und zumindest teilweise an einer Seite offen ist, **dadurch gekennzeichnet, dass** die Struktur eine Wandstruktur ist, wobei in dem System

die Wandstruktur mindestens ein Loch (16) umfasst, das dazu geeignet ist, in die Wandstruktur gebohrt zu werden, wo Feuchtigkeit und/oder Verunreinigungen an der Installationsposition der Gehäusestruktur des Lüftungskanals (1) entfernt werden, und die Struktur teilweise oder vollständig aufgeraut ist, wobei das mindestens eine Loch (16) kein Durchgangsloch ist;
der Lüftungskanal mit der zumindest teilweise offenen Seite der Gehäusestruktur des Lüftungskanals (1) dauerhaft und luftdicht an der Oberfläche der Wandstruktur befestigt werden kann, so dass die Einbauposition der Wand, die durch das mindestens eine Loch (16) aufgeraut und perforiert ist, und das mindestens eine Loch (16) innerhalb der zumindest teilweise offenen Seite der Gehäusestruktur des Lüftungskanals (1) angeordnet sind; und
das Lüftungskanalnetz so ausgelegt ist, dass es trockene Luft zirkulieren lässt, wodurch die Feuchtigkeit und/oder Verunreinigungen, die möglicherweise in der Wandstruktur absorbiert werden, durch die aufgeraute und perforierte Wandstruktur und das mindestens eine Loch (16) zu der in dem Lüftungskanalnetz zirkulierenden Luft durch die zumindest teilweise offene Seite der Gehäusestruktur wandern können.

6. System nach Anspruch 5, das außerdem ein Heizsystem umfasst, das geeignet ist, zumindest einen Teil der Struktur außerhalb des Lüftungskanalnetzes zu heizen.

7. System nach Anspruch 5 oder 6, das ferner ein Rohrsystem (1a) eines Luftzirkulationssystems umfasst, das in mindestens einem Bauwerk installierbar ist, wobei mindestens ein Teil des Rohrsystems (1a) des Luftzirkulationssystems so angeordnet ist, dass es zumindest für Feuchtigkeit durchlässig ist, wobei in dem System

das Rohrsystem (1a) des Luftzirkulationssystems so angeordnet ist, dass es trockene Luft in dem Rohrsystem (1a) des Luftzirkulationssystems zirkulieren lässt; und
das Rohrsystem (1a) des Luftzirkulationssystems so angeordnet ist, dass es Feuchtigkeit und/oder Verunreinigungen, die möglicherweise von der Struktur absorbiert werden, durch das Rohrsystem (1a) an die in dem Rohrsystem (1a) des Luftzirkulationssystems zirkulierende Luft überträgt.

8. System nach Anspruch 7, das ferner ein Heizsystem (1b) umfasst, das in mindestens einer Struktur installiert ist, wobei das Heizsystem (1b) so angeordnet ist, dass es Strukturen außerhalb des Rohrsystems (1a) des Luftzirkulationssystems beheizt.

9. System nach einem der vorhergehenden Ansprüche 5 bis 8, das ferner ein System zur Bestimmung von Zustandsdaten der Struktur aus der im Rohrsystem (1a) und/oder Lüftungskanalnetz des Luftumlaufsystems zirkulierenden Luft umfasst, wobei das Luftumlaufsystem ferner mindestens zwei im Luftumlaufsystem angepasste Sensoren (2) umfasst, wobei in diesem System

mindestens ein Sensor (2) geeignet ist, mindestens einen Ausgangswert der in das Rohrsystem (1a) und/oder Lüftungskanalnetz des Luftumlaufsystems eintretenden Luft zu messen;
mindestens ein Sensor (2) geeignet ist, mindestens einen resultierenden Wert der aus dem Rohrsystem (1a) und/oder dem Lüftungskanalnetz des Luftzirkulationssystems kommenden Luft zu messen; und
das System zur Ermittlung der Zustandsdaten des Bauwerks geeignet ist, die Zustandsdaten des Bauwerks auf der Grundlage von mindes-

tens einem Ausgangs- und einem Ergebniswert zu ermitteln.

10. System nach einem der vorhergehenden Ansprüche 5 bis 9, wobei der Lüftungskanal (1) als Sockelleiste ausgebildet ist.

11. System nach einem der vorhergehenden Ansprüche 5 bis 10, wobei die Verunreinigungen schädliche flüchtige organische Verbindungen (VOC), unangenehme Gerüche und Radon umfassen.

Revendications

1. Procédé d'élimination de l'humidité et/ou des impuretés d'une structure au moyen d'un système, lequel système comprend un réseau de conduits de ventilation et un système de circulation d'air pour faire circuler l'air dans le réseau de conduits de ventilation, lequel réseau de conduits de ventilation comprend au moins un conduit de ventilation (1) et lequel conduit de ventilation (1) comprend une structure de boîtier ouverte au niveau des deux extrémités et au moins partiellement ouverte sur un côté, **caractérisé en ce que** la structure est une structure murale, dans lequel procédé

au moins un trou (16) est percé dans la structure murale où sont éliminées l'humidité et/ ou les impuretés à une position d'installation de la structure de boîtier du conduit de ventilation (1) et la structure murale est rendue entièrement ou en partie rugueuse, dans lequel l'au moins un trou (16) n'est pas un trou traversant ;
le conduit de ventilation (1) est fixé avec le côté au moins partiellement ouvert de manière permanente et étanche à l'air à une surface de la structure murale de sorte que la position d'installation du mur, qui est rugueux et perforé par l'au moins un trou (16), et l'au moins un trou (16) soient disposés à l'intérieur du côté au moins partiellement ouvert de la structure de boîtier du conduit de ventilation (1) ; et
de l'air sec circule dans le réseau de conduits de ventilation, moyennant quoi l'humidité et/ ou les impuretés éventuellement absorbées dans la structure murale peuvent migrer à travers la structure murale en béton perforée et rugueuse, et l'au moins un trou (16) vers l'air circulant dans le réseau de conduits de ventilation à travers le côté au moins partiellement ouvert de la structure de boîtier.

2. Procédé tel que revendiqué dans la revendication 1, dans lequel une découpe capillaire (17) et/ou une découpe de radon (15) est/sont en outre formée(s) dans la structure.

3. Procédé tel que revendiqué dans la revendication 1 ou 2, dans lequel l'air circulant dans le réseau de conduits de ventilation est mis sous pression négative par rapport à l'air à l'intérieur du bâtiment.

4. Procédé tel que revendiqué dans l'une quelconque des revendications précédentes, dans lequel l'humidité et/ou les impuretés éventuellement absorbées dans l'air circulant dans le système de circulation d'air sont éliminées par séchage de l'air circulant et/ou par élimination d'au moins une partie de l'air circulant du système de circulation d'air et admission d'air frais pour le remplacer.

5. Système d'élimination de l'humidité et/ou des impuretés d'une structure, lequel système comprend un réseau de conduits de ventilation et un système de circulation d'air pour faire circuler l'air dans le réseau de conduits de ventilation, lequel réseau de conduits de ventilation comprend au moins un conduit de ventilation (1) et lequel conduit de ventilation (1) comprend une structure de boîtier ouverte au niveau des deux extrémités et au moins partiellement ouverte sur un côté,

caractérisé en ce que la structure est une structure murale, dans lequel système
la structure murale comprend au moins un trou (16), qui est adapté pour être percé dans la structure murale où sont éliminées l'humidité et/ou les impuretés à la position d'installation de la structure de boîtier du conduit de ventilation (1) et la structure est partiellement ou entièrement rendue rugueuse, dans lequel l'au moins un trou (16) n'est pas un trou traversant ;
le conduit de ventilation, avec le côté au moins partiellement ouvert de la structure de boîtier du conduit de ventilation (1), est adapté pour être fixé de manière permanente et étanche à l'air à la surface de la structure murale de sorte que la position d'installation du mur, qui est rugueux et perforé par l'au moins un trou (16), et l'au moins un trou (16) soient disposés à l'intérieur du côté au moins partiellement ouvert de la structure de boîtier du conduit de ventilation (1) ; et
le réseau de conduits de ventilation est adapté pour faire circuler de l'air sec, moyennant quoi l'humidité et/ou les impuretés éventuellement absorbées dans la structure murale peuvent migrer à travers la structure murale rugueuse et perforée, et l'au moins un trou (16) vers l'air circulant dans le réseau de conduits de ventilation à travers le côté au moins partiellement ouvert de la structure de boîtier.

6. Système tel que revendiqué dans la revendication 5, qui comprend en outre un système de chauffage adapté pour chauffer au moins une partie de la struc-

ture à l'extérieur du réseau de conduits de ventilation.

7. Système tel que revendiqué dans la revendication 5 ou 6, qui comprend en outre un système de tuyaux (1a) d'un système de circulation d'air pouvant être installé dans au moins une structure, dans lequel au moins une partie du système de tuyaux (1a) du système de circulation d'air est agencée de façon à être perméable au moins à l'humidité, dans lequel système

le système de tuyaux (1a) du système de circulation d'air est agencé pour faire circuler de l'air sec dans le système de tuyaux (1a) du système de circulation d'air ; et
le système de tuyaux (1a) du système de circulation d'air est agencé pour transférer l'humidité et/ les impuretés éventuellement absorbées par la structure à travers le système de tuyaux (1a) vers l'air circulant dans le système de tuyaux (1a) du système de circulation d'air.

8. Système tel que revendiqué dans la revendication 7, qui comprend en outre un système de chauffage (1b) installé dans au moins une structure, le système de chauffage (1b) étant agencé pour chauffer des structures à l'extérieur du système de tuyaux (1a) du système de circulation d'air.

9. Système tel que revendiqué dans l'une quelconque des revendications précédentes 5 à 8, qui comprend en outre un système pour déterminer des données de condition de la structure à partir de l'air circulant dans le système de tuyaux (1a) et/ou le réseau de conduits de ventilation du système de circulation d'air, le système de circulation d'air comprenant en outre au moins deux capteurs (2) adaptés dans le système de circulation d'air, dans lequel système

au moins un capteur (2) est adapté pour mesurer au moins une valeur de départ de l'air se dirigeant vers le système de tuyaux (1a) et/ou le réseau de conduits de ventilation du système de circulation d'air ;
au moins un capteur (2) est adapté pour mesurer au moins une valeur résultante de l'air provenant du système de tuyaux (1a) et/ou du réseau de conduits de ventilation du système de circulation d'air ; et
le système pour déterminer les données de condition de la structure est adapté pour déterminer les données de condition de la structure sur la base d'au moins une valeur de départ et une valeur résultante.

10. Système tel que revendiqué dans l'une quelconque des revendications 5 à 9, dans lequel le conduit de ventilation (1) est adapté en tant que plinthe.

11. Système tel que revendiqué dans l'une quelconque des revendications 5 à 10, dans lequel les impuretés comprennent des composés organiques volatils (VOC) nuisibles, des odeurs désagréables et du radon.

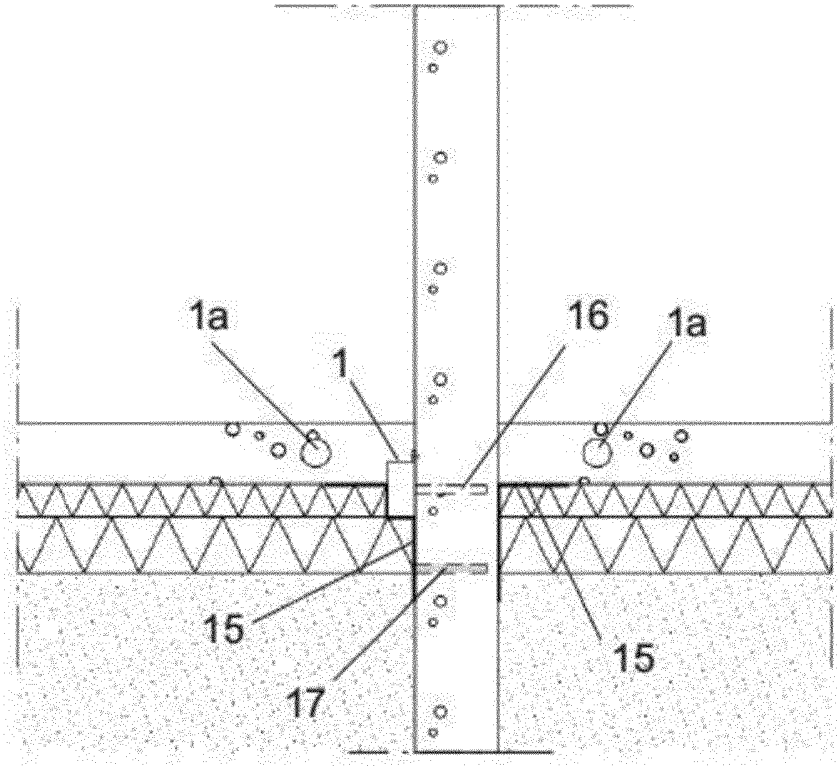


Fig. 1

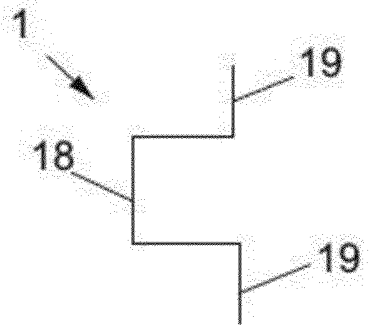


Fig. 4a

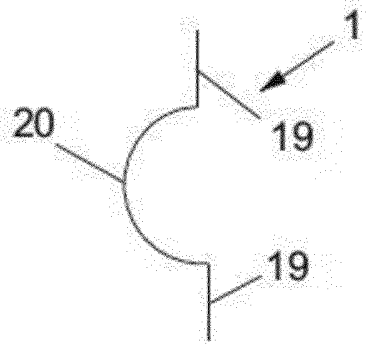


Fig. 4c

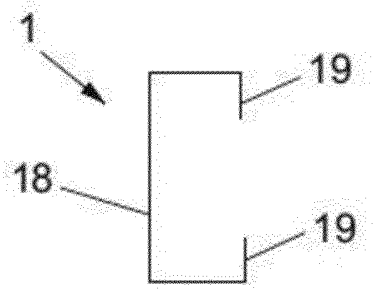


Fig. 4b

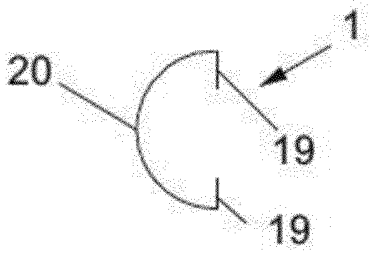


Fig. 4d

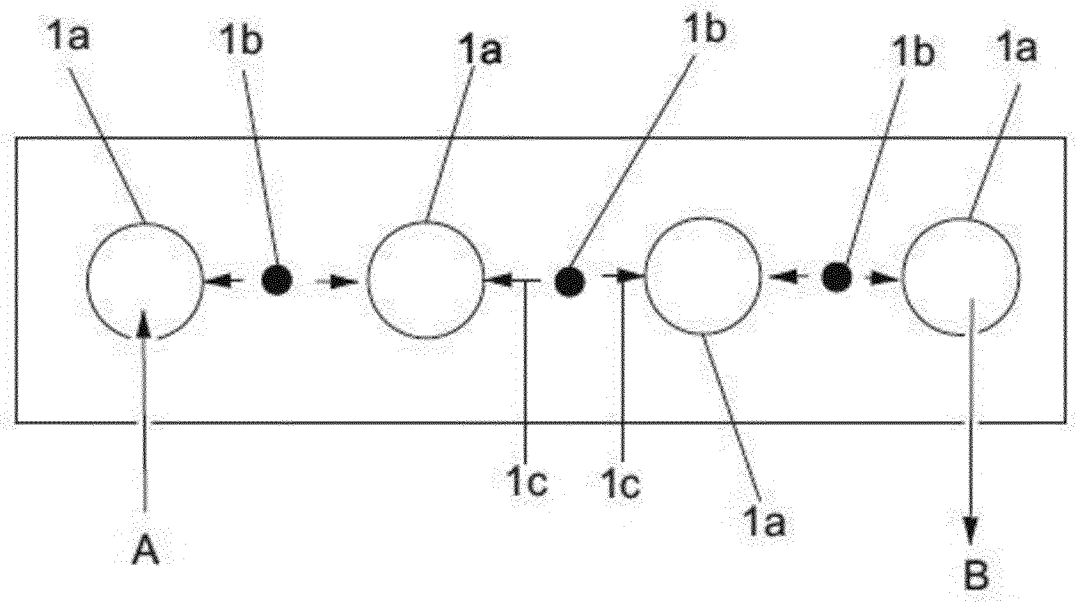

1a
1b
1a
1b
1b
1a
1c
1c
1a
A
B

Fig. 5

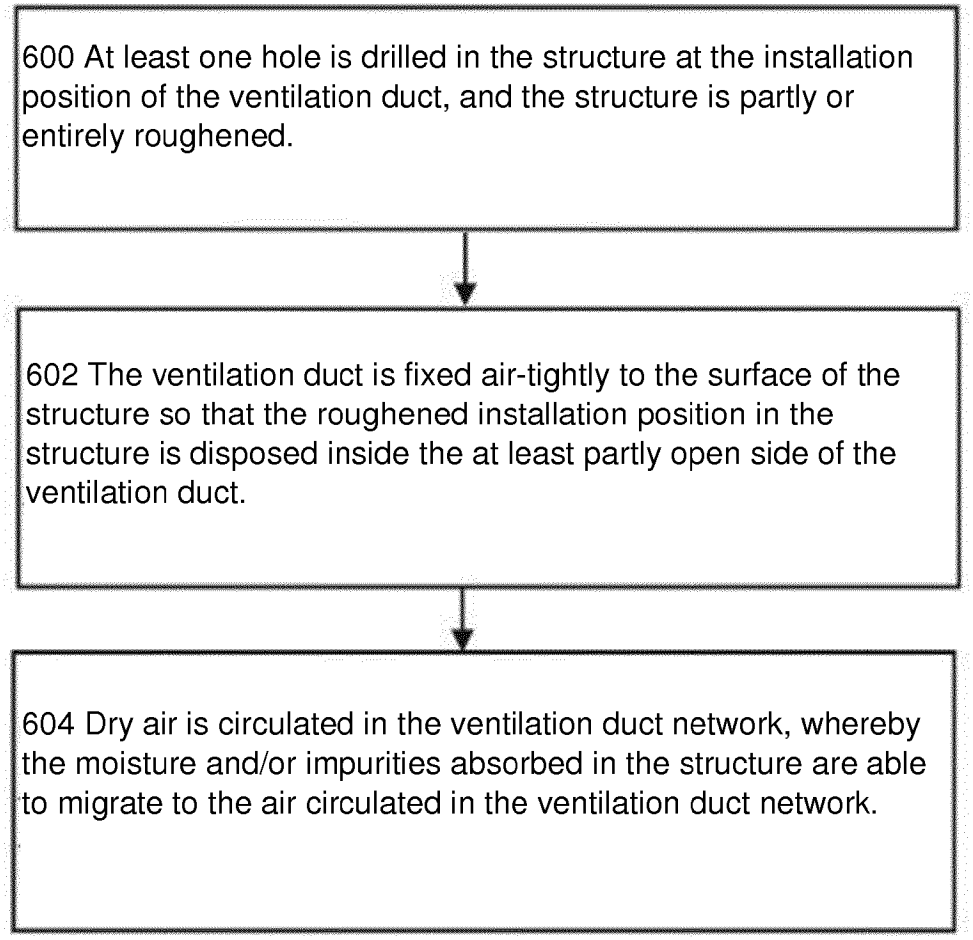

600 At least one hole is drilled in the structure at the installation position of the ventilation duct, and the structure is partly or entirely roughened.
602 The ventilation duct is fixed air-tightly to the surface of the structure so that the roughened installation position in the structure is disposed inside the at least partly open side of the ventilation duct.
604 Dry air is circulated in the ventilation duct network, whereby the moisture and/or impurities absorbed in the structure are able to migrate to the air circulated in the ventilation duct network.

Fig. 6

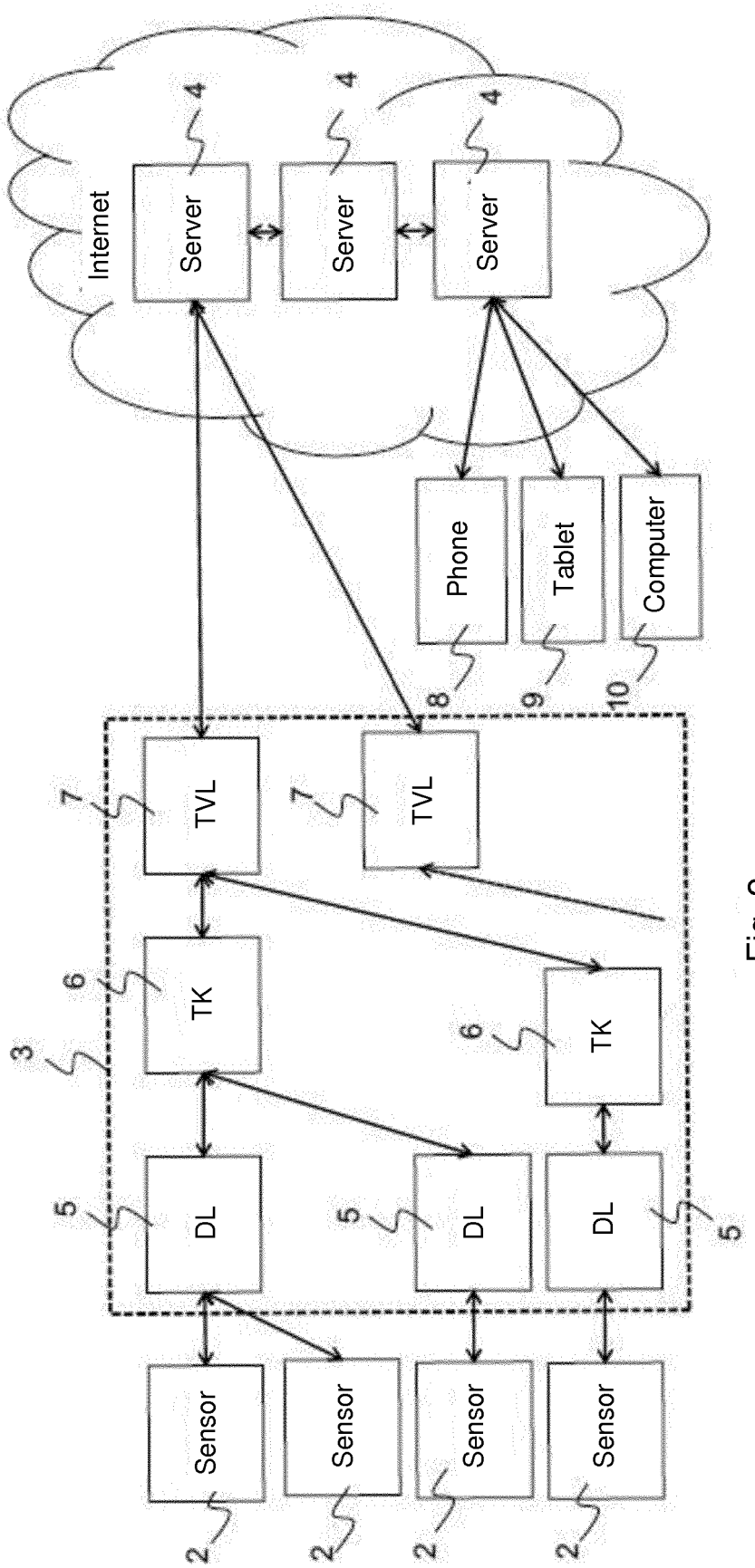

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Fig. 2

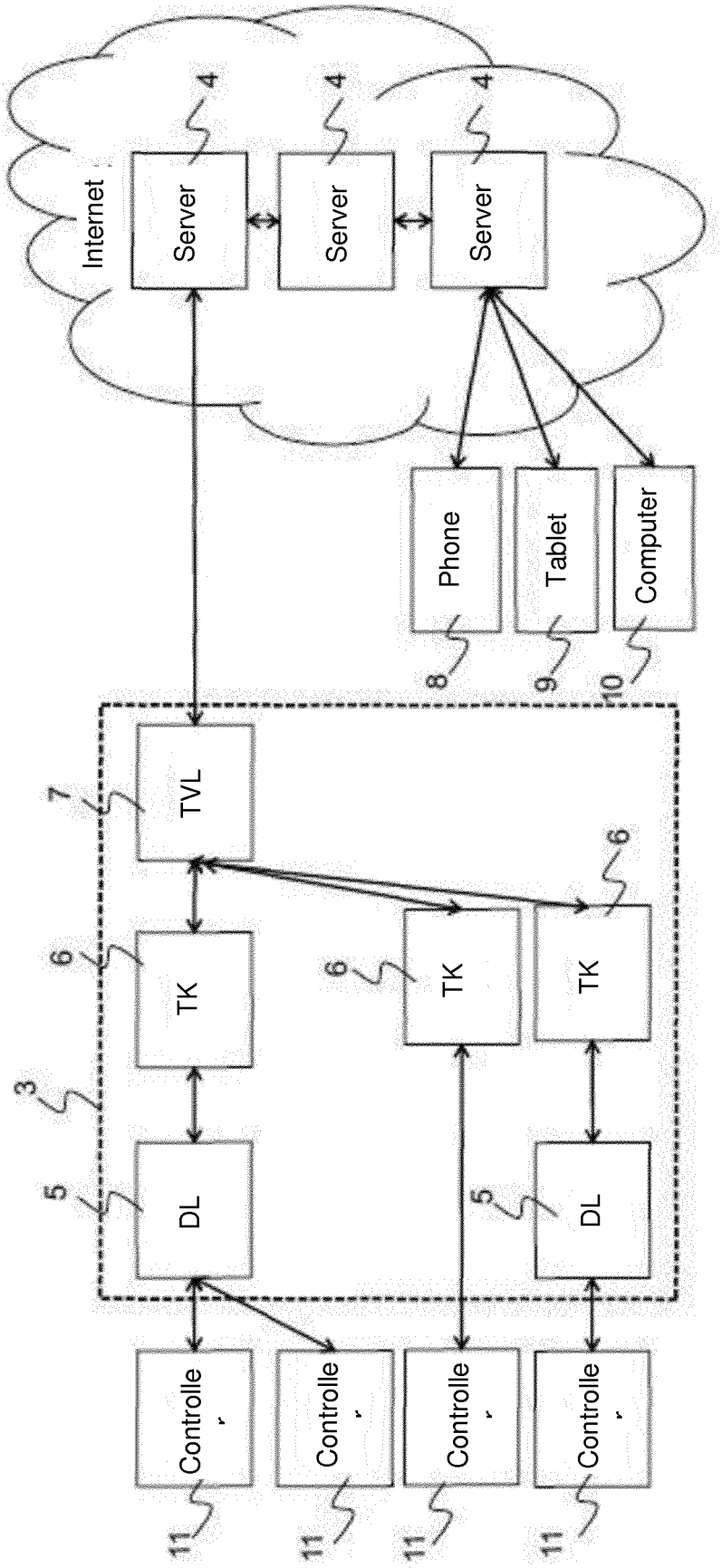

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9
10
TVL
7
TK
6
TK
6
TK
6
DL
5
DL
5
3
Controller
Controller
Controller
Controller
11
11
11
11

Fig. 3

REFERENCES CITED IN THE DESCRIPTION

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