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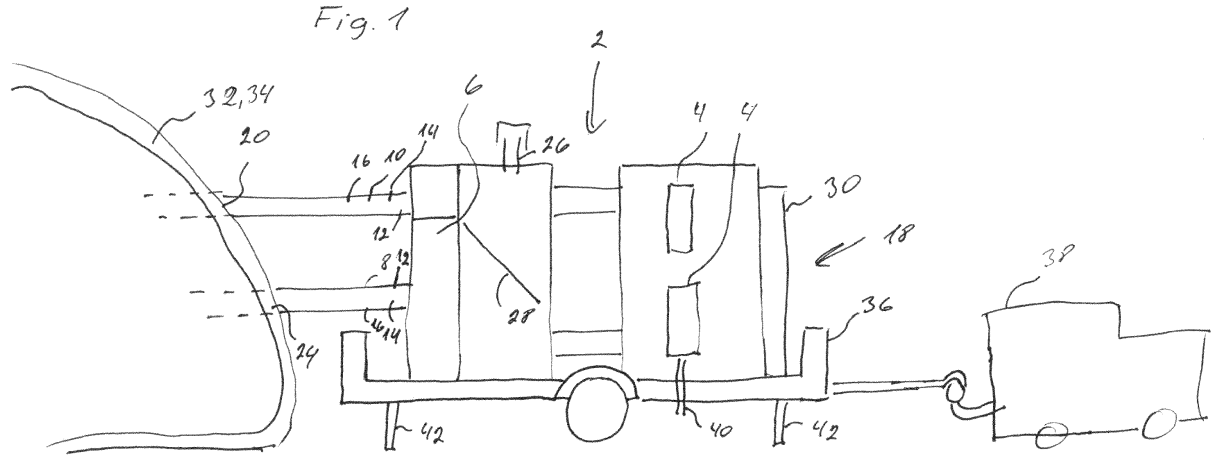
(54) MOBILE SYSTEM FOR CLIMATE CONTROL IN TENTS OR BUILDINGS

(57) The present invention relates to a system for cooling or heating adapted for ventilation in a tent or a building. It is an object of the invention to perform climate regulation in a tent or building by a mobile outdoor unit. A further object is to perform regulation of humidity in the tent or building. A further object is to reduce humidity in a building by the mobile outdoor unit. The object can be achieved by a system which can be formed in a mobile outdoor module, which mobile outdoor module is connected by at least an outlet air connection to a tent or building and an inlet air connection to the tent or building which system comprises a plurality of humidity sensors, which system is adapted to control and adjust the humidity in the tent or building by a combined cooling and heating performed by the heat pump and the cooling device.

Fig. 1



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Description

Field of the Invention

[0001] The present invention relates to a system adapted for cooling or heating and ventilation in a tent or building, which system comprises a combined heat pump or cooling device, which system comprises ventilation means for generating air flow from an inlet and further through an outlet, which system comprises one or more temperature sensors adapted to at least measure the temperature in the inlet and outlet, which system comprises one or more humidity sensors adapted to measure the humidity concentration of inlet and outlet air, which system comprises one or more CO2 sensors adapted to measure the CO2 concentration of the inlet and outlet air.

Object of the Invention

[0002] It is an object of the invention to perform climate regulation in a tent or building by a mobile outdoor unit.
[0003] A further object is to perform regulation of humidity in the tent or building.
[0004] A further object is to reduce humidity in a building by the mobile outdoor unit

Description of the Invention

[0005] The object can be achieved by a system as disclosed in the opening paragraph and further modified in that the system can be formed in a mobile outdoor module, which mobile outdoor module is connected by at least an outlet air connection to a tent or building and an inlet air connection to the tent or building which system comprises a plurality of humidity sensors, which system is adapted to control and adjust the humidity in the tent or building by a combined cooling and heating performed by the heat pump and the cooling device.
[0006] Hereby can be achieved that the mobile outdoor module can be transported to a tent or building or a building where climate control is to be achieved. It could be a building where water tubes inside the building are damaged and humidity needs to be removed. This is possible by this external mobile outdoor module which can easily be transported and connected to the tent or building. It is also possible to connect this mobile outdoor module to e.g. a party tent or building and to adjust the climate inside the tent or building. Especially in a tent or building it could be very important to reduce the humidity in the air. This should be possible by suction of air from the tent or building or from the building and by starting with cooling of the air by letting the air passing the evaporator of the cooling device. Hereby the low temperature of the air wills condensate humidity at the evaporator. From this evaporator there must be a drain which is easy to achieve by tubing out of the module. After the humidity has been removed from the air further heating could be performed by letting the air pass through the condenser of the cooling device. In that way the air can be heated again and returned into the tent or building or the building, but now as dry air. The mobile outdoor module can be connected to a building in which a need for removing of humidity exists. The mobile outdoor module may also be connected to a tent once the tent is put up. It could be a party tent or building where the mobile outdoor module is connected to the tent or building to ensure correct internal climate in the tent or building in terms of humidity and temperature.
[0007] In a preferred embodiment the system can comprise a counter flow heat exchanger to preheat fresh inlet air before heating by the heat pump. Hereby can be achieved that e.g. energy consumption used for heating is reduced in that at least some of the heat removed from the building or tent or building is reused to preheat the air to be sent into the building or tent or building. In other situations the same cross heat exchanger could be used for cooling where the air sucked out from a tent or a building has a lower temperature than the outside air. In such a situation the cross heat exchanger could be used in pre-cooling of air before it is sent to the cooling device.
[0008] In a further preferred embodiment the system can comprise ventilation means for fresh air to be cooled by a cooling device before cooled air is sent into the tent or building. Hereby is achieved that the air can be cooled to a temperature that may be even lower than the temperature in the tent or building. In that way the temperature could be reduced in a tent or building or the temperature could be kept at a constant level depending on the number of persons in the tent or building simply by adjusting the cooling effect necessary.
[0009] In a further preferred embodiment the system can comprise one or more filters in order to perform filtration of the fresh air before the system perform heating or cooling. The fresh air added to the air circulated in the system has to be filtered before use. Filtration could also be performed after the treatment in the combined heat pump and cooling device so that the air sent as inlet air to the tent or the building is filtered before leaving the module.
[0010] In a further preferred embodiment the system can perform measurement of the CO2 by the CO2 sensor in the outlet air connection from the tent or building which system performs adjustment of the CO2 in the inlet air connection to the tent or building by adding fresh outdoor air to the inlet to the tent or building, which system performs adjustment of temperature by the combined heat pump or cooling device. Hereby can be achieved that not only the humidity is under control but also the CO2 content. If it is a question of removing moisture from a building there is probably no need to reduce the CO2 content, but in a situation where many persons are placed in the same tent or building, maybe a party tent or building or a tent or building used for education purposes, it is necessary to keep the level of CO2 relatively low, if these persons should feel comfortable and keep their focus. Therefore, it is highly efficient to measure the CO2 and to adjust the

level by adding more or less fresh air to the inlet air.

[0011] In a further preferred embodiment the heat pump and cooling device can comprise a control system, which control system is adapted at least to perform control of the ventilation means. Hereby can be achieved that the existing control system that is to be found in the heat pump and cooling device could be modified to also control the ventilation means. Hereby is achieved that only one control system is necessary in the mobile outdoor module.

[0012] In a further preferred embodiment the control system can be adapted to receive a plurality of sensor signals, such as signals from temperature sensors, humidity sensors, or CO2 sensors. Hereby can be achieved that the same control system also has access to the different sensors that could be placed in the system, and it also allows for external sensors to be connected and be placed e.g. in a tent or a building to detect the actual climate in the tent or the building.

[0013] In a further preferred embodiment the control system can be adapted to perform ventilation based on the sensor signals, such as signals from temperature sensors, humidity sensors or CO2 sensors, whereby the system performs control of the climate in a tent or building connected to the system. Hereby the control system can be based on signals received from sensors placed in the system or in the tent or building and perform climatic regulation based on signals received. Hereby the same control system can be used for a plurality of different tasks in the system.

[0014] In a further preferred embodiment the system can be placed on a trailer, which trailer can be hooked to a car. Hereby can be achieved that the mobile outdoor module is very easy to transport from one place of use to another or from use in one position to a service organisation where example e.g. filters and cooling devices could be checked before next use. By keeping the weight of the system relatively low it is possible for the trailer to be hooked to nearly all cars allowed to carry a trailer up to 750 kilos. When the trailer arrives at e.g. a tent or a building it is necessary of course to stabilise the trailer to stand rather stable on the ground, but after that only power and the tubes for air have to be connected to the tent or building before the system is ready for operation.

[0015] In a further preferred embodiment the system can the system be adapted to be placed at a frame placed at the trailer. Hereby can be achieved that the system can be placed at a trailer in a way where it is supported by a frame. The relative heavy components from the system are placed at a frame, where the total weight is distributed over a larger area of the trailer. The frame comprises upper sections, which can support the cooling device and also the device comprising counter flow heat exchange and the necessary filtration and may be also part of the cooling device such as evaporator and condenser. Hereby is achieved that the cooling device and the other devices are supported at the trailer so transportation can be performed without any risk of losing part of the cooling device simply because it is fastened to the frame and the frame is fastened to the trailer. In operation the trailer would be placed near a tent or a building where heating or cooling is to be performed. The trailer needs a power supply; all other connections are reduced to an inlet and outlet to the tent or building.

[0016] In a further preferred embodiment the invention can concern a method for climate control in a tent or building by a system as disclosed previously in at least the following steps of operation:

A: perform measurement by more humidity sensors adapted to measure the humidity concentration of inlet and outlet air,

B: perform control and adjust the humidity in a tent or building by a combined cooling and heating performed by the heat pump and the cooling device,

C: perform measurement of the CO2 by the CO2 sensor in the outlet air connection from the tent or building,

D: perform adjustment of the CO2 in the inlet air connection to the tent or building adding fresh outdoor air to the inlet to the tent or building,

E: perform adjustment of temperature by the combined heat pump or cooling device.

[0017] By this method it is possible to reduce the humidity of the air coming out from a building before it is returned into the building. This could be very important if this invention is used in a tent or building where the humidity from the soil probably makes the humidity content of the air increase. Also the control of the CO2 is necessary, if many persons are inside the building or the tent or building. Therefore, it is necessary to keep the CO2 content in the air relatively low, probably as low as 500 ppm where all human beings will feel comfortable. Also adjustment of temperature is possible simply by cooling or heating of the air passing through the module.

Description of the Drawing

[0018]

Fig. 1 shows a possible embodiment of a mobile outdoor module.

Fig. 2 shows a possible embodiment for a frame seen from the top.

Fig. 3 shows a possible embodiment for a frame seen from one end of the frame.

Detailed Description of the Invention

[0019] Fig. 1 shows a system 2 placed on a trailer 36. The module 2 comprises a combined heat pump or cooling device 4, which is operated together with ventilation means 6. The system has an air inlet 8 and an air outlet 10. Furthermore, it is indicated that temperature sensors 12 are placed in both inlet 8 and outlet 10. Furthermore, it is indicated that also humidity sensors 14 are placed in the inlet 8 and the outlet 10. Furthermore, it is indicated that also CO2 sensors 16 are placed in the inlet 8 and the outlet 10 as well. On the trailer 36 a mobile outdoor module 18 is placed. This outdoor module 18 is connected to a tent 32 or building 34 by an outlet air connection 20 and by an inlet air connection 24. A fresh outdoor air connection 26 is indicated, and inside the mobile outdoor module 18 a counter flow heat exchanger 28 is indicated. Furthermore, a control system is indicated. The module system 2 and the mobile outdoor module are placed on a trailer 36. This trailer is hooked to a car 38. The trailer comprises a water drain 14, and the trailer 36 has support legs 42.

[0020] During operation a mobile outdoor module on a trailer 36 can be placed near e.g. a tent (32) or building 34 wherein many persons are having a party. By changing the air inside the tent or building it is possible to keep the humidity at least in this tent or building at a relatively low level. Furthermore, the temperature is controlled, and if many people are placed in a tent or building it is necessary to also adjust the CO2 content in the air by adding fresh air. Temperature and humidity can be adjusted because the system comprises a combined heat pump and cooling device 4. By circulating the air to e.g. the heat pump it is possible to heat the air and hereby reduce the humidity. Further reduction of humidity is possible by sending the air from the tent or building to the cooling device and this way dry out the air before the air is further heated in the heat pump. It is furthermore possible for the outdoor module 18 to comprise a counter flow heat exchanger 28 and this way reduce the heating costs by heating a tent or building because up to maybe 70% of the heating energy can be reduced by sending the air to the counter flow heat exchanger.

[0021] Fig. 2 shows a frame 44, which is built by a ground frame 46, which is to be placed and fixed at the trailer 36. Further is indicated an upper section 48 of the frame. The upper section 48 of the frame is to support the different cooling equipments.

[0022] Fig. 3 shows the same frame as at fig. 2 but now seen from the end of the frame 44. Once again we can see the basic frame 46, which is to be placed at the trailer 36 and we can see a support 50, which is supporting the upper section 48. Hereby can be seen that the upper support 48 is able to perform an effective support of the relative high components which form the invention that is to be placed at the trailer 36.

Reference signs:

[0023]

2 System
4 Combined heat pump or cooling device
6 Ventilation means
8 Inlet
10 Outlet
12 Temperature sensors
14 Humidity sensors
16 CO2 sensors
18 Mobile outdoor module
20 Inlet air connections
24 Outlet air connection
26 Fresh outdoor air
28 Counter flow heat exchanger
30 Control system
32 Tent
34 Building
36 Trailer
38 Car
40 Water drain
42 Trailer legs
44 Frame
46 Base frames
48 Top frames
50 Supports

Claims

1. System (2) for cooling or heating adapted for ventilation in a tent (32) or building (34), which system (2) is formed in a mobile outdoor module (18), which mobile outdoor module (18) is connected by at least an outlet air connection (20) from a tent (32) or building (34) and an inlet air connection (24) to the tent (32) or building (34), which system (2) comprises a combined heat pump (4) or cooling device (5), which system (2) comprises ventilation means (6) for generating air flow from an inlet (8), and further through an outlet (10), which system (2) comprises one or more temperature sensors (12) adapted to at least measure the temperature in the inlet (8) and outlet (10), which system (2) comprises one or more humidity sensors (14) adapted to measure the humidity concentration of inlet and outlet air, **characterized in that** the system (2) comprises a plurality of humidity sensors (14), which system is adapted to control and adjust the humidity in the tent (32) or building (34) by a combined cooling and heating performed by the heat pump (4) and the cooling device (5).

2. System according to claim 1, **characterized in that** the system (2) comprises a counter flow heat exchanger (28) to preheat fresh inlet air (26) before heating by the heat pump (4).

3. System according to claim 1 or 2, **characterized in that** the system (2) comprises ventilation means (6) for fresh air to be cooled by cooling device (5) before cooled air is sent into the tent (32) or building (34).

4. System according to one of the claims 1-3, **characterized in that** the system (2) comprises one or more filters to perform filtration on the fresh air before the system (2) performs heating or cooling.

5. System according to one of the claims 1-4, **characterized in that** the system performs measurement of the CO2 by the CO2 sensor (16) in the outlet air connection (20) from the tent (32) or building (34), which system performs adjustment of the CO2 in the inlet air connection (24) to the tent (32) or building (34) by adding fresh outdoor air (26) to the inlet to the tent (32) or building (34), which system performs adjustment of temperature by the combined heat pump (4) or cooling device (5).

6. System according to one of the claims 1-5, **characterized in that** the heat pump (4) and cooling device comprise a control system (30), which control system (30) is adapted at least to perform control of the ventilation means (6).

7. System according to one of the claims 1-6, **characterized in that** the control system (30) is adapted to receive a plurality of sensor signals, such as signals from temperature sensors (12), humidity sensors (14) or CO2 sensors (16).

8. System according to one of the claims 1-7, **characterized in that** the control system (30) is adapted to perform ventilation based on the sensor signals, such as signals from temperature sensors (12), humidity sensors (14) or CO2 sensors (16), whereby the system (2) performs control of the climate in a tent (32) or building (34) connected to the system (2).

9. System according to one of the claims 1-8 **characterized in that** the system (2) is adapted to be placed on a trailer (36), which trailer (36) is adapted to be hooked to a car (38).

10. System according to one of the claims 1-9 **characterized in that** the system (2) is adapted to be placed at a frame (44,46,48) placed at the trailer (36).

11. Method for climate control in a tent (32) or building (34) by a system (2) as disclosed in the claims 1-9, **characterized in** at least the following steps of operation:

A: perform measurement by more humidity sensors (14) adapted to measure the humidity concentration of inlet and outlet air,

B: perform control and adjust the humidity in a tent (32) or building (34) by a combined cooling and heating performed by the heat pump (4) and the cooling device (5),

C: perform measurement of the CO2 by the CO2 sensor (16) in the outlet air connection (20) from the tent (32) or building (34),

D: perform adjustment of the CO2 in the inlet air connection (24) to the tent (32) or building (34) by adding fresh outdoor air (26) to the inlet to the tent (32) or building (34),

E: perform adjustment of temperature by the combined heat pump (4) or cooling device (5).

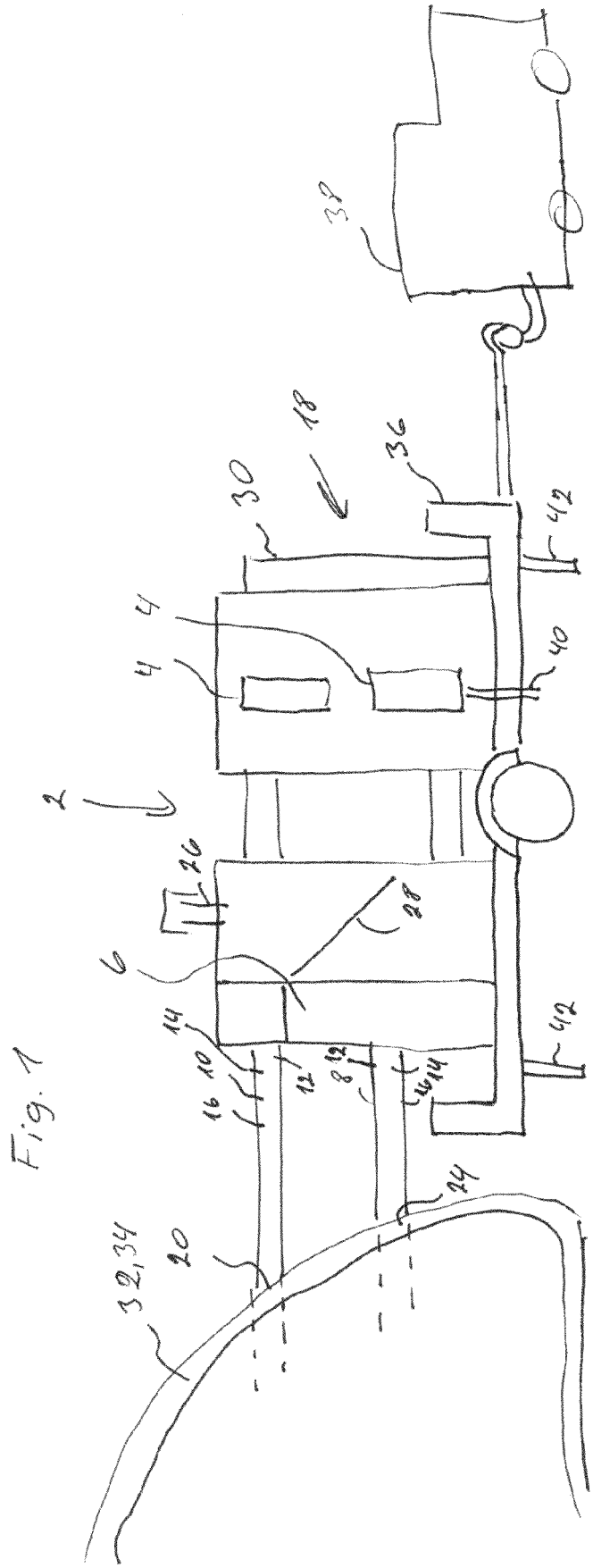


Fig. 1

Fig 2

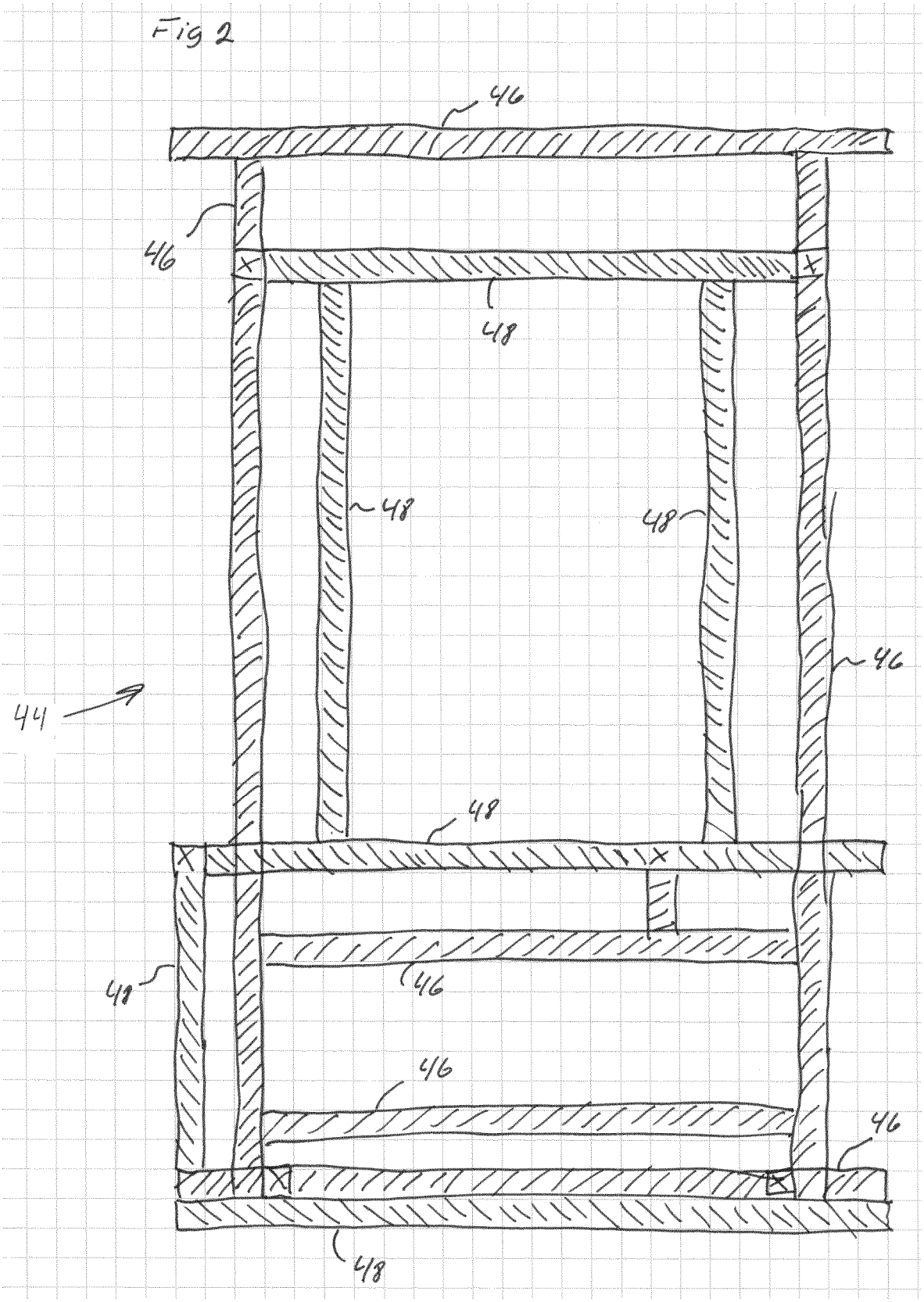
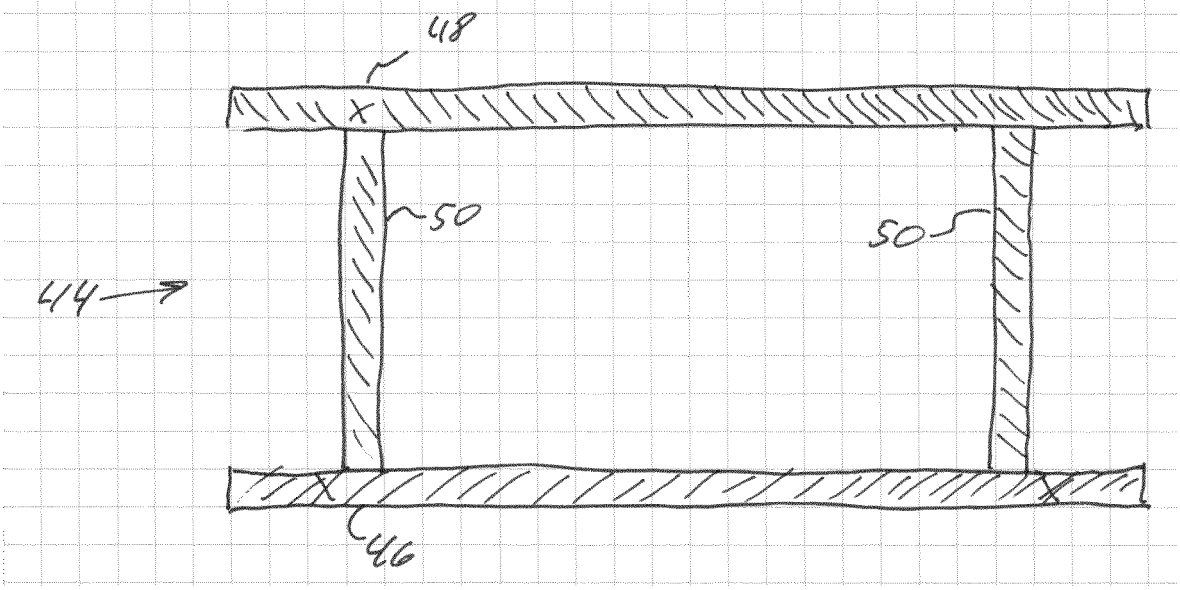


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 19 18 0734

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)
F24F
E04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 October 2019	Djemour, Anna

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 18 0734

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