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(54) **ROOF VENTILATION SYSTEM**

(57) The present invention relates to an automatic opening system for natural ventilation roof units, comprised of a lever mechanism, a base and upper openable part, for the automatic opening of roof light lids, windows,

hatches or other ventilation elements and could also be used for building ventilation, more specifically for the creation of smoke and / or hot gases free zones in the event of fire. It can also be used for daily ventilation.

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## Description

### Technical field of the invention

[0001] The present invention relates to an automatic opening system for natural ventilation roof units, comprised of a lever mechanism, a base and upper openable part, for the automatic opening of roof light lids, windows, hatches or other ventilation elements and could also be used for building ventilation, more specifically for the creation of smoke and / or hot gases free zones in the event of fire. It can also be used for daily ventilation.

### State of the prior art

[0002] In the event of fire, the smoke and heat ventilation systems (SHEVS) can create and maintain a smoke free layer above the floor by exhausting the smoke. They also could be used for the extraction of hot gases released in the event of fire, during its initial phase. The use of such systems could create smoke free zones before the smoke layer spreads. Their value has been firmly proven in the evacuation of people from buildings or other building sites, as well as in the reduction of smoke damage and financial loss. They can facilitate ease of access for extinguishing a fire by improving visibility, reducing temperature under the roof and by limiting the lateral spread of the fire. In order to obtain these benefits it is crucial for the vent systems to function both fully and reliably if and when needed during their lifetime. The SHEVS is a safety system designed to play a positive role during any event of a fire.

[0003] Natural ventilation systems are smoke and heat exhaust systems which are designed to open using a set programme, after a fire has occurred. They can either be automatically or manually activated, or by using a combination of both. For a specific design, where only manual start-up is appropriate, the system can be installed without an automatic launching mechanism.

[0004] Natural ventilation systems should be fitted with self-powered opening mechanisms such as gas containers, spring systems, local power supply and / or external power supply.

[0005] Patent application GB2479883 A and patent application GB2479884 A discloses lever type ventilation systems designed for two-sided installation along the width of the smoke duct valve.

[0006] The systems disclosed in the two patent documents may be driven by an electric motor and have a locking mechanism for securing them in a closed position, while a cantilever system allows the upper openable part to open to about 140 degrees. The ventilation systems under consideration, however, have certain limitations regarding the basic parameters of their systems, according to the European standards, for example in the area of the smoke duct valves. They are only intended for an electromotor opening mechanism and not for a pneumatic actuator.

[0007] The Patent applications GB2479883 A and GB2479884 A are inherently so-called tandem systems using two identical opening mechanisms at both ends of the valve. These mechanisms are mounted bilaterally, and single or unilateral use is not possible i.e. it is not possible to operate a single mechanism because it will twist the lid of the system. In contrast to these, the automatic opening system for natural ventilation roof units under current consideration is provided with a lever mechanism that is single and is centre mounted on the upper openable part of the SHEVS.

[0008] The proposed solutions as outlined in patent applications GB2479883 A and GB2479884 A can only integrate the electromotor opening mechanism, which imposes serious limitations on the length-width parameters of the valves. By increasing the size of the valves increases the weight of the SHEVS. This requires higher power from the engine, and hence places more serious requirements on the cabling system and on the control central panels. Therefore with a certain size of valve it becomes difficult, unprofitable, or impossible to open the vent system with an electric motor.

[0009] The closest invention to the present invention is the vent system as disclosed in EP 2 003 262 B1. Essentially, the system disclosed in EP 2 003 262 B1 is a lever vent system driven by two actuators - an electric motor and a gas spring (plunger). The system provides an opening of 60, 90 or 150 degrees from the duct. The opening process is carried out by an electric motor in combination with one or two plungers. The plunger system provides additional power to the motor at the moment of opening. This is necessary because the electric motor is fixed close to the hinges, giving an adverse leverage effect. For this reason, the energy required to be invested in opening and closing the system is very high. The main effect of the combination of the used opening mechanisms is that a more compact motor is used and the ventilation system, respectively, is also more compact. This is an advantage from a transportation point of view. The system also has a locking mechanism for securely fixing the lid in a closed position. However, the vent system disclosed in EP 2 003 262 B1 is adapted for two actuators - an electric motor in combination with one or two plungers (it is impossible to mount a pneumatic mechanism), while the present invention is adapted for only one type of opening mechanism, the possibility being to be driven by either an electric motor or a pneumatic mechanism. Compared to the more general capacity of the claimed invention, all the above-described patent documents have limitations on the length-width parameters and their electrical parameters.

[0010] The opening mechanism of the ventilation system known from EP 2 003 262 B1 is located very close to the hinges, this design feature is disadvantageous in terms of the requirement to use a mandatory combination of an electrical, pneumatic, or hydraulic opening mechanism with one or more gas springs. This makes the known system more complex and more costly.

**[0011]** The drawbacks of the ventilation system known from EP 2 003 262 B1 are overcome by the present invention which uses only one opening mechanism - an electric motor, or a pneumatic mechanism mounted on the lower support cross section and upper openable part cross section which serve for strutting (to fix) the base and upper openable part. This arrangement allows for the use of only one opening mechanism, which is the essential distinctive feature of this invention. Replacing an electromotor opening mechanism with a pneumatic opening mechanism does not require any changes in the detail of the ventilation systems.

### Description of the invention

**[0012]** The objective of the present invention is to provide an automatic opening system for natural ventilation roof units comprising of a lever mechanism, base and upper openable part, for the automatic opening of roof light lids, windows, hatches and other ventilation elements that could be used for a natural ventilation, by providing a two-stage opening the upper openable part up to 90-95 degrees and up to 140 or 165 degrees, depending of the capacity of the electrical motor or pneumatic mechanism. The system is designed for the exhaust of smoke and/or hot gases in the event of fire, as well as for daily ventilation.

**[0013]** Elements of the system according to the invention (fig. 1):

- A base;
- An opening mechanism comprising a single, centre mounted lever for raising the upper openable part, provided with a mechanism either an electric motor or a pneumatic device mounted on fixed base lower support cross section and upper openable part cross section;
- The fixed base lower support cross section is used to support the lever;
- The upper openable part cross section fixing the opening mechanism to the upper openable part;
- A lever for lifting the upper opening part works together with the opening mechanism
- Locks for locking the system in both positions - the first on the lower cross section locks the upper openable part in the closed position and is self-unlocking when the opening mechanism is activated and the second on the lever keeps the upper openable part locked when reaching the specified degrees of opening angle;
- Upper openable part, consisting of a frame, with an attached polycarbonate panel and seals, being the lid of the system;
- Hinges attaching the upper openable part to the base.

**[0014]** Preferably, the elements of the system are as follows:

- The base of the system consists of zinc galvanized sheet metal and insulation wadding, fastened by bottom and top plates, formed according to the profile of the frame and fixing elements for connection to the roof surface and the various other elements of the system.
- An opening mechanism, being a single centre mounted lever for raising the upper openable part, provided with a mechanism either with an electric motor, or a pneumatic mechanism, mounted on the fixed base lower support cross section and upper openable part cross section.
- A lever for lifting the upper openable part, being part of the opening mechanism.
- Fixed base lower support cross section and upper openable part cross section which serve for strutting (to fix) the base and upper openable part;
- Locks for locking the system in both positions - the first locks the upper openable part in the closed position and is self-unlocked when the opening mechanism is activated, and the second which self-unlocks when reaching the specified degrees of opening angle.
- Upper openable part, consisting of a frame of aluminium, or steel profiles, with an attached polycarbonate panel and seals being the lid of the system;
- Hinges for attaching the upper openable part to the base.

**[0015]** The principle of operating the system consists of two stages in operating the opening mechanism. The first stage means opening up to 90-95 degrees and the second stage means opening up to 140 or 165 degrees.

**[0016]** In the present invention, the lock type is one and the same in both positions - the first lock locks the upper openable part in the closed position and is self-unlocking when the opening mechanism is opened and the second lock is self-unlocking upon reaching the specified degrees of the opening angle.

**[0017]** The activation of the opening mechanism is carried through a control panel signal, a plurality of initiating signals for this activation may be used: a smoke detector, fire alarm control panel, button, building control system, etc.

**[0018]** The angle of the opening is determined by the size and type of the electric motor or pneumatic mechanism used, which in turn is proportional to the overall size of the system and which will affect its overall cost. Using a larger mechanism opens the system to a larger angle, but at an increased cost. The angle of opening affects the aerodynamic efficiency of the system, i.e. what amount of smoke will be extracted per unit of time under certain conditions.

### In the drawings

**[0019]**

**Fig.1.** Elements of the system and their positions on the figure:

- **Position 1**- base;
- **Position 2** - opening mechanism;
- **Position 3** - lever mechanism being part of the opening mechanism;
- **Position4** - fixed base lower support cross section ;
- **Position 5** - upper openable part cross section;
- **Position 6** - lock on the upper openable part cross section;
- **Position 7** - lock on the lever mechanism, on the fixed base lower support cross section;
- **Position 8** - upper openable part;
- **Position 9** - hinges.

**Fig. 2.** Central section of the system. Positions on the figure:

- **Position 1** - base;
- **Position 2** -opening mechanism;
- **Position 3** - lever mechanism being part of the opening mechanism;
- **Position 4** -fixed base lower support cross section;
- **Position 5** - upper openable part cross section;
- **Position 6** - lock on the upper openable part cross section;
- **Position 7** - lock on the lever mechanism and on the fixed base lower support cross section /not visible/;
- **Position 8** - upper openable part;
- **Position 9** - hinges.

**Fig. 3.** Lock on the upper openable part cross section

**Fig. 4.** Lock on the lever mechanism, on the fixed base lower support cross section

### Embodiments of the invention

**[0020]** The preferred embodiments of the ventilation system include the opening of its upper openable part 8 by means of an integrated opening mechanism 2 based on electrical motor or pneumatic mechanism.

**[0021]** The elements of the system which do not depend on the type of opening mechanism 2:

- Base 1 - made of zinc galvanized sheet metal with a thickness of 1 to 3 mm; thermal insulation, preferably stone wool, with a thickness of 50 to 100 mm; fixing elements for connection to the roof surface and the remaining elements of the system.
- The upper openable part 8 consisting of lower and upper frames of shaped profiles, preferably of aluminium, with polycarbonate panel (optionally polycarbonate of 16-32 mm thickness), package solu-

tions with multi wall polycarbonate, 3 + 3 mm to 16 + 4 mm thickness, dense polycarbonate or Plexiglas (PMMA - Polymethyl Methacrylate), vulcanised rubber seals (EPDM - Ethylene Propylene Diene Monomer) and steel hinges.

- The fixed base lower support cross section 4 and upper openable part cross section 5, being strutting of steel or aluminium profiles.
- The locks 6 and 7 for locking the system.

### Preferred embodiment of the system using electrical motor mechanism:

**[0022]** The electrical motor designated for opening the system is fixed to the fixed base lower support cross section 4 through the lever mechanism 3 in the slots of its main body. The opening mechanism is attached to the upper openable part cross section 5 at the position of the lock 6. The main body of the opening mechanism 2 is made of extruded aluminium, and has a movable stainless steel piston. Depending on the length of the opening mechanism 2, as well as its overall length when open, it assumes an angle of opening of between 140 and 165 degrees. The ventilation system will open depending on the length of the used opening mechanism in order to obtain the desired opening angle, depending on the purpose and the designation of the system, i.e. is it for smoke extraction or for daily ventilation.

### Preferred embodiment of the system using pneumatic mechanism:

**[0023]** The pneumatic mechanism designated for opening the system is fixed to the fixed base lower support cross section 4 of the lever mechanism 3 at the slots of the main body of the opening mechanism 2. The opening mechanism 2 is attached to the upper openable part cross section 5 at the position of the lock 6. The main body of the opening mechanism 2 is made of extruded aluminium and has a movable stainless steel piston. Depending on the length of the opening mechanism 2, as well as its overall length when open, it assumes an opening angle of between 140 and 165 degrees. The ventilation system will open in respect to the opening mechanisms used 2, there is the possibility of using mechanisms of different lengths (in opened and closed positions) in order to obtain the desired opening angle, depending of the purposes and the designation of the system, i.e. if it is for smoke extraction or for daily ventilation.

### Action of the system:

#### **[0024]**

A. In one preferred embodiment of the system comprising electrical motor mechanism:

1. When locked the upper openable part 8 is

closed firmly on the base 1 of the ventilation system. The lock 6 on the upper openable part cross section 5 firmly closes the upper openable part 8 on the base 1 and the opening mechanism 2 is now closed - the piston is inside the main body. This is the common status of the ventilation system. In this status the firm locking of the upper openable part 8 to the base 1, and the EPDM seals ensures the water and air resistance of the whole ventilation system. The upper opening part 8 is mounted at a certain angle with respect to the roof surface, so that in the closed position the rain water is directed to the roof and no infiltration is allowed to the bonding zone of the base 1.

2. In the event of an activation signal, the opening mechanism 2 begins to operate at various stages, opening the lock 6 on the upper openable part cross section 5. During this stage the upper opening part 8 is no longer attached to the base 1 and can therefore initiate the opening process.

3. The opening process continues, depending on the purpose of the system: daily ventilation or smoke extraction. In the event that the systems' purpose is for daily ventilation, the angle of opening will be limited at up to 30 degrees. When the said degrees are reached the activation signal stops and the system remains opened at 30 degrees for daily ventilation. 30 degrees are recommended choice in the event of daily ventilation, but can be changed in accordance with the user's wish. When the system is opened at 30 degrees it is locked in position by the locking of the lever mechanism 3 in the eccentric slots of the lever mechanism 3 to the fixed base lower support cross section 4 until 95 degrees is reached.

4. In the event of a signal for smoke extraction, whether the system is partially opened or fully locked, it will be recognised as a signal of first priority and the opening process will begin, or continue to the maximum opening angle of 140 degrees, or more. In the event of such a priority opening, the opening mechanism 2 continues to work, and when the angle of 95 degrees is reached, the system is unlocked in the eccentric slots of the lever mechanism 3 on the fixed base lower support cross section 4 and the lock 7 on the fixed base lower support cross section 4 locks. The opening and the lever mechanisms 2 and 3 continue the opening process until the preferred maximum opening angle has been reached. During opening, between 95 degrees and the maximum opening angle, the lever

mechanism 3 remains locked to the fixed base lower support cross section 4. The aim of this locking is to prevent the upper openable part 8 being closed by wind or any other conditions.

5. Upon reaching the maximum opening angle, the upper openable part 8 and lever mechanism 3 remain locked in this position.

B. In one preferred embodiment of the system comprising pneumatic mechanism.

**[0025]** In this preferred embodiment there is only one functioning option due to the nature of the opening mechanism 2: the system can only be used for smoke exhaustion having only one type of opening - up to the maximum opening angle. In this case, two-stroke (open/close) pneumatic mechanisms are used and the system works by opening and closing only at the two endpoints - i.e., fully open and fully closed. With this design, the signal is single and continues to fully open the system to reach the maximum desired angle.

**[0026]** Activation signals for both opening mechanisms:

1 Activation signal in the case of an electrical motor mechanism: In this case the activation signal is electrical and is fed by the control central panel. The voltage can be constant or variable depending on the type of electric motor. The supply should be permanent for the functioning of the opening mechanism 2.  
2 Activation signal in the case of a pneumatic mechanism: In this case the activation signal is pneumatically compressed air, which has been supplied by a pneumatic control pannel and has been transferred to the opening mechanism 2 by way of a two-tube routing (having either 6, 8 or 10 mm diameter) in order to ensure both opening and closure. It should be supplied simultaneously in order to ensure the full functionality of the system.

## Claims

1. An automatic opening system for natural ventilation roof units as roof light lids, windows, hatches and other ventilation units, comprising of a base (1), an opening mechanism (2), operating either with an electrical motor or a pneumatic mechanism; a lever mechanism (3) for raising the upper openable part (8); and a locking mechanism, **characterised in that** the opening mechanism (2) is a single centre mounted lever for raising the upper openable part (8), provided either with an electrical motor or a pneumatic mechanism, mounted on a fixed base lower support cross section (4) and upper openable part cross section (5), attaching, both the base (1) and the upper openable part (8), respectively; the lever mechanism

(3) for raising the upper opening part (8) being part of the opening mechanism (2); the locking mechanism being performed by two locks (6), (7), the first lock (6) being secured to the upper openable part cross section (5), and self-unlocked, when the opening mechanism (2) is activated, and securing the upper opening part (8) in a closed position, while the second lock (7) is attached to the lever mechanism (3) and to the fixed base lower support cross section (4), providing the possibility of a two-stage opening when opening the upper openable part (8) by self-unlocking at up to 90 - 95 degrees; and at up to/or from 140 up to 165 degrees, respectively.

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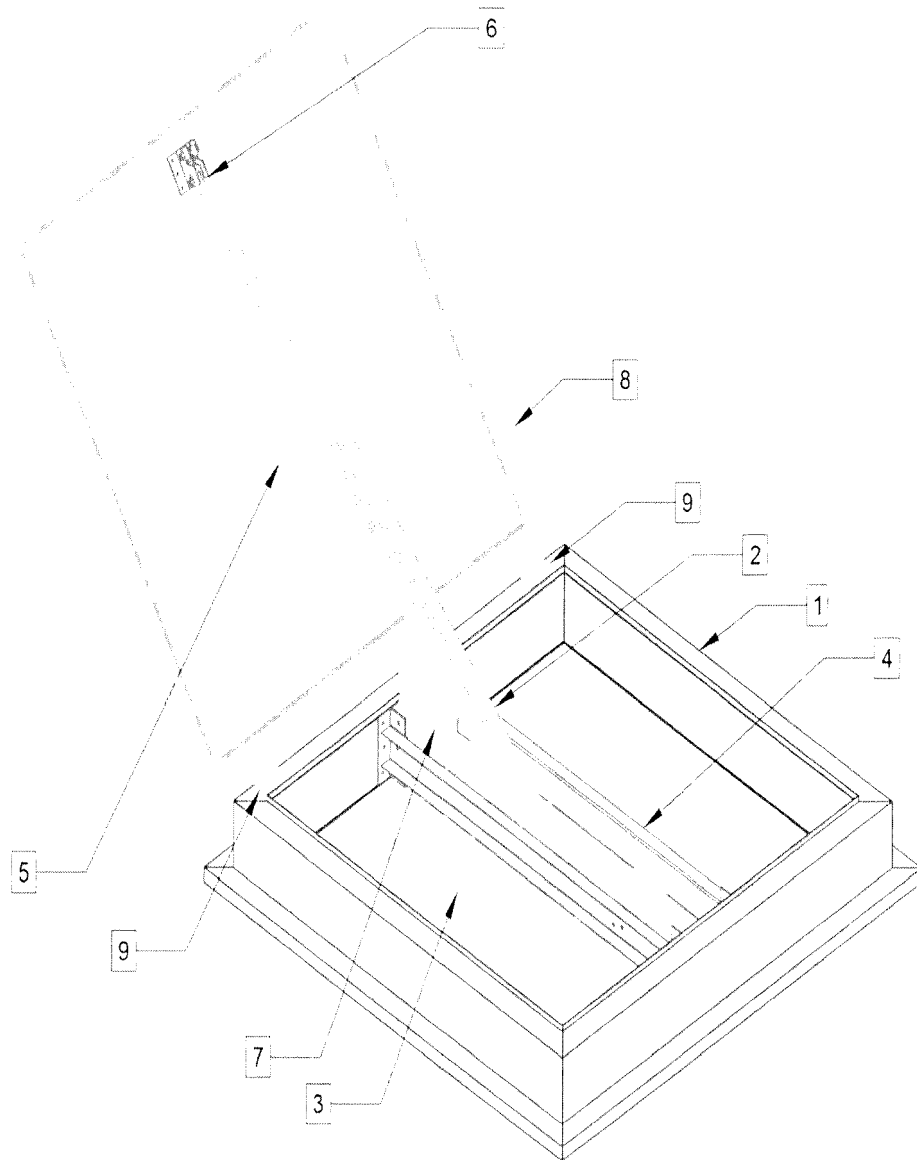


Fig. 1.

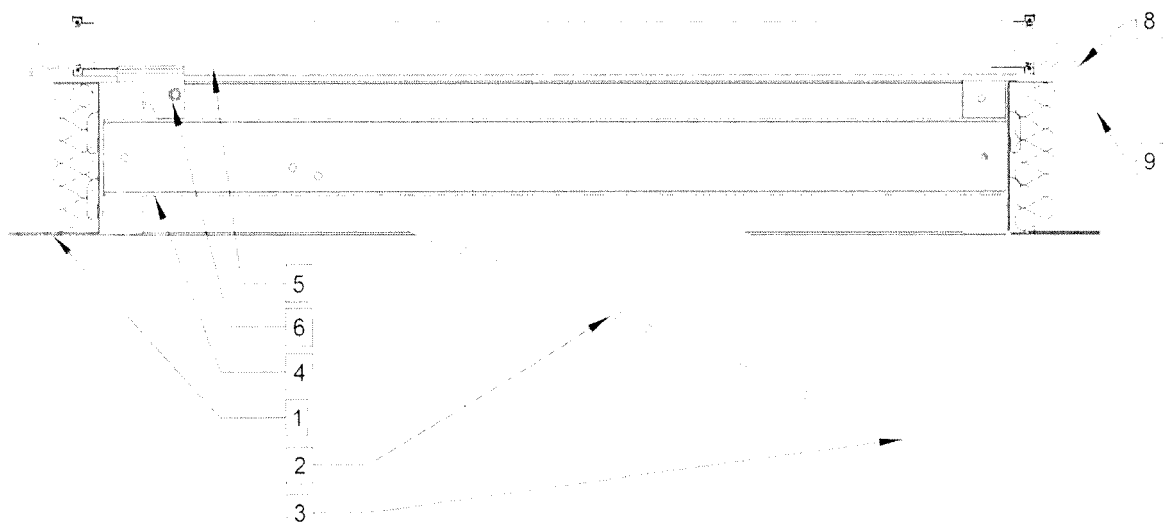


Fig. 2.

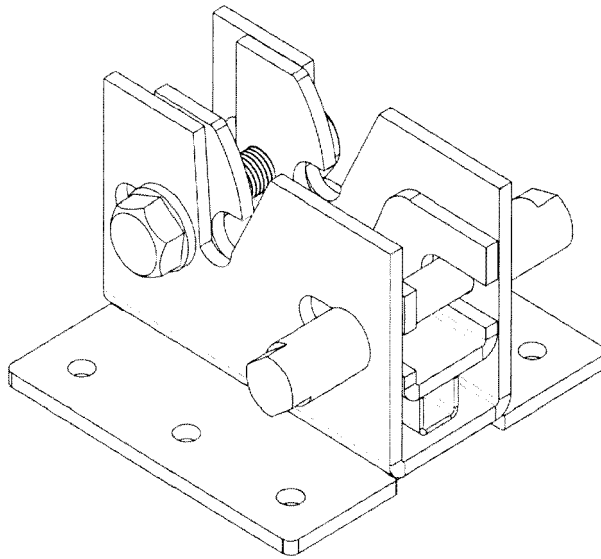


Fig. 3.

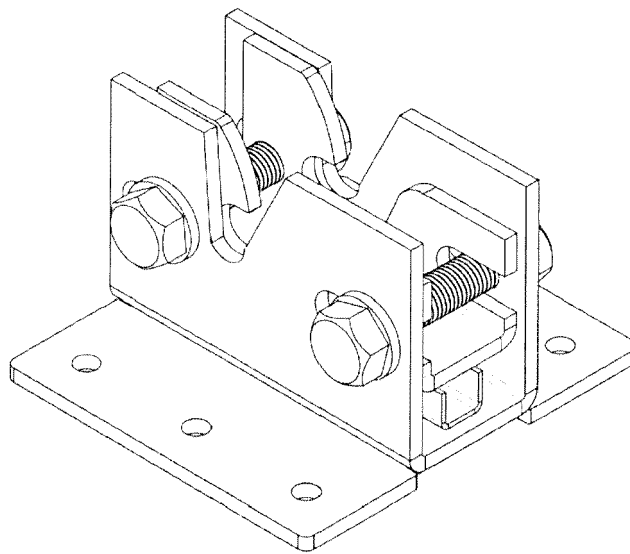


Fig. 4



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Application Number  
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| DOCUMENTS CONSIDERED TO BE RELEVANT                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                               |                                                         |                                                            |
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| Place of search<br><b>Munich</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                               | Date of completion of the search<br><b>17 July 2018</b> | Examiner<br><b>Anconetani, Mirco</b>                       |
| CATEGORY OF CITED DOCUMENTS<br>X : particularly relevant if taken alone<br>Y : particularly relevant if combined with another document of the same category<br>A : technological background<br>O : non-written disclosure<br>P : intermediate document<br>T : theory or principle underlying the invention<br>E : earlier patent document, but published on, or after the filing date<br>D : document cited in the application<br>L : document cited for other reasons<br>& : member of the same patent family, corresponding document |                                                                                                                                                               |                                                         |                                                            |

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