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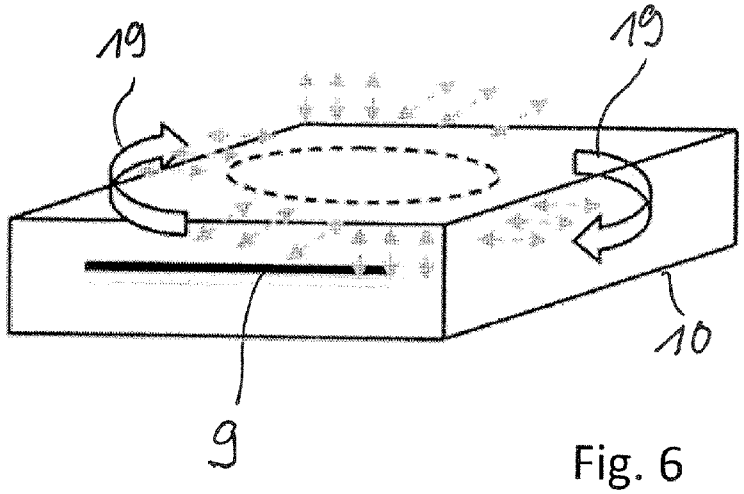

Fig. 6

(57) Abstract: The application discloses A DIN slot size infotainment system for a car dashboard with a DIN slot opening. The DIN slot size infotainment system is provided with a supply air region and with an exhaust air region. The infotainment system comprises a disk drive with a disk drive casing, a disk drive mechanism and at least one electronic component. The disk drive casing comprises a supply air inlet and an exhaust air outlet, wherein the supply air inlet is provided for communication with the supply air region and wherein the exhaust air out is provided for communication with the exhaust air region. The disk drive mechanism comprises a disk reception area for driving an optical data carrier disc, wherein the disk reception area is connected with the supply air inlet and the exhaust air outlet such that, upon rotation of an optical data carrier disc being provided in the disk reception area, a cooling airflow is generated between the supply air inlet and the exhaust air outlet. The at least one electronic component is provided in the area between the supply air inlet and the exhaust air outlet, wherein the at least one electronic component is arranged such that the cooling airflow contacts at least one surface area of the at least one electronic component.

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CAR INFOTAINMENT SYSTEM WITH A DISK DRIVE HAVING AN IMPROVED THERMAL EFFICIENCY

Car infotainment systems provide more and more features and connectivity functions as technology evolves and customers' expectation increases, resulting in more heat being generated by the additional electronic components. With more generated heat within the same space volume in the system, particularly in a 1-DIN system, more efficient heat dissipation methods are required.

The DIN standard was originally established by the German standards body “Deutsches Institut für Normung” as DIN 75490, and is therefore commonly referred to as the "DIN car radio size". It was adopted as international standard ISO 7736 in 1984. Head units generally come in 1, 2, 2.5 and 3 DIN configurations. In particular, these configurations comprise the single DIN (180 x 50 mm panel) and the double DIN (180 x 100 mm panel) size. The depth is not standardized.

In particular, when a CD drive of an infotainment system is reading and playing songs from a loaded disc, heat will be generated from the electronic components embedded on the main printed circuit board (PCB) and the drive electronic components. This will contribute to an overall temperature rise within the infotainment system.

In existing car radio infotainment systems, both software and hardware thermal management and control are used to prevent damage to the radio system and its components. A good thermal management implementation can also enhance the system reliability and operational efficiency, as well as user experience

in accessing all the infotainment system features and functionalities for extended duration and temperature.

CN20032072955 discloses a portable CD drive, wherein a casing is shaped in a way that an airflow of the CD provides a cooling effect.

JP20040212711 discloses a CD ROM drive of a computer, wherein a fan structure is attached to a disk to provide a cooling airflow.

It is an object of the application to provide an improved heat dissipation arrangement for a car infotainment system while keeping a bill of material (BOM) low.

According to the application, no extra-fan is necessary for the cooling of electronic components in the car infotainment system. Instead, an inserted data disc with a navigation system, audio data or other car infotainment data is used for cooling. If there is no data disk inserted there is no heat from the disk drive and the laser and in general less data processing will be required as well. In this situation, a driven air flow is not generally required for an infotainment system according to the application.

The application provides a DIN slot size infotainment system, especially with a single DIN size, for a car dashboard with a corresponding DIN slot opening which is furthermore provided with a supply air region and with an exhaust air region.

The DIN slot size infotainment system comprises a disk drive with a disk drive casing, a disk drive mechanism and one or more electronic components.

The disk drive casing comprises a supply air inlet and an exhaust air outlet. The supply air inlet is provided for communication with the supply air region and the exhaust air outlet is provided for communication with the exhaust air region. In this context, "communication" refers to an air stream. Likewise "A communicates with B" means that A is connected to B via an air channel.

The casing comprises a front surface or front plate for inserting the disk, a rear surface opposite to the front surface, two side surfaces, which are typically in contact with a DIN slot of a dashboard, a bottom surface and a top surface.

The disk drive mechanism comprises a disk reception area for driving an optical data carrier disc, wherein the disk reception area is connected, or in communication, with the supply air inlet and the exhaust air outlet.

The supply air inlet, the disk reception area and the exhaust air outlet are arranged such that, upon rotation of an optical data carrier disc that is provided in the disk reception area, a cooling airflow is generated between the supply air inlet and the exhaust air outlet.

An optical data carrier disk refers to an optically readable portable disk such as a CD, a DVD, a blue ray disk or others. This stands in contrast to a permanently mounted magnetic

drive, such as a computer hard disk. The disk drive may also be configured to read more than one disk. This functionality may be used to read a music CD and a data CD with geographical information (GIS data) at the same time. The electronic components may comprise functionality to display and correlate the GIS data with positional information from satellites/mobile phone cells, for example.

For improved cooling, the one or more electronic components are provided in an area between the supply air inlet and the exhaust air outlet, and they are arranged such that the cooling airflow contacts at least one surface area of the one or more electronic components.

In one embodiment, the infotainment system, comprises one or more temperature sensors and a disk drive control that is connected to the disk drive mechanism and to the temperature sensors. The disk drive control comprises means for determining if a pre-determined temperature threshold is exceeded based on a signal of the at least one temperature sensor and means for activating the disk drive mechanism when the predetermined temperature threshold is exceeded. In particular, the disk drive control may detect when the disk is at rest or not used for reading and activate the disk drive.

Furthermore, the disk drive control may comprise means for detecting a start-up mode of the infotainment system and means for activating the disk drive mechanism when the infotainment system is in the start-up mode and the predetermined temperature threshold is exceeded. The start-up mode may be triggered by a user operating a power on button.

In particular in a start-up mode, a user will be less affected if the disk drive mechanism is controlled according to cooling requirements and not according to data reading requirements.

Furthermore, the disk drive control comprises may comprise means for receiving a start-up signal and means for activating the disk drive mechanism when the pre-determined temperature threshold is exceeded and the start-up signal is received. In particular, the start-up signal may be generated by turning a car key or by detecting availability of current supply to the infotainment system.

To further improve circulation, the disk drive may comprise a casing portion that surrounds the disk reception area, wherein the casing portion is shaped for directing the cooling air stream. The casing portion comprises a rounded shape that is arranged adjacent to an outer rim of the optical data carrier disk when the disk is inserted in the disk reception area. The rounded shape is adapted to the shape of the disk and to the intended airflow. The rounded shape may comprise various forms such as a circular section, a “bob track” shape, a spiral bob track shape etc.

To further improve the cooling effect on the electronic components, at least one of the electronic components may comprise a heat sink. The heat sink may be in thermal contact with the casing for faster heat dissipation.

According to the application, one or more of the electronic components of the disk drive may be placed laterally outside the disk reception area and adjacent to the disk reception

area in order to receive the cooling airflow of the disk. In the context of the application, "laterally" refers to a direction in a plane that is substantially parallel to the top and bottom surfaces of the disk drive casing.

This position of the electronic components is especially advantageous if the cooling air stream is generated by the disk rotation only. If there are other sources of airflow, such as a fan, a location of strongest cooling may be shifted towards the airflow from the other airflow source.

To further enhance the cooling, the disk drive may further comprise a motor fan, which is arranged adjacent to a casing surface. According to the application, one or more of the electronic components may be arranged in a region in which the cooling air stream and an airflow of the motor fan flow substantially in the same direction and thereby reinforce each other.

The disk drive may comprise multiple slits to enhance the airflow, especially at a rear side or at the side surfaces of the disk drive casing. To further enhance the airflow, the disk drive may comprise upper openings at a top surface of the disk drive casing, wherein the openings are arranged substantially laterally outside the disk reception area. The upper openings may be made in a rectangular shape that is easy to manufacture and provides a large surface. The openings are provided at a top surface in order to use the effect that hot air rises to the top. According to the application, an opening also refers to an opening with a grid-like structure.

The application furthermore discloses a car dashboard with a DIN slot opening, wherein the DIN slot infotainment system is provided in the DIN slot opening. The exhaust air outlet of the DIN slot infotainment system communicates with an exhaust air region of the car dashboard and wherein the supply air inlet of the DIN slot infotainment system communicates with a supply air region of the dashboard. Thereby, the infotainment system can supply and discharge air effectively.

The application discloses furthermore a car with the aforementioned dashboard, wherein the dashboard is attached to a front portion of a passenger compartment of the car.

Moreover, the application discloses a car with an interior equipment. The interior equipment comprises the aforementioned dashboard and a car ventilation system. The car ventilation system communicates with at least one of the supply air region and the exhaust air region of the dashboard. Thereby, the car ventilation can be harnessed to provide a cooling airflow to the car infotainment system. In particular, the car ventilation system may communicate with the supply air region to be able to blow cooled air into the infotainment system. However, the cooling air may also be sucked in by connecting the exhaust air region.

In the context of this application “car” does not only refer to passenger cars but also to other motor driven vehicles, which can be licensed for driving on a public road and which provide a passenger compartment like buses, trucks, jeeps and utility vehicles. Furthermore, the passenger compartment can be open to the top, as in a cabriolet, for example.

A heat dissipation arrangement according to the application can provide several advantages such as

a) Enhancement of user experience and interaction as the full functionality infotainment system could operate in a wider-range of higher temperature and duration.

b) Usage of existing operational disc rotational movement from the assembled disc drive to improve heat dissipation within the infotainment system, without additional space requirement.

c) Existing hardware solutions, such as a heat sink or a ventilator, may be reduced or removed without any significant impact on heat dissipation.

In addition to keeping the BOM low, a heat dissipation arrangement according to the application makes efficient use of the limited space in a car infotainment system such that electronic components with additional features may be provided. This stands in contrast other hardware solutions, which may face constraints with height, width, side-effects and other limitations for the system.

According to the application, components for the various features or functionalities are placed in a way that obstructions to the heated air dissipation are reduced and the effectiveness of existing hardware cooling solutions is enhanced. Even if the heat sources are not in a direct heat conduction path or in contact with existing cooling solutions, the efficiency and effectiveness of the existing solutions can be improved.

The application will now be explained in further detail with respect to the following Figures in which

Figure 1 shows a first cooling arrangement for a disk drive of a car infotainment system with a first placement of electronic components,
Figure 2 shows a second cooling arrangement for a disk drive with a second placement of electronic components,
Figure 3 shows an airflow of the first cooling arrangement,
Figure 4 shows an airflow of the second cooling arrangement,
Figure 5 shows a modified chassis for directing an airflow in the disk drive,
Figure 6 shows a placement of a disk movement space in the disk drive,
Figure 7 shows a flow diagram for a thermal control and management system of the disk drive,
Figure 8 shows a placement of electronic components,
Figure 9 shows a first arrangement of air openings,
Figure 10 shows a second arrangement of air openings,
Figure 11 shows a disk cooling arrangement with a first placement of electronic components,
Figure 12 shows a disk cooling arrangement with a second placement of electronic components, and
Figure 13 shows an overview over different hardware cooling solutions according to the application.

Fig. 1 shows a perspective view and a top view of a cooling arrangement for a disk drive 10, wherein an air outlet 11 is provided in a lateral surface of a casing 8. A directed airflow 12 passes through the air outlet 11. The airflow 12 can

be seen best in the top view of Fig. 1. A disk insertion slit 9 is shown to indicate a position of a disk area.

The casing comprises a front surface or front plate 2, a rear surface 3, a left side surface 4, a right side surface 5, a top surface 6 and a bottom surface 7. For simplicity, reference numbers to the casing surfaces have are omitted in the following Figures.

Fig. 2 shows a perspective view and a top view of a cooling arrangement for a disk drive 10, wherein a heat dissipation element 13 is provided next to a lateral surface of a casing 8. An electronic component 7 is in thermal contact with the heat dissipation element 13.

A thermal flow 14 is directed from the heat conducting element 13 to the surrounding air. In general, the thermal flow 14 will also produce an associated convective airflow.

Fig. 3 shows an arrangement which is similar to the arrangement of Fig. 1, but in which electronic components 15 are placed in the way of the airflow 12, thereby reducing a cooling effect of the arrangement.

Fig. 4 shows an arrangement which is similar to the arrangement of Fig. 2. In addition to the electronic component 7, further electronic components 15 are placed next to the heat dissipation element 13.

Fig. 5 shows a schematic view of a portion of a disk drive. A disk drive mechanism 17 is coupled to a spin axis, which is not shown. A disk 18 is in mechanical connection to the spin

axis and rotates with the spin axis in a direction of rotation 19. Casing parts 20, 21 partially surround the disk 18.

During operation of the disk drive, the casing parts 20, 21 take up heat from electronic components and dissipate the heat towards the disk 18 in a first heat flow 22 and to the outside in a second heat flow 23. The first heat flow 22 heats up the air around the disk 18. The heated air is then moved away by thermal convection and by the generated airflow of the disk rotation 19.

Fig. 6 shows a perspective view of a disk drive 10, wherein heat flows are indicated by dashed double arrows.

Figure 7 shows a flow diagram for a thermal control and management system of the disk drive. To avoid damage to the infotainment system's components, a software solution a thermal control and management system may be implemented to continuously monitor the system temperature, particularly for critical electronics components.

In a first step 30, the radio infotainment system is in an active mode. A temperature of the infotainment system is monitored in a step 31. In a decision step 32, it is decided if the system temperature has exceeded a warning temperature threshold T_warn. If this is the case, the system reduces pre-determined features, for example lower system volume output, to lower the overall heat generation in a step 33. If not, the process loops back to the monitoring step 31.

In a decision step 34, it is decided if the system temperature has exceeded a critical temperature T_crit, which is

greater than the warning temperature T_warn. If this is not the case, the process loops back to the monitoring step 31.

If, on the other hand, the temperature has continued to rise and the critical temperature T_crit is exeeded, critical components are put into a standby mode in a step 35. An advisory message is displayed to inform the user in a step 36 and the system goes into a standby mode in a step 37.

Thereby, the heat generation is reduced significantly until the system temperature drops below a "Critical" and a "Warning" temperature threshold, respectively. Generally, it will take some time before the temperature drops again below the "Warning" temperature threshold, and the system resumes the full functionality.

According to one aspect of the application, an existing infotainment system with an installed disc drive is used to improve heat dissipation. In order to read the loaded disc content, the disc needs to be in rotational motion. According to the application, the rotational disc motion emulates a rotating fan, to dissipate heat away from the drive Optical Pick-Up and other system electronic components. The disc rotation is utilized to enhance the heat dissipation through forced air convective heat transfer within the infotainment system when accessing written data in the disc, e.g. seeking, jumping, playing from the disc.

In particular, a ventilation that is generated by disk rotation may be used during system start up. During summer or hot weather, an automobile may be parked under the sun, which

causes the infotainment system to be heated prior to power-on, especially when the vehicle is switched off. As the infotainment system is powered on, the electronic components begin to generate heat, in addition to the surrounding hot air.

Due to the environmental surrounding heat, the enclosed system and the additional heat generated from the system electronic components, the system thermal threshold, which is monitored by a software implementation, as shown in Fig. 7, would be exceeded within a short time frame. Likewise, the system temperature may increase gradually with prolonged usage, and the system would go into a reduced operational mode as the Warning thermal threshold is reached.

The software implementation would put the system into reduced operational mode and subsequently into the standby mode as the temperature exceeds a critical threshold. As the system goes into the reduced operational mode and subsequently into standby mode, the user could only access the basic radio features e.g. FM/AM mode. This puts most of the electronic components into rest mode and consequently reduces the heat generation from them. The system returns back to normal operation mode when the system temperature is reduced to an acceptable temperature that corresponds to a certain margin below a range warning threshold.

According to the application, the rotational disc movement is used during system startup or during normal usage to dissipate the heated air away from the heated components. The system temperature is gradually reduced and a uniform overall

system temperature is created. Thereby, the thermal management and the overall user experience is improved.

In a cooling arrangement according to the application, the infotainment system first detects the disc presence. With disc presence detected, the spindle motor is activated to rotate the disc, to generate the moving air to enhance the heat dissipation, without activating disc reading or other electronic components. Once reaching the system acceptable temperature, the infotainment system returns to normal operation mode, and disc reading may commence depending on user selection.

Advantageously, obstructions to a disk generated airflow or thermal flow that are caused by the architecture, chassis, drive or other components are reduced such that the rotational movement of the disk is put into efficient usage to dissipate the heated air from the system.

According to the application, the operational disc rotational movement from the assembled disc drive within the infotainment system is utilized to generate a forced air convective movement to dissipate heated air to the surrounding, without requiring any additional component or bill of material cost.

In a second design step according to the application, other hardware solutions may be used in conjunction with the airflow of the disk drive to maximize the heated air dissipation within an infotainment system, particularly in 1-DIN systems.

Although it is not required, a separate fan or a connection to a ventilation unit may be used in addition to dissipate

the heated air through the convection transfer to the surrounding.

To further improve the heat dissipation, this application also proposes a strategic placement of the disc drive, of critical electronic components and of tactical openings on the system chassis, to enhance the heated air dissipation, as described in Figure 8, 9 and 10. This helps to reduce the system temperature effectively and consequently improves the drive and other electronic components reliability.

Fig. 8 shows an arrangement of vertical slits 40 at a rear surface 3 of a disk drive 10. A sectional enlargement shows rounded upper ends 41 of the vertical slits 40.

Fig. 9 shows an arrangement of rectangular openings 42, 43, 44, 45 in an upper surface 6 of the disk drive 10. The rectangular openings are provided around a disk region. During operation, warm air travels to the upper side of the disk drive and leaves the disk drive via the openings 42, 43, 44, 45. The upward air movement is assisted by the airflow generated by the disk. For example, the casing 20, 21 around the disk may be formed in an upward spiral shape to assist the upward flow of the warm air by adding a vertical component to the horizontal airflow generated by the disk.

Figure 10 shows an embodiment, in which critical electronic components, a motor fan and/or a heat sink are placed in an outer area 46 that surrounds a disk area 47. The rotational velocity of the disk and a generated airflow is fastest at the perimeter of the disk. Furthermore, the inertia of the air causes the air stream to point tangentially away from the

disk. Thereby, a heat dissipation can be made effective when components to be cooled are arranged just outside the disk area 47.

Figure 11 shows an embodiment, in which a disk movement and a motor fan are utilized to generate a combined airflow for dissipating heat away from electronic components 15. In the example of Fig. 11, two electronic components 15 are placed in a disk area and two further electronic components 15 are placed just outside the disk area. The two further electronic components are placed at a side of the motor fan where the disk generated air stream reinforces the air stream of the motor fan.

Figure 12 shows an embodiment, in which a disk movement is utilized to direct an airflow against a heat sink 13. Electronic components are placed close to the heat sink and outside of a disk area.

To maximize the heated air dissipation effect within the infotainment system by forced air convection through the operational disc rotation, the following feasible hardware solutions are also proposed, as summarized in Figure 13:

a) According to the application, a disc placement is strategically located to ensure maximum efficiency through the exchange area.

b) Critical electronics components are strategically located to yield maximum benefits from the forced air convection.

c) Tactical openings on system covers to enable heated air dissipation to the surrounding.

d) Strategic placement of a well-designed heat sink with excellent thermal conductivity and well-designed surfaces, to enable efficient heated air dissipation to the surrounding.

e) Usage of thermal pad or thermal grease to fill up all voids between the heat sink and the electronic component, to maximize the heat transfer, through reduction of heat resistance.

f) An optional motor fan is incorporated within the system to assist rapid removal of heated air that is dispatched and diverged by the forced air convection from the disc rotation movement.

Further measures comprise the usage of energy efficient chip sets, the choice of components material and design, as well as the use of anodized coatings to improve heat conduction.

Fig. 14 shows a passenger compartment 48 of a car with a dashboard 49. The dashboard 49 comprises a DIN slot 50, wherein a car infotainment system 10 is placed. Furthermore, a ventilation system 51 is provided in the dashboard. In the example of Fig. 14, a supply air region 52 is located above the infotainment system 10 and an exhaust air region 53 of the dashboard is located below the infotainment system 10.

Although the above description contains much specificity, these should not be construed as limiting the scope of the embodiments but merely providing illustration of the foresee-

able embodiments. Especially the above stated advantages of the embodiments should not be construed as limiting the scope of the embodiments but merely to explain possible achievements if the described embodiments are put into practise. Thus, the scope of the embodiments should be determined by the claims and their equivalents, rather than by the examples given.

Glossary

BOM	Bill Of Material
CD	Compact Disc
DVD	Digital Versatile Disc
BD	Blu-ray Disc
HD	High Definition
OPU	Optical Pick-Up
RPM	Revolution Per Minute
PCB	Printed Circuit Board

CLAIMS

1. A DIN slot size infotainment system for a car dashboard with a DIN slot opening that is provided with a supply air region and with an exhaust air region, wherein the DIN slot size infotainment system comprises a disk drive with the following features:

- a disk drive casing with a supply air inlet and an exhaust air outlet, wherein the supply air inlet is provided for communication with the supply air region and wherein the exhaust air outlet is provided for communication with the exhaust air region,

- a disk drive mechanism with a disk reception area for driving an optical data carrier disc,
wherein the disk reception area is connected with the supply air inlet and the exhaust air outlet such that, upon rotation of an optical data carrier disc being provided in the disk reception area, a cooling airflow is generated between the supply air inlet and the exhaust air outlet,

- electronic components being provided in the area between the supply air inlet and the exhaust air outlet, wherein electronic components are arranged such that the cooling airflow contacts at least one surface area of the at least one electronic component.

2. DIN slot size infotainment system, comprising
- at least one temperature sensor,
- a disk drive control that is connected to the disk drive mechanism and to the at least one temperature sensor, wherein the disk drive control comprises means for determining if a pre-determined temperature threshold is

exceeded based on a signal of the at least one temperature sensor and means for activating the disk drive mechanism when the pre-determined temperature threshold is exceeded.

3. DIN slot infotainment system according to claim 2, wherein the disk drive control comprises means for detecting a startup mode and means for activating the disk drive mechanism when the infotainment system is in the start-up mode and the pre-determined temperature threshold is exceeded.

4. DIN slot infotainment system according to claim 2 or claim 3, wherein the disk drive control comprises means for receiving a startup signal and means for activating the disk drive mechanism when the pre-determined temperature threshold is exceeded and the startup signal is received.

5. DIN slot infotainment system according to one of the preceding claims, the disk drive comprising a casing portion that surrounds the disk reception area, wherein the casing portion comprises a rounded shape that is arranged adjacent to an outer rim of the optical data carrier disk.

6. DIN slot infotainment system according to one of the preceding claims, wherein the at least one electronic component comprises a heat sink, a surface of the heat sink being arranged in the airflow.

7. DIN slot infotainment system according to claim 6, wherein the heat sink of the at least one electronic component is in thermal contact with the casing.

8. DIN slot infotainment system according to one of the preceding claims, wherein the at least one electronic component of the disk drive is placed laterally outside the disk reception area and adjacent to the disk reception area.

9. DIN slot infotainment system according to one of the preceding claims, the disk drive further comprising a motor fan, which is arranged adjacent to a casing surface, wherein the at least one electronic component is arranged in a region in which the cooling air stream and an airflow of the motor fan flow substantially in the same direction.

10. DIN slot infotainment system according to one of the preceding claims, further comprising multiple slits at a rear surface or at a side surface of the disk drive casing.

11. DIN slot infotainment system according to one of the preceding claims, the disk drive comprising upper openings at a top surface of the disk drive casing, wherein the openings are arranged substantially laterally outside the disk reception area.

12. Car dashboard with a DIN slot opening, wherein a DIN slot infotainment system according to one of the claims

1 to 11 is provided in the DIN slot opening, wherein the exhaust air outlet of the DIN slot infotainment system communicates with an exhaust air region of the car dashboard, and wherein the supply air inlet of the DIN slot infotainment system communicates with a supply air region of the dashboard.

13. Car with a dashboard according to claim 13, wherein the dashboard is attached to a front portion of a passenger compartment of the car.

14. Car with an interior equipment, the interior equipment comprising a dashboard according to claim 13 and a car ventilation system, wherein the car ventilation system communicates with at least one of the supply air region and the exhaust air region of the dashboard.

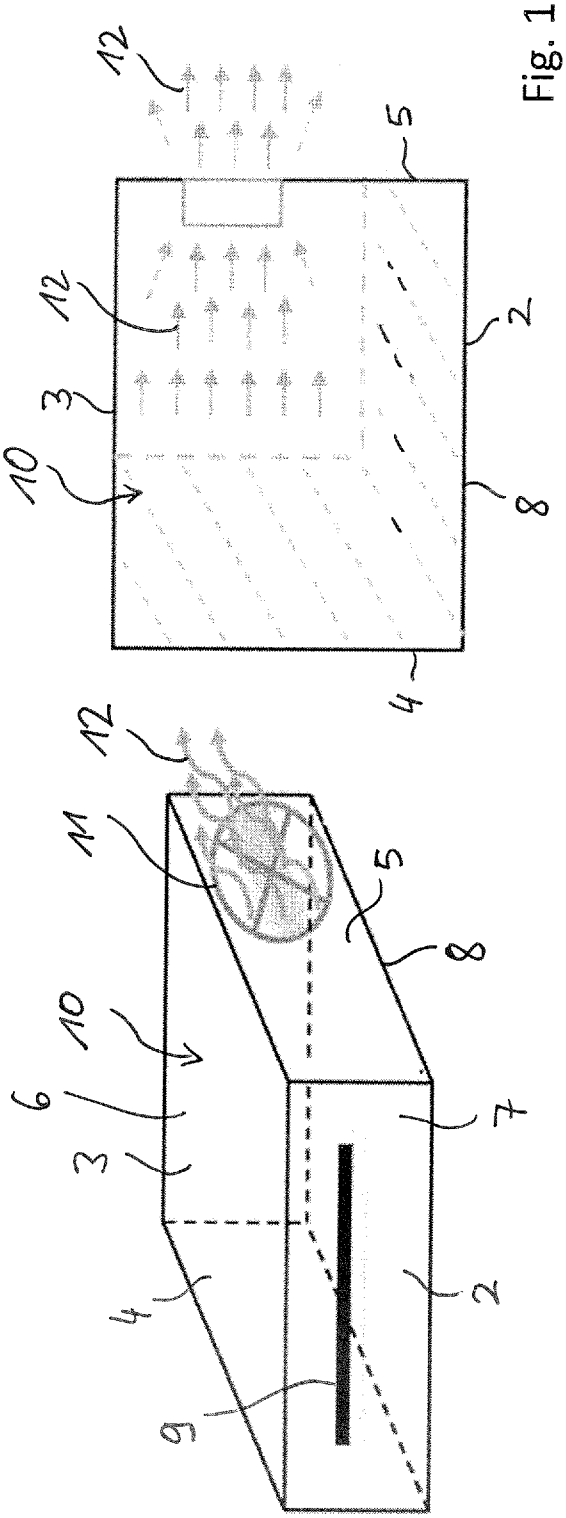

Fig. 1

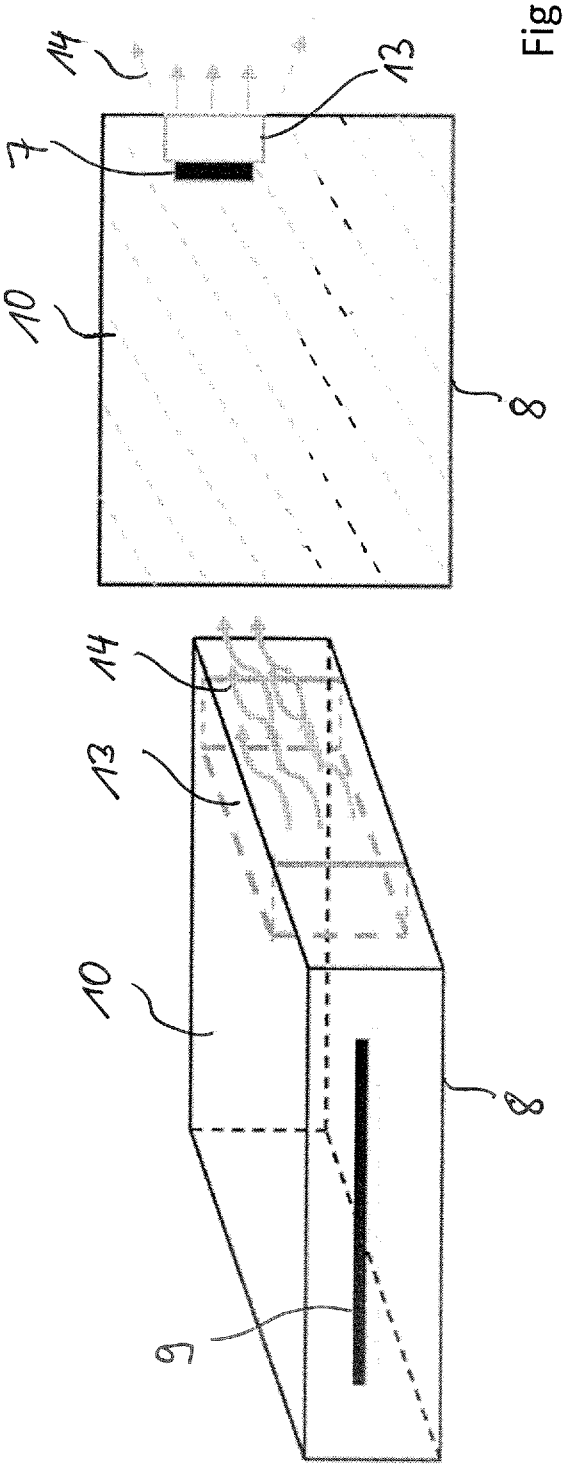

Fig. 2

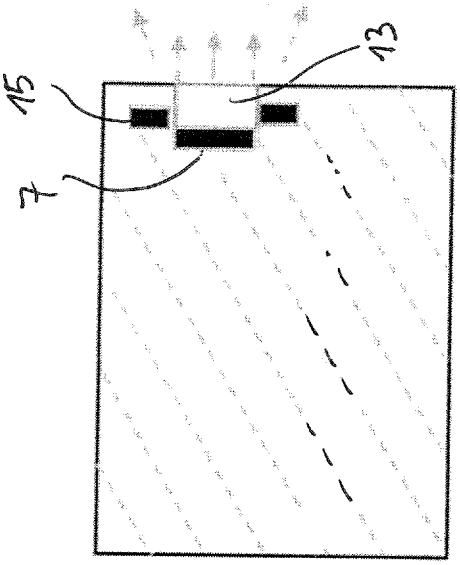

Fig. 4

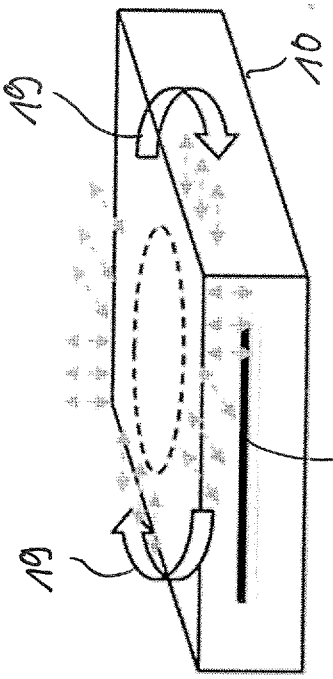

Fig. 6

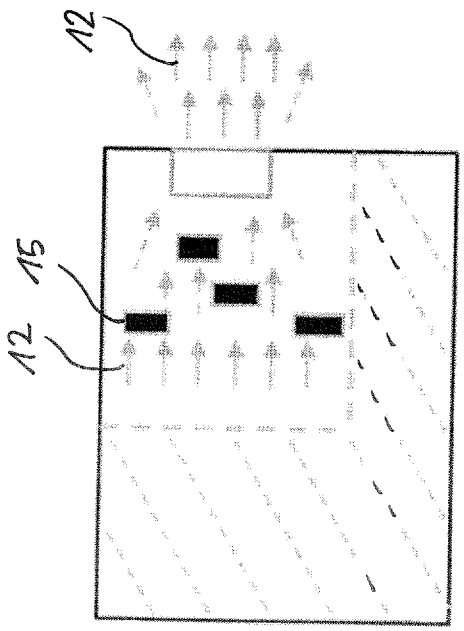

Fig. 3

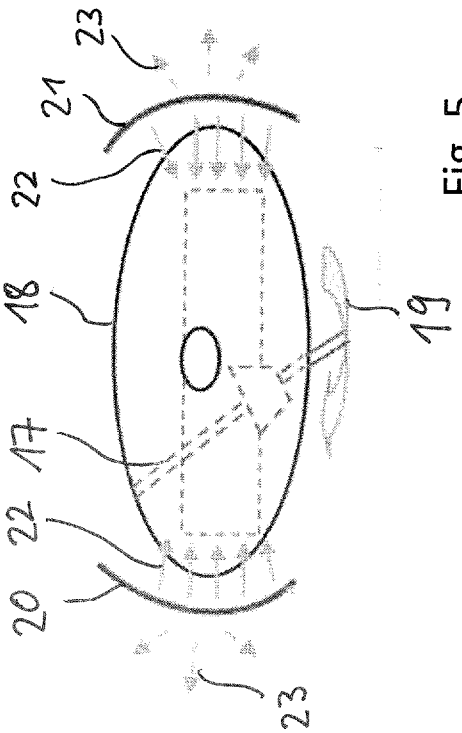

Fig. 5

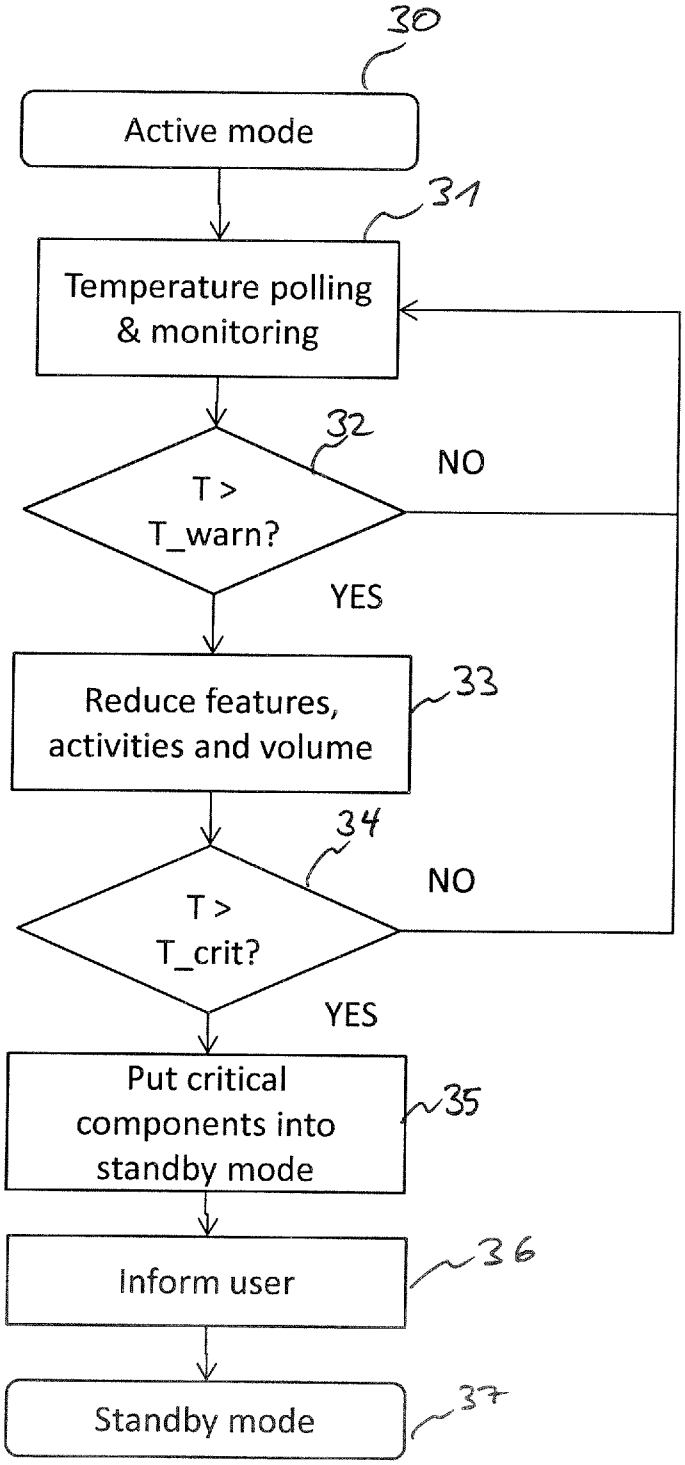
30
Active mode
31
Temperature polling & monitoring
32
T > T_warn?
NO
YES
Reduce features, activities and volume
33
34
T > T_crit?
NO
YES
Put critical components into standby mode
35
Inform user
36
Standby mode
37

Fig. 7

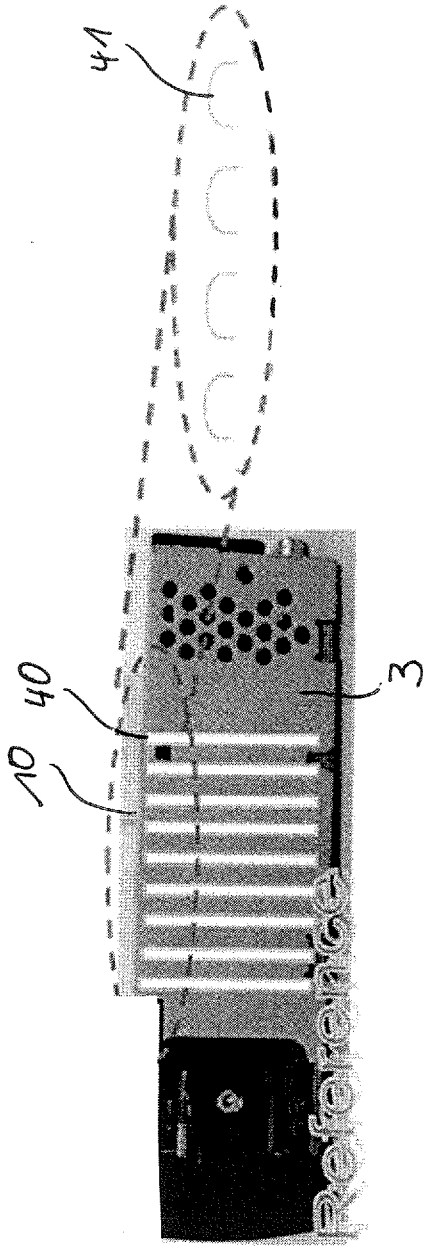

Fig. 8

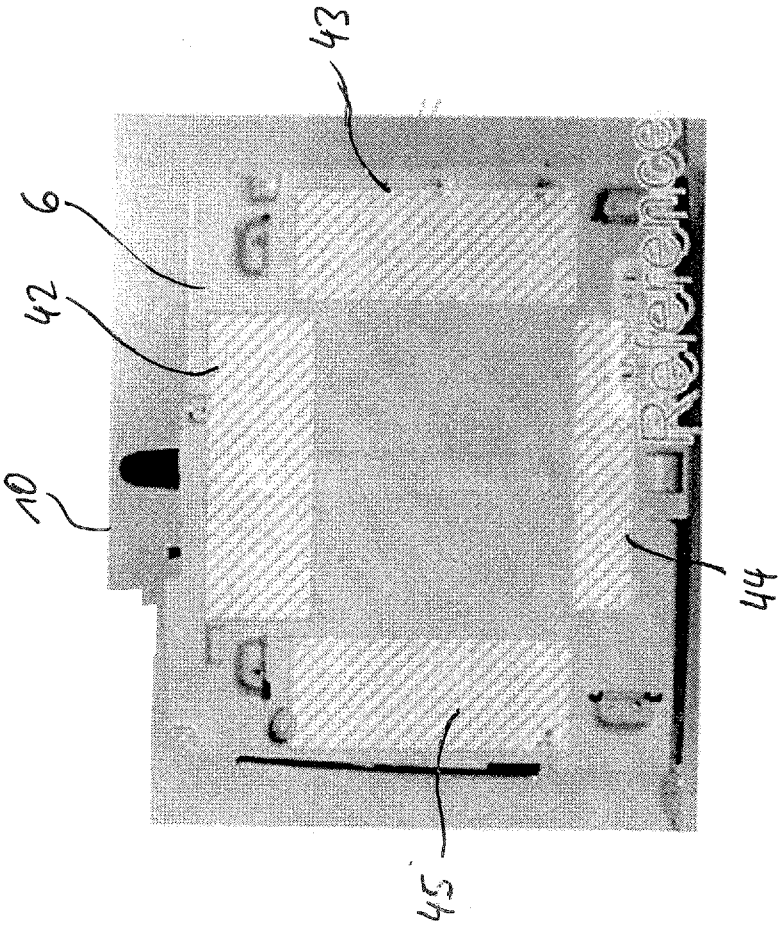

Fig. 9

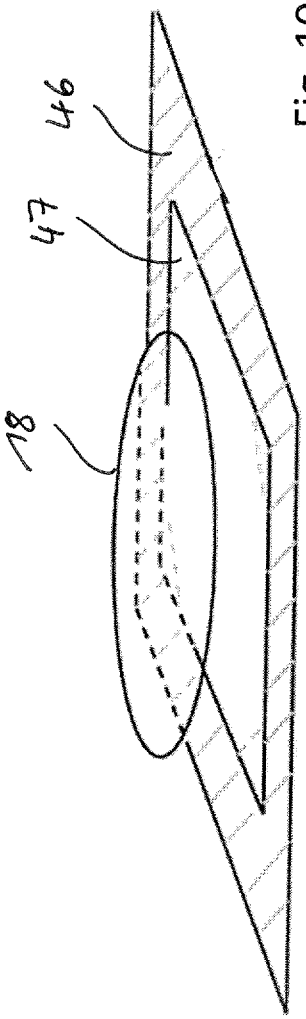

Fig. 10

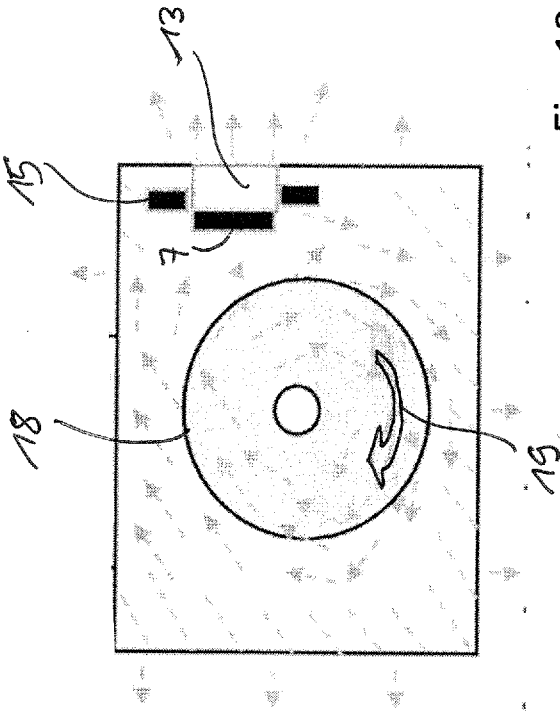

Fig. 12

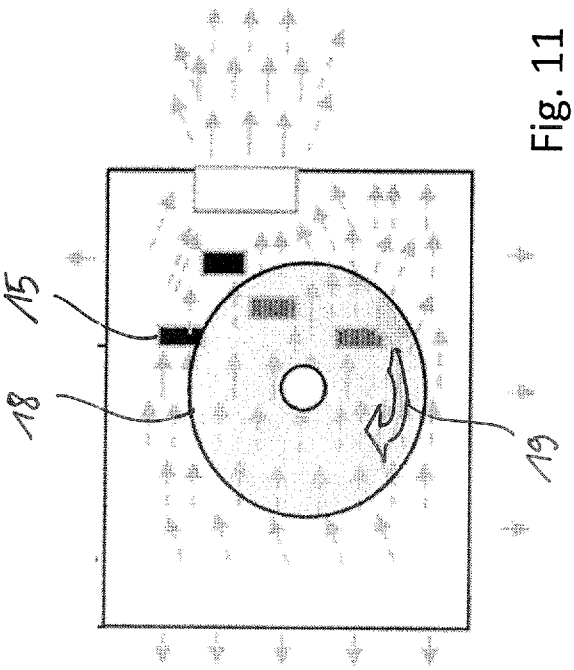

Fig. 11

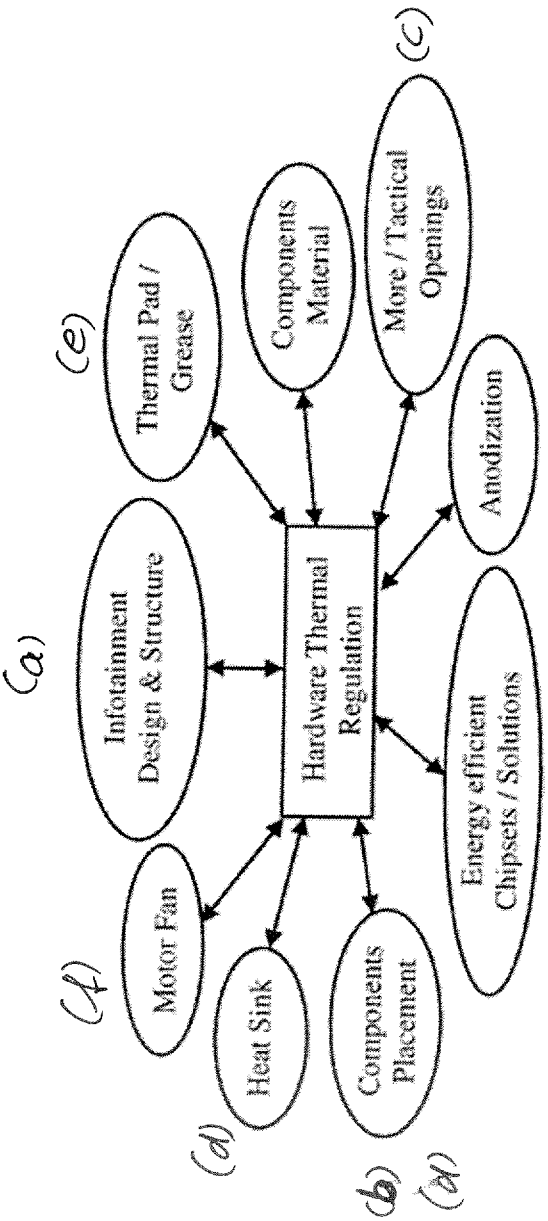
Hardware Thermal Regulation
Infotainment Design & Structure
Motor Fan
Heat Sink
Components Placement
Energy efficient Chipsets / Solutions
Anodization
More / Tactical Openings
Components Material
Thermal Pad / Grease
(a)
(f)
(d)
(b)
(x)
(c)
(e)

Fig. 13

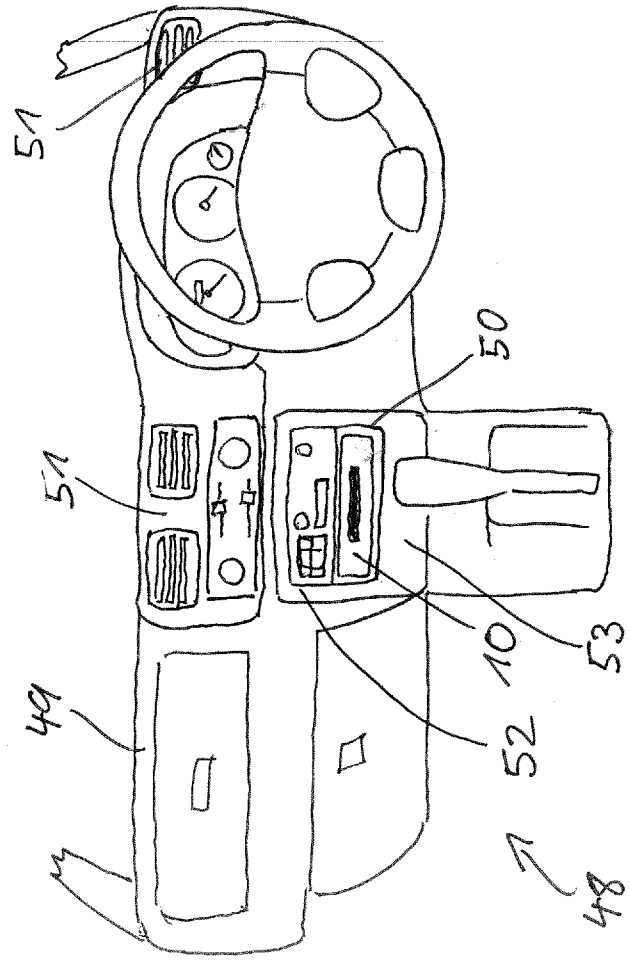

Fig. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2012/055265

A. CLASSIFICATION OF SUBJECT MATTER

B60R 16/02(2006.01)i, G01D 9/00(2006.01)i, B62D 41/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B60R 16/02; B60H 1/32; H05K 7/20; G06F 1/20; B60H 1/00; B60R 11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: air, flow, inlet, outlet, cool, dash board, infotainment, and disk

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2009-279980 A (CLARION CO., LTD.) 03 December 2009 See paragraphs [0010],[0019],[0021]; figures 1,2.	2-4 1,5-14
Y	US 2010-0202107 A1 (NOISTERNIG et al.) 12 August 2010 See abstract, paragraphs [0002],[0018],[0025],[0026],[0028]; figures 3,4.	1,5-14
A	EP 2292472 A1 (DELPHI TECHNOLOGIES, INC.) 09 March 2011 See paragraphs [0015],[0016]; figure 1.	1-14
A	JP 2001-253306 A (DENSO CORP.) 18 September 2001 See claims 1,2; figure 1.	1-14
A	EP 0897348 B1 (FORD MOTOR COMPANY LIMITED) 24 October 2001 See paragraph [0011]; figure 1.	1-14

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 April 2013 (24.04.2013)	**25 April 2013 (25.04.2013)**

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Authorized officer

HAN, Joong Sub

Telephone No. 82-42-481-5606

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/IB2012/055265

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