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(54) AIR DEHUMIDIFIER, ESPECIALLY FOR AIR COOLING OR AIR CONDITIONING MACHINES

(57) The invention relates to an air dehumidifier, especially for air cooling or air conditioning machines, arranged inside a cooling chamber (1) upstream of an air outlet from the cooling chamber (1). The air dehumidifier (4) comprises a body (41) in which is mounted a purifying cassette (42) comprising a sieve (424) coupled to an ul-

trasonic radiator (5), whereby below the purifying cassette (42) is arranged a snow and/or ice collector (43) which is associated with a snow and/or ice conveyor (44) which opens into a snow and ice collection container (45). The collection container is mounted outside the cooling chamber (1).

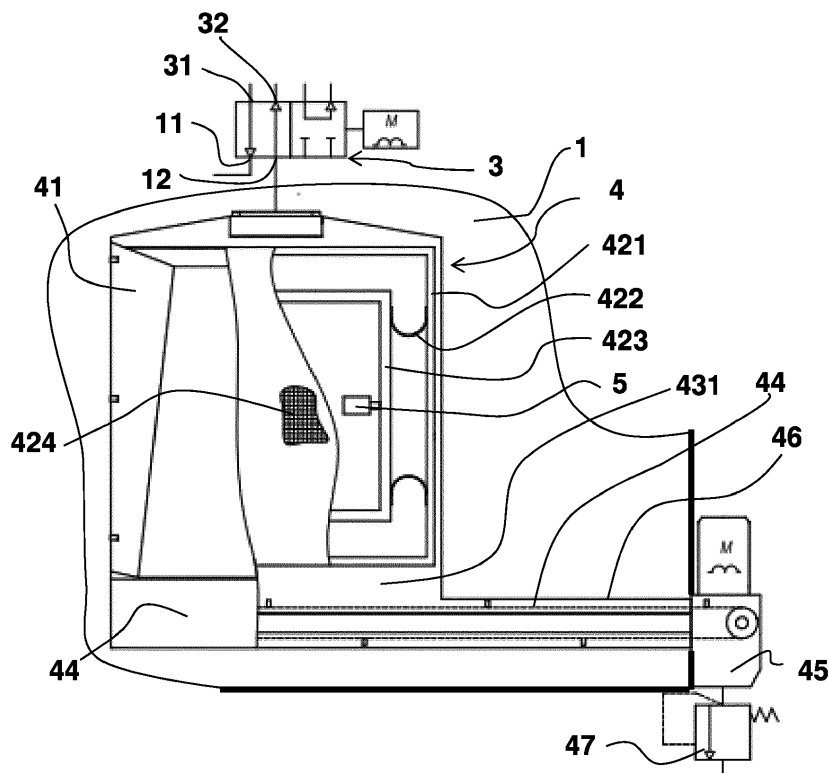


Fig. 2a

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Description

Technical field

[0001] The invention relates to an air dehumidifier, especially for air cooling or air conditioning machines, arranged inside a cooling chamber upstream of an air outlet from the cooling chamber.

Background art

[0002] In air cooling machines, the dehumidification of the cooling air which contains water is a major problem, since water at temperatures below 0 °C changes to a solid state and is deposited on cold surfaces inside the cooling device as snow or ice. Freezing causes a decrease in efficiency of the air cooling machine and even interruption of its operation. This results in frequent maintenance operations of the machine, during which the machine needs to be stopped to allow snow and/or ice removal.

[0003] Nowadays, adsorbers or dryers are used as dehumidifiers.

[0004] RU 2200283 C1 discloses an adsorber in which a special sorption material is used. At low temperatures, the sorption material has low absorbing power, which leads to frequent exchanges of columns/adsorbers for regeneration thereof, until the sorption material is no longer capable of operating. In addition, the presence of water in the air flow leads to the formation of snow/ice at the inlet of the adsorber working volume filled with the sorption material. The amount of snow/ice increases rapidly and reduces the cross-section of the device until it is entirely filled, thus disabling its function. Moreover, at atmospheric pressure the absorbing power of the adsorbers is considerably lower than when working with compressed air. Snow and/or ice is removed from the adsorber after interruption of cooling by heating it.

[0005] RU 2360186 C1 describes a dryer in which drying is performed by cooling. To design this type of dryer for temperatures below -60 °C is very difficult, since cascade refrigeration systems using different cooling media need to be employed. In addition, the air flow cooling dryer requires increased heat transfer surfaces at atmospheric pressure.

[0006] Continuous regeneration disk adsorbers are known, but their use is associated with a significant increase in temperature in the operating mode and with increased energy consumption for the regeneration system.

[0007] Patent application JP 2004066162 describes a device for the removal of oil mist, which is formed by a labyrinth air dehumidifier, in which separation occurs as a result of multiple enlargement and reduction in the passage cross-section. Water or oil is collected on plates which form a labyrinth and flows downwards. Such a device cannot operate in cases of phase transition, i.e. freezing of water or another substance, because in these

cases the passage cross-section is completely blocked.

[0008] Furthermore, known is patent application GB 2380246, which discloses a method of removing moisture from a cooling unit. This solution is based on air passing through a body which is filled with a metal mesh. In this case, the moisture is deposited on the mesh and flows down into the body. Reducing the temperature below 0 °C creates the same problem as in adsorption dryers, i.e., ice freezing on the inlet surface of the mesh block until the passage cross section is completely covered. In this solution, too, snow and/or ice is removed from the metal mesh by heating, which means that the cooling process must be interrupted.

[0009] Various systems are known in the background art using an ultrasonic transducer coupled to a sieve of a vibrating sieving machine. One of these systems is Vibrasonic® 2000 Mesh Deblinding System, produced by company Russel Finex Limited, of Russel House, Brownells Lane, Feltham, Middlesex TW13 PEW, England. This device prevents clogging of the sieve of a vibrating sieving machine, especially when sieving very fine materials, such as powder glazes, aluminum oxide, powder toners, etc. The device is not intended to remove moisture from cold air in cooling systems.

[0010] The goal of the invention is to extend the operating time of an air cooling machine without interruption caused by removal of snow and/or ice from an air dehumidifier and to ensure moisture removal during the operation of the machine.

Principle of the invention

[0011] The aim of the invention is achieved by an air dehumidifier whose principle consists in that it comprises a body in which is mounted a purifying cassette comprising a sieve coupled to an ultrasonic radiator, below the purifying cassette is arranged a snow and/or ice collector which is associated with a snow and/or ice conveyor which opens into a snow and/or ice collection container. The collection container is disposed outside the cooling chamber. The air dehumidifier enables to remove snow and/or ice from the cooling chamber without interrupting the operation of the air cooling or air conditioning machine. Continuity of operation reduces the cost of defrosting the system and, as a result, increases the energy efficiency of the entire system.

[0012] In a preferred embodiment, the purifying cassette comprises an outer frame in which an inner frame is mounted by means of flexible connectors, the inner frame being coupled to the ultrasonic radiator, whereby the inner space of both frames is filled with a metal sieve. Vibrations of the inner frame cause the sieve to oscillate, thereby releasing icing which falls into the inner space of the snow and/or ice collector.

[0013] To remove snow and/or ice from the inner space of the cooling chamber, it is advantageous if at least the outer part of the snow and/or ice conveyor between the cooling chamber and the snow and/or ice collection con-

tainer is mounted in a housing, whereby the housing may be provided also in the inner space of the cooling chamber.

[0014] To balance the pressure inside the cooling chamber, a balancing valve is mounted on the housing.

Description of the drawings

[0015] Exemplary embodiments of the invention are schematically represented in the enclosed drawings, wherein Fig. 1 shows an arrangement of an air dehumidifier and a block valve in a cooling chamber, Fig. 2 is a partial cross-sectional front view of the air dehumidifier in the cooling chamber, Fig. 2b is a side view of the air dehumidifier, Fig. 3a is a front view of a purifying cassette and Fig. 3b is an axonometric view of the purifying cassette.

Examples of embodiment

[0016] In air cooling machines, air containing water in the form of water vapor is used as a refrigerant. The water vapor, however, solidifies at temperatures below 0 ° C. In order to prevent solid particles of water, i.e. snow and/or ice, from entering the conduits and other components of the cooling machine system, dehumidifiers are used, the dehumidifiers being usually located directly in a cooling chamber 1. Low temperature cooling air is supplied to the cooling chamber 1 through an inlet air conduit 21 and from the cooling chamber 1 air is discharged through an outlet air conduit 22. The inlet air conduit 21 is connected to an inlet 31 of a two-way or block valve 3, to the outlet 32 of which is connected the outlet air conduit 22 and which is arranged in the inner space of the cooling chamber 1. The cooling air from the inlet air conduit 21 passes through the inlet 31 of the double three-way or block valve 3 and from there it is supplied to the air inlet 11 of the cooling chamber 1. Upstream of the air outlet 12 of the cooling chamber 1, an air dehumidifier 4 is arranged inside the cooling chamber 1 through which air passes before leaving the cooling chamber 1 and in which solid particles of water are collected. The double three-way or block valve 3 is coupled to a machine control system.

[0017] The dehumidifier 4 comprises a body 41 in which a purifying cassette 42 is mounted. Beneath the purifying cassette 42, in the body 41 of the dehumidifier 4 is arranged a snow and/or ice collector 43 into whose inner space 431 extends a snow and/or ice conveyor 44 which passes through the wall of the cooling chamber 1 to the outer space, where it opens into a snow and/or ice collection container 45. The snow and/or ice collection container 45 may be mounted on the outer jacket of the cooling chamber 1 or at a certain distance from it. At least the outer part of the conveyor 44 between the cooling chamber 1 and the snow and/or ice collection container 45 is mounted in a housing 46, on which a balancing valve 47 is mounted to balance the pressure inside the

cooling chamber 1, whereby in the illustrated embodiment, the housing 46 passes also through the inner space of the cooling chamber 1 and extends to the body 41 of the dehumidifier 4. The balancing valve 47 may be also mounted on the collection container 45, or directly on the cooling chamber 1.

[0018] The purifying cassette 42 comprises an outer frame 421 in which an inner frame 423 is mounted by means of flexible connectors 422. The space inside the two frames 421 and 423 is filled with a metal sieve 424. The inner frame 423 of the purifying cassette 42 is coupled to an ultrasonic radiator 5 from which vibrations are transmitted to the sieve 424. The radiator 5 is coupled to the machine control system for control. Several purifying cassettes 42 may be arranged one after the other in the body 41 in the air flow direction.

[0019] The snow and/or ice conveyor 44 is formed, for example, by a screw conveyor or chain conveyor and is coupled to a known drive (not shown) which is coupled to the machine control system.

[0020] During cooling, cooling air passes through the body 41 through the sieve 424 of the purifying cassette 42, and if it contains moisture, the moisture is deposited on the sieve 424 in the form of snow and/or ice, thereby reducing the passage cross section of the sieve 424 and decreasing its flow capacity. As soon as the reduction in flow capacity of the sieve 424 reaches the set limit, the machine control system issues a command to move the double three-way or block valve 3 to a position in which cooling air does not enter the cooling chamber 1 but flows through the air conduits and machine components arranged upstream of the cooling chamber 1. As a result, the air flow in the cooling chamber 1 ceases and no air passes through the sieve 424. The machine control system actuates the ultrasonic radiator 5, the vibrations of which are transmitted to the sieves 424 of the purifying cassette 42. Due the vibrations of the sieves 424, solid particles of the snow and/or ice fall off the sieves 424 and are moved by gravity to the snow and/or ice collector 43 arranged in the lower part of the body 41. Once a predetermined amount of snow and/or ice has been collected in the collector 43 or whenever snow and/or ice is removed from the sieve 424, the machine control system actuates the conveyor 44 to transfer snow and/or ice to the collection container 45 arranged outside the cooling chamber 1. Snow and/or ice is removed from the collection container 45 as needed, preferably allowed to dissolve or is dissolved by forced heating and flows out to an adjoining waste pipe (not shown).

[0021] After removing snow and/or ice from the sieves 424 of the purifying cassette 42, the machine control system stops the ultrasonic radiator 5 and moves the double three-way or block valve 3 to a working position in which air flows through the valve 3 to the cooling chamber 1, after passing through the cooling chamber 1 it passes through the dehumidifier 4 and exits from the cooling chamber 1 through the valve 3.

[0022] During the circulation and cooling of the air and

the removal of snow and ice from the cooling chamber 1, underpressure is generated in the cooling chamber 1, which is balanced by suctioning the ambient air through the balancing valve 47, which is in the illustrated embodiment arranged on the snow and/or ice collection container 45. In this arrangement, it is advantageous if the air being sucked in passes by the cold conveyor 44, thereby being cooled, with at least a portion of the moisture being precipitated therefrom.

Industrial applicability

[0023] The air dehumidifier according to the invention is applicable especially in air cooling or air conditioning machines.

List of references

[0024]

1	cooling chamber	
11	air inlet to the cooling chamber	
12	air outlet from the cooling chamber	
21	inlet air conduit	
22	outlet air conduit	
3	double three-way or block valve	
31	inlet of the double three-way or block valve	
32	outlet of the double three-way or block valve	
4	air dehumidifier	
41	body of the air dehumidifier	
42	purifying cassette	
421	outer frame of the cassette	
422	flexible connectors	
423	inner frame of the cassette	
424	metal sieve	35
43	snow and/or ice collector	
431	inner space of the snow and/or ice collector	
44	snow and/or ice conveyor	
45	snow and/or ice collection container	
46	housing of the conveyor	40
47	balancing valve	
5	ultrasonic radiator	

Claims

1. An air dehumidifier, especially for air cooling or air conditioning machines, arranged inside a cooling chamber (1) upstream of an air outlet from the cooling chamber (1), **characterized in that** it comprises a body (41) in which is mounted a purifying cassette (42) comprising a sieve (424) which is coupled to an ultrasonic radiator (5), whereby below the purifying cassette (42) is arranged a snow and/or ice collector (43) which is associated with a snow and/or ice conveyor (44) which opens into a snow and ice collection container (45) which is disposed outside the cooling chamber (1).

2. The air dehumidifier according to Claim 1, **characterized in that** the purifying cassette (42) comprises an outer frame (421) in which an inner frame (423) is mounted by means of flexible connectors (422), whereby the space inside the two frames (421, 423) is filled with a metal sieve (424) and the inner frame (423) is connected to an ultrasonic radiator (5).
3. The air dehumidifier according to Claim 1 or 2, **characterized in that** at least the outer part of the conveyor (44) between the cooling chamber (1) and the snow and/or ice collection container is mounted in the housing (46).
4. The air dehumidifier according to Claim 3, **characterized in that** the entire snow and/or ice conveyor (44) is mounted in the housing (46).
5. The air dehumidifier according to any of the preceding claims, **characterized in that** the inner space of the cooling chamber (1) is coupled to the outer space by means of a balancing valve (47).
6. The air dehumidifier according to Claim 5, **characterized in that** the balancing valve (47) to balance the pressure inside the cooling chamber (1) is mounted on the housing (46).
7. The air dehumidifier according to Claim 5, **characterized in that** the balancing valve (47) is mounted on the snow and/or ice collection container (45).

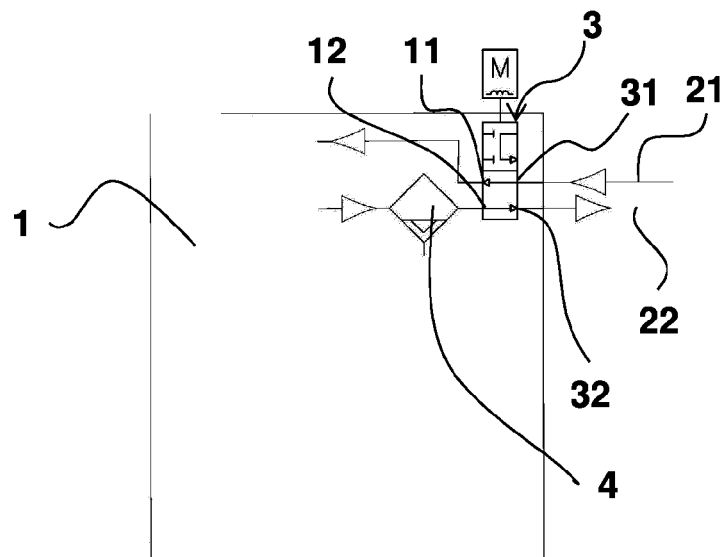


Fig. 1

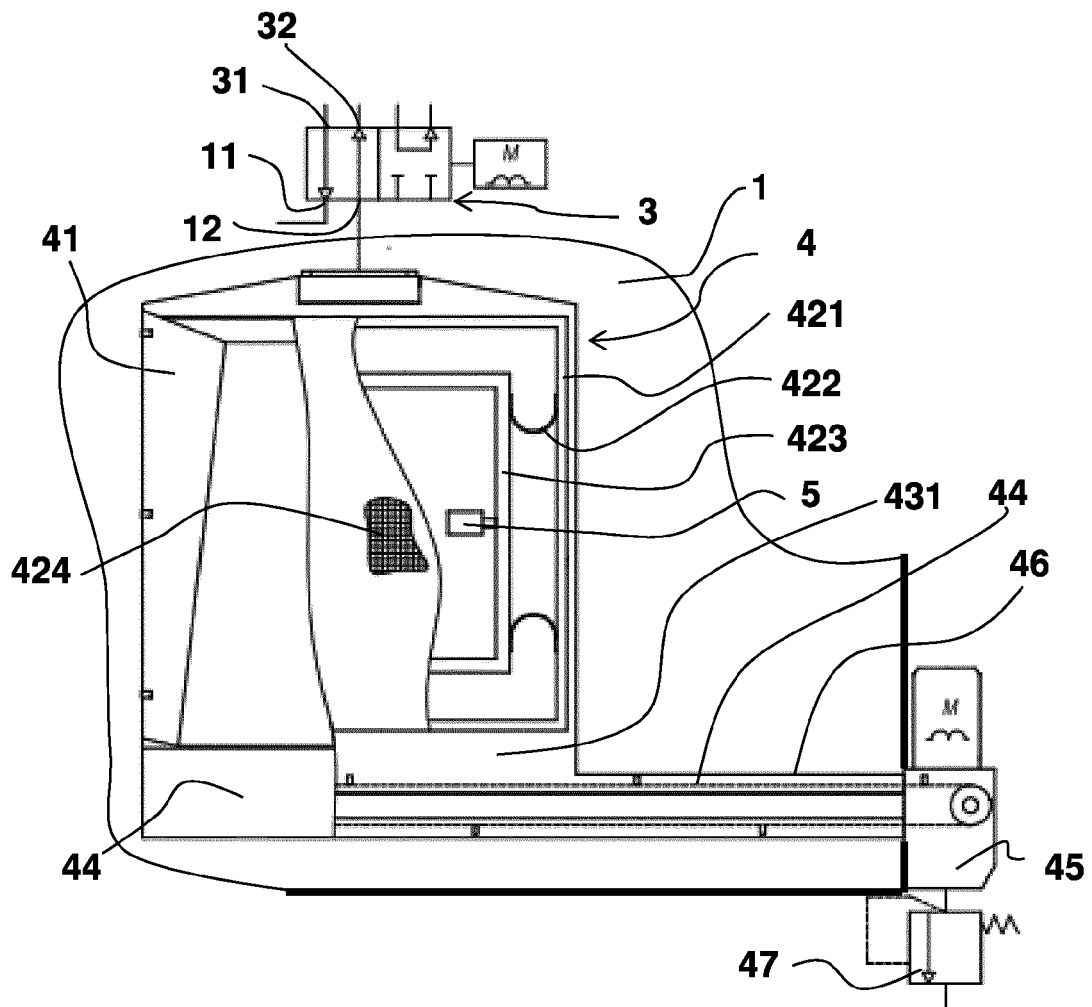


Fig. 2a

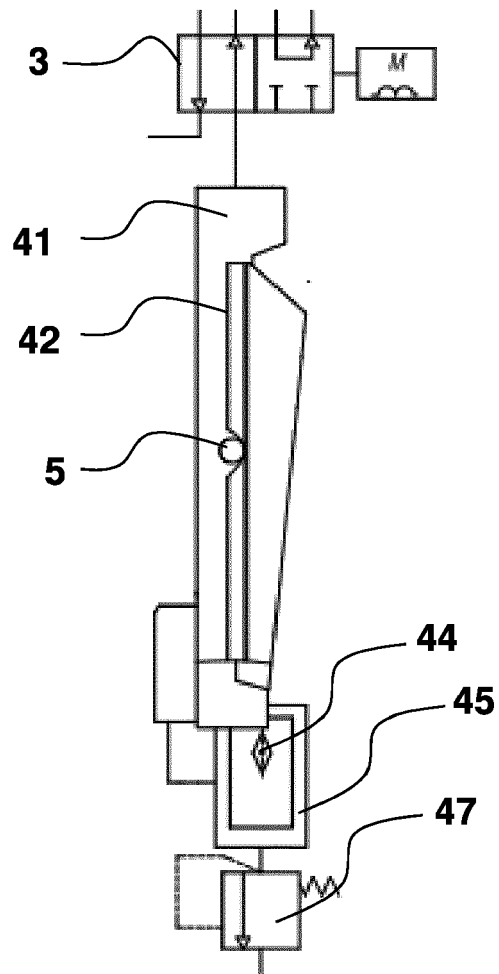


Fig. 2b

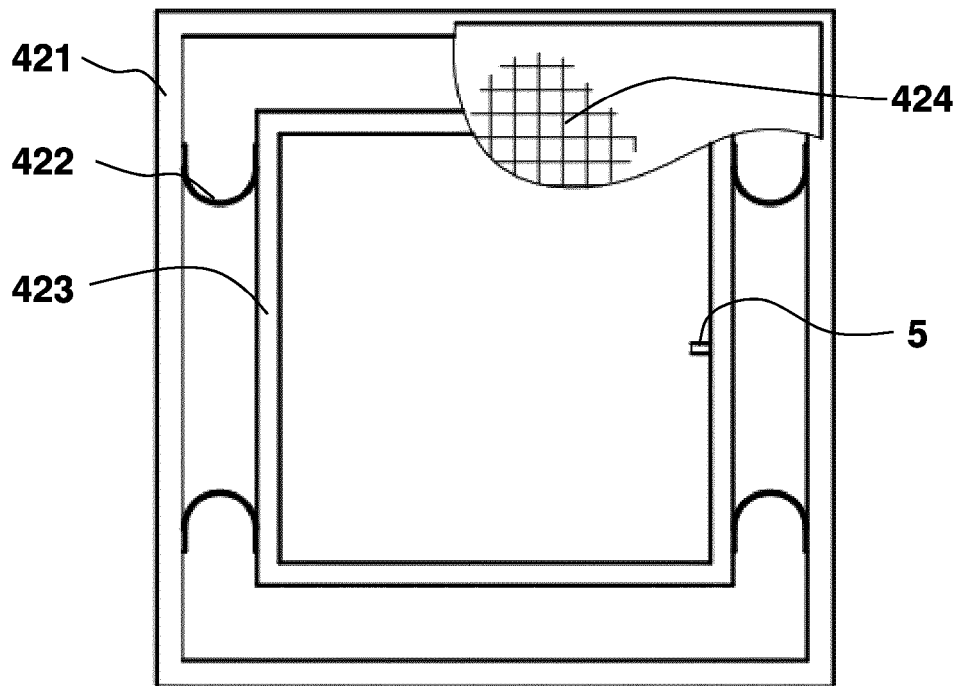


Fig. 3a

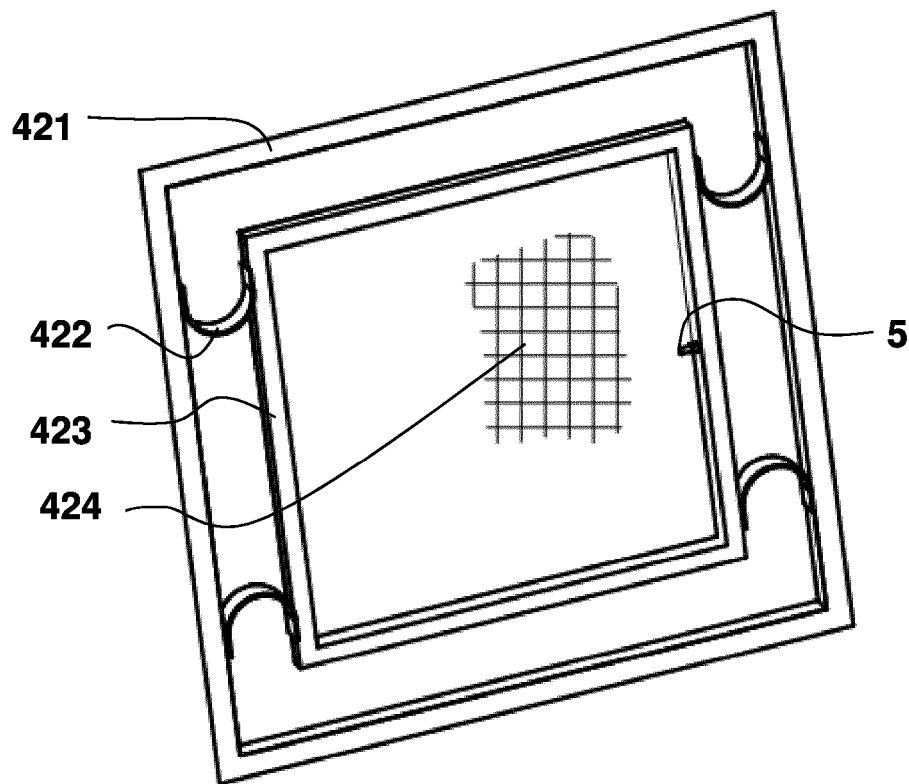


Fig. 3b



EUROPEAN SEARCH REPORT

Application Number
EP 19 21 5543

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DOCUMENTS CONSIDERED TO BE RELEVANT			
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			TECHNICAL FIELDS SEARCHED (IPC)
			F25D F24F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 April 2020	Examiner Kolev, Ivelin
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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