US 20070169991A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2007/0169991 A1

Bertsch (43) Pub. Date: Jul. 26, 2007

(54) DEVICE AND METHOD FOR HEAT AND NOISE INSULATION OF MOTOR VEHICLES

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(21) Appl. No.: **10/878,879**

(22) Filed: **Jun. 28, 2004**

(30) **Foreign Application Priority Data**

Jun. 26, 2003 (DE)..... 103 28 680.2

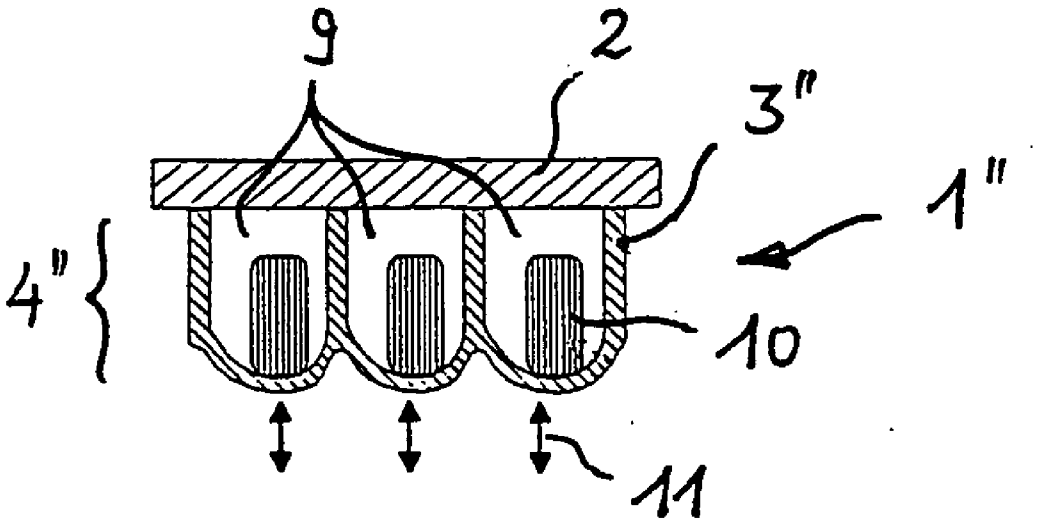
Publication Classification

(51) **Int. Cl.**
E04B 1/82 (2006.01)

(52) **U.S. Cl.** **181/290**

(57) **ABSTRACT**

A device for heat and noise insulation has a first carrier layer rigidly connected with a component to be insulated, particularly an oil-carrying element of an internal combustion engine, as well as an insulating layer with a plurality of individual damping elements, particularly fiber or honeycomb elements which are individually connected with the carrier layer and/or joined to it in articulated manner. An air cushion is formed between the individual damping elements within the insulating layer and/or between the carrier layer and the insulating layer. The cushion can be changed by adjusting several of the damping elements, the entire insulating layer and/or the carrier layer. A method for insulating comprises connecting the carrier layer to a component to be insulated and attaching a plurality of the damping elements to the carrier layer, with the air cushion being formed between the damping elements, within the insulating layer or between the carrier layer and the insulating layer.



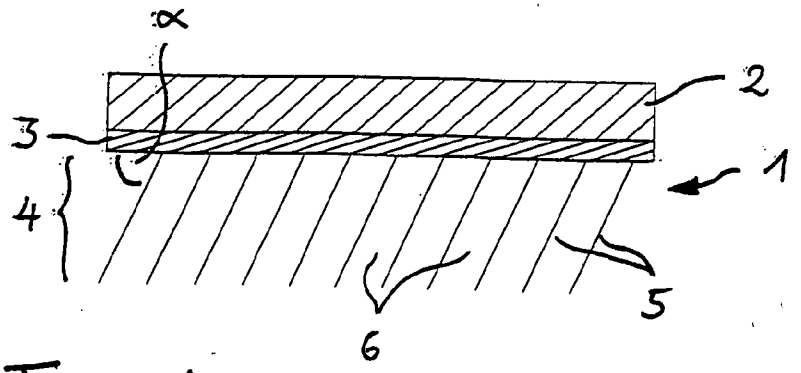


Fig. 1

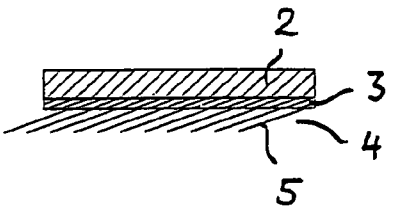


Fig. 2a

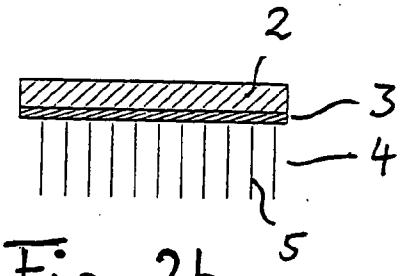


Fig. 2b

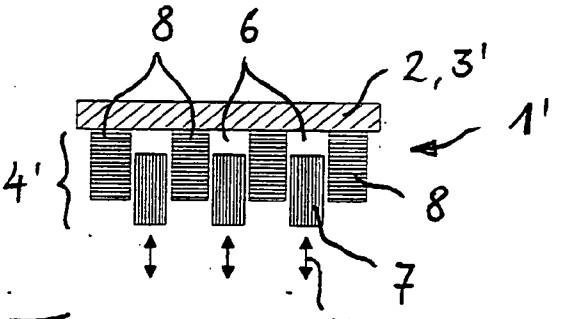


Fig. 3

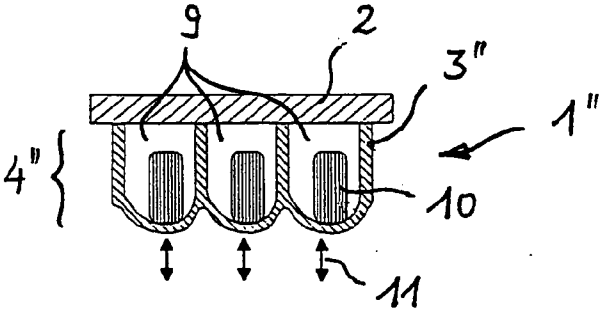


Fig. 4

DEVICE AND METHOD FOR HEAT AND NOISE INSULATION OF MOTOR VEHICLES

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a device for heat insulation and/or noise insulation for a component such as an oil-carrying element of an internal combustion engine. The device has a first carrier layer that is rigidly connected with the component to be insulated and an insulating layer that demonstrates poor heat and noise conduction properties.

[0003] 2. The Prior Art

[0004] A heat-insulating and noise-insulating paneling for the engine space of a motor vehicle is described in German Patent No. DE 198 21 532 A1, which comprises a cover layer on the engine side and a cover layer facing away from the engine side, as well as a first, thin carrier layer made of an acoustically insulating, temperature-resistant, duroplastic foam material and an insulating layer made of a plastic foam material, a particle laminate foam material, or a nonwoven fabric. One cover layer consists of a nonwoven fabric, a woven fabric, or a knitted fabric, whereby the fibers are woven together, spun together, or connected with one another in some other manner (particularly by means of binders). The same holds true for the fiber nonwoven fabric of the insulating layer. The paneling is structured as a molded part that has been pressed to produce a unit, and is intended for lining car body components such as the face wall of the engine space or the transmission tunnel.

[0005] Furthermore, a heat-insulating and noise-insulating component comprising a reinforcing carrier layer and an absorbent insulating layer is known from German Patent No. DE 199 59 089 A1. In this connection, the carrier layer is formed by a metal intermediate wall of a motor vehicle, for example a partition between the passenger space and the engine space of the motor vehicle. The insulating layer, on the other hand, is formed from several plies of fiber nonwoven fabric that have been consolidated in themselves, or shape-retaining foam materials, as necessary. Within the insulating layer, convection channels through which air can flow, having defined inlet and outlet openings and a rigidly defined position and expanse, are furthermore provided, to increase the heat resistance (i.e. for cooling) of the component.

SUMMARY OF THE INVENTION

[0006] It is therefore an object of the invention to provide a device that provides effective heat insulation and/or noise insulation with simple means, which insulation can be changed during operation and thereby adapted to operating conditions.

[0007] This object is accomplished by means of a device which has a plurality of individual damping elements, particularly fiber or honeycomb elements, which are individually connected with the carrier layer and/or joined to it in articulated manner. An air cushion is formed between the individual damping elements, within the insulating layer and/or between the carrier layer and the insulating layer, which cushion can be changed by means of an adjustment of several damping elements, the entire insulating layer and/or the carrier layer. The air cushion demonstrates reduced heat and noise conduction properties and thereby acts as a damping material. The air cushion can be changed in accordance with the operating conditions of the motor vehicle, by adjusting the damping elements, the insulating layer and/or the carrier layer. Therefore the heat and noise conduction properties of the device can be adapted to the operating conditions of the motor vehicle.

[0008] In an embodiment of the device according to the invention, several damping elements are implemented as elastic fibers made of a material having poor heat conduction properties. The fibers are adjustable by way of an air stream, particularly the head wind of a motor vehicle. In this way, a device that can be adjusted in a particularly simple manner is created, which automatically changes its heat transfer properties as a function of the driving speed of the motor vehicle, if the head wind moves the fibers because of their air resistance. In this connection, a particularly good shielding property of the device is provided, in particular in the case of a cold start and a low start-up speed, so that the device is preferably suitable for being affixed on the outside of an internal combustion engine. In this connection, the device according to the invention improves the cold-start behavior of the internal combustion engine. The device is particularly advantageous for use on the outside of an oil pan, with fibers hanging down.

[0009] In another embodiment of the device according to the invention, several damping elements are implemented as fibers having shape-changing properties, which are adjustable by way of a thermal and/or electrical control that turns them on, which is preferably imparted by way of the carrier layer. Therefore the fibers can be adjusted actively and in a targeted manner, independent of the head wind or the influence of gravity, so that an adjustment of the heat and noise conduction properties in accordance with current requirements possible at any time. Fibers that are adjustable by means of piezo effects, bimetal effects, and/or memory effects are preferred. A preferred turn-on control by way of the carrier layer allows simultaneous and parallel turn-on control of all the damping elements.

[0010] In another embodiment of the device according to the invention, there are several damping elements which are configured as movably mounted honeycomb elements. These elements are adjustable in their position and/or orientation via a carrier layer that can be turned on. The honeycomb elements are implemented as hollow bodies that are stable in shape, to a great extent, and are preferably rigidly connected with the carrier layer or at least indirectly coupled with it. In this connection, a honeycomb element is not limited, according to the invention, to a specific structure, for example an octagonal or eight-sided structure, but instead, a honeycomb element can have any desired tube-like/chamber-like structure. Preferably, the honeycomb elements are filled with air or another gas that conducts heat poorly, whereby a more or less strong vacuum can also be provided. In addition, a certain air cushion is provided in the region of the honeycomb elements, which cushion is surrounded by the honeycomb elements at least in certain segments. By adjusting the honeycomb elements, it is therefore also possible to adjust the air cushion.

[0011] In another embodiment of the device according to the invention, several damping elements are implemented as honeycomb elements arranged to be immovable relative to

the component to be insulated. These movable honeycomb elements are mounted between the immovable honeycomb elements, or the immovable honeycomb elements demonstrate shape-changing properties and can be adjusted by way of a thermal and/or electrical turn-on control, which is preferably imparted by way of the carrier layer. The honeycomb elements implemented to be immovable are not displaceable in a translational manner. An air cushion consisting of many individual volumes is preferably formed between them, and individual volumes can be adjusted by a translational adjustment of movable honeycomb elements and/or a shape change of the immovable honeycomb elements.

[0012] In another embodiment of the device according to the invention, the insulating layer has several air pockets that are separated from one another. A damping element is arranged in at least one of the air pockets. In this connection, a ply that delimits and surrounds the air pockets is assigned to the insulating layer. This ply can also be represented by the carrier layer. Any desired gas having poor heat-conducting properties can be accommodated in the air pockets, if applicable, under vacuum conditions. The damping element is preferably implemented as a honeycomb element, or as another barrier body that has mass and poor heat/noise-conducting properties. The damping element preferably serves to adjust the air pockets from the inside out.

[0013] The invention also includes a method for heat insulation and/or noise insulation, wherein a first carrier layer is connected with a component to be insulated, particularly an oil-carrying element of an internal combustion engine. A plurality of individual damping elements, particularly fiber or honeycomb elements, are individually connected with the carrier layer and/or joined to it in articulated manner, to form an insulating layer. An air cushion is formed between the individual damping elements, within the insulating layer and/or between the carrier layer and the insulating layer, which cushion is changed by means of an adjustment of several damping elements, the entire insulating layer and/or the carrier layer. The method according to the invention makes effective insulation of the internal combustion engine possible, in that one or more oil-carrying elements are provided with an insulating device comprising a plurality of damping elements. According to the invention, the damping elements, the insulating layer and/or the carrier layer are adjustable, in such a manner that the air cushion that is preferably formed in or around the damping elements can be adapted to the operating conditions of the internal combustion engine. In addition to the conditions in the engine, the ambient conditions must also be taken into consideration.

[0014] In an embodiment of the method according to the invention, several damping elements are implemented as elastic fibers made of a material having poor heat conduction properties. These fibers are adjustable by way of an air stream, particularly the head wind of a motor vehicle. In this connection, the method utilizes the head wind of the motor vehicle in order to automatically change the heat transfer properties of the air cushion as a function of the driving speed of the motor vehicle, if the head wind moves the fibers because of their air resistance. In this connection, the method produces a particularly good shielding of the internal combustion engine, in particular in the case of a cold start and a low start-up speed. The method thereby makes it possible to improve the cold-start behavior of the internal combustion engine, by achieving a faster warm-up of the internal combustion engine.

[0015] In another embodiment of the method according to the invention, several damping elements are implemented as fibers having shape-changing properties, which are adjusted by way of a thermal and/or electrical control that turns them on, which is preferably imparted by way of the carrier layer. Therefore the fibers can be adjusted actively and in a targeted manner, independent of the head wind or the influence of gravity, so that an adjustment of the heat and noise conduction properties in accordance with current requirements possible at any time. Fibers that are adjustable by means of piezo effects, bimetal effects, and/or memory effects are preferred. A turn-on control by way of the carrier layer allows simultaneous and parallel turn-on control of all the damping elements.

[0016] In another embodiment of the method according to the invention, several damping elements are implemented as movably mounted honeycomb elements that are adjusted in their position and/or orientation by way of a carrier layer that can be turned on or moved. The honeycomb elements are implemented as hollow bodies that are stable in shape, to a great extent, and which are connected with the carrier layer or articulated on it. In this connection, a honeycomb element is not limited, according to the invention, to a specific structure, for example an octagonal or eight-sided structure, but instead, a honeycomb element can have any desired tube-like/chamber-like structure. Preferably, the honeycomb elements are filled with air or another gas that conducts heat poorly, whereby a more or less strong vacuum can also be provided. In addition, a certain air cushion is provided in the region of the honeycomb elements, which cushion is surrounded by the honeycomb elements at least in certain segments. By means of adjusting the honeycomb elements, it is therefore also possible to adjust the air cushion.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawings. It is to be understood, however, that the drawings are designed as an illustration only and not as a definition of the limits of the invention.

[0018] In the drawings, wherein similar reference characters denote similar elements throughout the several views:

[0019] FIG. **1** shows a fundamental diagram relating to a first exemplary embodiment of the device according to the invention;

[0020] FIGS. **2***a* and **2***b* show additional fundamental diagrams relating to the adjustment of the device according to FIG. **1**;

[0021] FIG. **3** shows a fundamental diagram relating to a second exemplary embodiment of the device according to the invention; and

[0022] FIG. **4** shows a fundamental diagram relating to a third exemplary embodiment of the method according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0023] Referring now in detail to the drawings, FIG. **1** shows a first exemplary embodiment of a device **1** according

to the invention for heat insulation and noise insulation, in schematic, simplified manner. The insulating device **1** is affixed to the outside of an oil-carrying component **2** to be insulated, of a diesel internal combustion engine, not shown in detail. Component **2** to be insulated is preferably an oil pan or another oil-carrying component of the engine.

[**0024**] A carrier layer **3** is affixed to component **2** to be insulated, in order to form device **1**; in turn, a plurality of damping elements in the form of fibers **5** is attached to this layer. Fibers **5** represent essential parts of an insulating layer **4**. Fibers **5** are preferably produced from mineral silicates, ceramics, carbon, metal, or heat-resistant, particularly duroplastic plastics. Fibers that can be used are also described in German Patent No. DE 198 21 532 A1. Between the fibers, a continuous air cushion **6** is formed, in the manner of an animal fur, which cushion represents another essential part of the insulating layer **4**.

[**0025**] Fibers **5** are preferably attached to carrier layer **3** in a hanging manner and at a minimum angle α of between 70° and 90°. In the operation of the motor vehicle, fibers **5** are then preferably exposed to the head wind, whereby a force equilibrium occurs between the force of gravity, the air resistance, and the internal tension of fibers **5**. Depending on how the fibers are attached in carrier layer **3**, the thickness of the fibers, and the material properties of the fibers, different behaviors of the fibers can be adjusted. Preferably, as shown in FIGS. **2***a* and **2***b,* there is a change in the angle α between the fibers and the carrier layer when the head wind flows through the fibers **5** in different ways.

[**0026**] FIG. **2***a* assumes a strong lateral flow from the right, in which fibers **5** rest against carrier layer **3**, as shown. In this connection, the air cushion between the fibers is reduced in terms of its thickness and its volume, so that a reduced insulation property is achieved. FIG. **2***b* assumes a weak flow from the left, whereby the fibers stand up and an increased insulation property is achieved by means of a larger air cushion between the fibers **5**.

[**0027**] In a modified exemplary embodiment, device **1** is implemented without an air flow at rest, in accordance with FIG. **2***b*. The fibers are configured to be easy to bend.

[**0028**] In another exemplary embodiment, not shown, the fibers are elastically bendable, so that a particularly strong and rigid attachment of the fibers in the carrier layer can be implemented, while at the same time, strong bending of the fibers as a result of the head wind of the motor vehicle can be achieved.

[**0029**] In another modified exemplary embodiment, fibers **5** are implemented to be adjustable using piezo effects, bimetal effects and/or memory effects. A preferred turn-on control occurs by way of carrier layer **3**, which passes a corresponding adjustment signal on to all the fibers **5** at the same time, in parallel. In this way, also, an orientation of the fibers relative to the carrier layer and thereby relative to component **2** to be insulated can be changed, and this in turn results in a changed degree of insulation.

[**0030**] Turn-on control of the fibers takes place, according to the invention, on the basis of the internal need for heat of component **2**, i.e. of the entire internal combustion engine, and/or on the basis of external general conditions such as the ambient temperature, the driving speed of the motor vehicle, etc. Furthermore, turn-on control of the fibers can take place as a function of the noise emission requirements, i.e. the noise development of the component **2**, i.e. the internal combustion engine.

[**0031**] FIG. **3** shows another exemplary embodiment **1'** of the device for heat insulation and noise insulation according to the invention. In this connection, the component **2** to be insulated serves, at the same time, as the carrier layer **3'**, i.e. as an integral part of the carrier layer, on which an insulating layer **4'** is again arranged, on the outside. In this connection, several damping elements are implemented as movably mounted honeycomb elements, which are adjustable in their position relative to the component **2** to be insulated. Honeycomb elements **8** that are immovable, to a great extent, relative to the component **2**, are provided between the movable honeycomb elements.

[**0032**] Honeycomb elements **7**, **8** are hollow bodies that are stable in shape, to a great extent, which are preferably firmly connected with the carrier layer. In this connection, a honeycomb element is implemented, according to the invention, as a component comprising uniformly octagonal tubes arranged parallel to one another, but is not limited to a specific structure, for example an octagonal or eight-sided structure. Instead, a honeycomb element can have any desired tube-like/chamber-like structure. The honeycomb elements are preferably filled with air or another gas that conducts heat poorly, whereby a more or less strong vacuum can also be provided. A tube structure of the immovable honeycomb elements **8** is preferably rotated by 90° relative to the structure of the movable honeycomb elements **7**, in order to achieve air cushions that are delimited in themselves. In addition, an air cushion **6** is provided in the region of the honeycomb elements, which cushion is surrounded by the honeycomb elements, at least in segments, and forms another integral part of insulating layer **4'**. By adjusting honeycomb elements **7**, air cushion **6** is therefore also adjustable (indicated by arrows **11**).

[**0033**] In a modified exemplary embodiment, the immovable honeycomb elements have shape-changing properties and are adjustable by way of a thermal and/or electrical turn-on control that is preferably imparted by the carrier layer. In this connection, a modified insulating layer can consist exclusively of such immovable honeycomb elements.

[**0034**] In another embodiment according to FIG. **4**, a modified device **1"** has a carrier layer **3"** as well as an insulating layer **4"**. The insulating layer **4"** is fixed on a component **2** to be insulated, at certain points or along lines. The insulating layer **4"** is implemented to be elastically deformable or very stretchable and, in more or less sealed manner, surrounds several air pockets **9** that are separated from one another, whereby a damping element in the form of a honeycomb element **10** is arranged in each of the air pockets **9**.

[**0035**] Such a honeycomb element **10** is preferably implemented like the honeycomb elements already described and/or as another barrier body that has mass and is poorly heat/noise-conductive. It is filled with any desired gas that has poor heat conductivity, if applicable under vacuum conditions. The honeycomb elements **10** preferably adjust the air pockets from the inside, in that they are adjustable, for example, by means of piezo effects, bimetal effects and/or memory effects. A preferred turn-on control by way

of the carrier layer **3"** allows simultaneous and parallel turn-on of all the honeycomb elements **10** that are in touch contact with the carrier layer **3"** or are attached to it.

[**0036**] From the devices described, a method according to the invention for heat insulation and/or noise insulation results. In this method, a carrier layer is connected with a component to be insulated, particularly an oil-carrying element of an internal combustion engine. A plurality of individual damping elements, particularly fiber or honeycomb elements, are individually connected with the carrier layer and/or joined to it in articulated manner, to form an insulating layer. An air cushion is formed between the individual damping elements, within the insulating layer and/or between the carrier layer and the insulating layer, which cushion is changed by means of an adjustment of several damping elements, the entire insulating layer and/or the carrier layer.

[**0037**] The method according to the invention makes effective insulation of the internal combustion engine possible, in that one or more oil-carrying elements are provided with an insulating device comprising a plurality of damping elements. According to the invention, the damping elements, the insulating layer and/or the carrier layer are adjustable, in such a manner that the air cushion that is preferably formed in or around the damping elements can be adapted to the operating conditions of the internal combustion engine. In addition to the conditions in the engine, the ambient conditions must also be taken into consideration.

[**0038**] In an embodiment of the method according to the invention according to FIGS. **1**, **2***a*, and **2***b*, several damping elements are implemented as elastic fibers made of a material having poor heat conduction properties, which fibers are adjustable by way of an air stream, particularly the head wind of a motor vehicle. In this connection, the method utilizes the head wind of a motor vehicle in order to automatically change the heat transfer properties of the air cushion as a function of the driving speed of the motor vehicle, if the head wind moves the fibers **5** because of their air resistance. In this connection, the method produces a particularly good shielding of the internal combustion engine, in particular, in the case of a cold start and a low start-up speed. The method thereby makes it possible to improve the cold-start behavior of the internal combustion engine, by achieving a faster warm-up of the internal combustion engine.

[**0039**] In another embodiment of the method according to the invention, several damping elements are implemented as fibers having shape-changing properties, which are adjusted by way of a thermal and/or electrical control that turns them on, which is preferably imparted by way of the carrier layer. Therefore the fibers can be adjusted actively and in a targeted manner, independent of the head wind or the influence of gravity, so that an adjustment of the heat and noise conduction properties in accordance with current requirements is made possible at any time. Fibers that are adjustable by means of piezo effects, bimetal effects, and/or memory effects are preferred. A turn-on control by way of the carrier layer allows simultaneous and parallel turn-on control of all the damping elements.

[**0040**] In another embodiment of the method according to the invention, according to FIGS. **3** and **4**, several damping elements are implemented as movably mounted honeycomb elements **7**, **8**, **10** that are adjusted in their position and/or orientation by way of a carrier layer **3'**, **3"** that can be moved. The honeycomb elements are implemented as hollow bodies that are stable in shape, to a great extent, which are connected with the carrier layer or articulated on it. The honeycomb elements are preferably filled with air or another gas that conducts heat poorly. In addition, a certain air cushion **6** is provided in the region of the honeycomb elements **7**, **8**, which cushion is surrounded by the honeycomb elements **7**, **8** at least in certain segments. By adjusting the honeycomb elements, it is therefore also possible to adjust the air cushion. On the other hand, according to FIG. **4**, sharply defined air cushions **9** can be assigned to honeycomb elements **10**, but these are also adjustable by a movement/adjustment of the honeycomb elements **10** (indicated by the arrows **11**).

[**0041**] The characteristics of the exemplary embodiments of the device according to the invention, which are described merely as examples, and of the method which is to be understood analogously, can be combined with one another in practically any desired manner, so that additional advantageous characteristics and combinations of characteristics can result.

[**0042**] Accordingly, while only a few embodiments of the present invention have been shown and described, it is obvious that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. A device for heat insulation and noise insulation of a component, comprising:

a first carrier layer adapted to be rigidly connected with the component to be insulated; and

an insulating layer having a plurality of individual damping elements that are individually connected with the carrier layer in an articulated manner;

wherein an air cushion is formed between the individual damping elements, within the insulating layer or between the carrier layer and the insulating layer, said cushion being changeable by adjusting several of said damping elements, the entire insulating layer, or the carrier layer.

2. Device according to claim 1, wherein several of said damping elements are elastic fibers made of a material having poor heat conduction properties, said fibers being adjustable by way of an air stream.

3. Device according to claim 1, wherein several of said damping elements are fibers having shape-changing properties, said fibers being adjustable by way of a thermal or electrical control that turns said fibers on.

4. Device according to claim 1, wherein several of said damping elements are movably mounted honeycomb elements that are adjustable in their position or orientation by way of said carrier layer.

5. Device according to claim 1, wherein several of said damping elements are honeycomb elements arranged to be immovable relative to the component to be insulated when said device is connected with the component to be insulated, and wherein movable honeycomb elements are mounted between the immovable honeycomb elements.

6. Device according to claim 1, wherein several of said damping elements are honeycomb elements arranged to be immovable relative to the component to be insulated when said device is connected to said component to be insulated, and wherein the immovable honeycomb elements demonstrate shape-changing properties and can be adjusted by a thermal or electrical turn-on control imparted by way of the carrier layer.

7. Device according to claim 1, wherein the insulating layer has several air pockets separated from one another and wherein one of said damping elements is arranged in at least one of the air pockets.

8. A method for providing heat insulation or noise insulation in motor vehicles, comprising;

connecting a carrier layer with a component to be insulated; and

individually connecting a plurality of individual damping elements with the carrier layer to form an insulating layer,

wherein an air cushion is formed between the individual damping elements, within the insulating layer or between the carrier layer and the insulating layer, which cushion is changed by adjusting several damping elements, the entire insulating layer or the carrier layer.

9. Method according to claim 8, wherein several of said damping elements are elastic fibers made of a material having poor heat conduction properties, which fibers are adjustable by way of an air stream.

10. Method according to claim 8, wherein several of said damping elements are fibers having shape-changing properties, which are adjusted by way of a thermal or electrical control that turns them on.

11. Method according to claim 8, wherein several of said damping elements are implemented as movably mounted honeycomb elements that are adjusted in their position or orientation by way of a carrier layer that can be turned on or moved.

* * * * *