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(54) **HEAT EXCHANGER ASSEMBLY**

(57) A heat exchanger assembly includes a heat exchanger core and a housing with walls that encloses the heat exchanger core. The walls of the housing are spaced from the heat exchanger core, wherein the created space

is filled at least partly by a resilient material so that the resilient material constitutes an exclusive connection between the housing and the heat exchanger core.

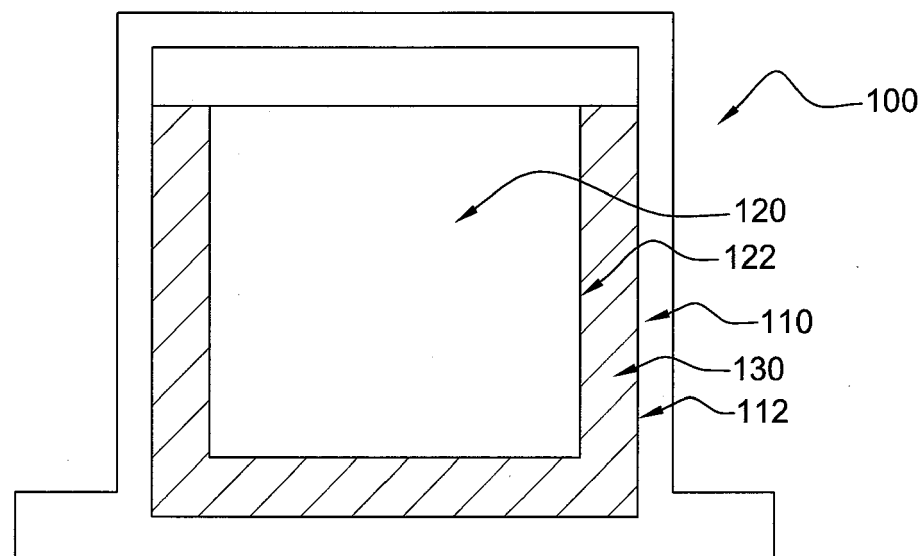


Fig. 3a

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Description

[0001] The present invention relates to heat exchangers, particularly, the present invention relates to a heat exchanger assembly for an air conditioning system of a vehicle.

[0002] In case of vehicle air conditioning systems, heat exchangers, particularly water condensers and chillers facilitate circulation of refrigerant fluid and coolant in adjacent yet separated spaces, to allow heat exchange between heat exchanging fluids. The chiller facilitates extraction of heat from a battery pack. Particularly, the heat exchanger, i.e. the chiller facilitates heat exchange between coolant and refrigerant fluid. The coolant after extracting heat from the battery pack is cooled by the refrigerant from an air conditioning loop for ensuring a supply of cool coolant to the battery pack, thereby resulting in cooling of the battery pack. The cooling of the battery pack prevents any damage thereto due to overheating and also ensures efficient operation thereof. Also, in case of a condenser, refrigerant gas loses heat energy by heat exchange, gets cooled, and condenses into liquid phase. Thereafter, the high pressure, high temperature liquid refrigerant passes through an expansion valve, wherein the expansion valve lowers the pressure of the refrigerant, and thereby cools it due to phase change of the liquid refrigerant. The low pressure and low temperature refrigerant liquid and flash gas leaving the expansion valve flows at proper rate through various elements disposed along the air conditioning loop such as the evaporator and compressor to complete an air conditioning cycle.

[0003] The heat exchanger, specifically, a condenser disposed in an air conditioning loop is connected to a compressor via aluminum-rubber hoses and receives compressed refrigerant in gaseous state from the compressor. The compressor due to inherent nature of operation thereof creates vibration and pulsations in the refrigerant lines of the air conditioning loop. These vibrations reach the condenser. From the condenser, the vibrations are transmitted to a vehicle body. The vibrations generate unwanted noise, especially in case of electric vehicles. These vibrations may cause damage to critical elements mounted on the vehicle body. Conversely, the vibrations from the vehicle can be transferred to the air conditioning loop and damage its components. Some condensers may be housed inside a housing that in turn is mounted on the vehicle body or frame via mountings and rubber dampers to prevent condenser vibration from reaching the vehicle body. The heat exchanger core of the condenser along with the housing, mountings and rubber dampers are collectively referred to as heat exchanger assembly. The rubber dampers may sometimes be ineffective in preventing condenser vibrations from reaching the vehicle body. Specifically, as the condenser is in direct contact with the housing, the vibrations are transmitted from the condenser to the vehicle body via the housing and the mountings in spite of the presence of the rubber dampers. The vibration and noise reaching

the vehicle cabin may cause discomfort to vehicle occupants. Also, due to condenser vibrations, chances are that the condenser repeatedly strikes against interior walls of the housing, and accordingly, service life and mechanical efficiency of the condenser is adversely affected. Still further, in case of heat pump mounted on the vehicle body, for efficient operation of the heat pump, the heat pump is required to be thermally insulated from the environment.

[0004] An object of the present invention is to provide a heat exchanger assembly for an air conditioning system that obviates the above mentioned drawbacks with associated conventional heat exchanger assembly that comprises a heat exchanger encapsulated by a dedicated housing.

[0005] The present invention envisages a heat exchanger assembly for an air conditioning system of a vehicle in accordance with an embodiment of the present invention. The heat exchanger assembly includes a heat exchanger core and housing with walls that enclose the heat exchanger core. The walls of the housing are spaced from the heat exchanger core, wherein the created space is filled at least partly by a resilient material so that the resilient material constitutes an exclusive connection between the housing and the heat exchanger core.

[0006] Preferably, the resilient material fills the whole space between the housing and the heat exchanger core.

[0007] Preferably, the housing is of plastic material.

[0008] Preferably, the resilient material is foam.

[0009] Preferably, the resilient material is rubber.

[0010] Preferably, the resilient material is polyurethane foam.

[0011] Preferably, the resilient material is Ethylene Propylene Diene Monomer (EPDM) foam.

[0012] Preferably, the resilient material has stiffness in the range of 5-500 N/mm.

[0013] Preferably, the heat exchanger core is a condenser.

[0014] Further, the heat exchanger assembly may include auxiliary elements, which are located inside the housing and connected with the housing exclusively through the resilient material.

[0015] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying figures, wherein:

FIGURE 1a illustrates schematic representation of a prior art heat exchanger assembly including a heat exchanger core and an auxiliary element such as for example, a receiver drier bottle encapsulated by a housing;

FIGURE 1b illustrates schematic representation of a prior art heat exchanger assembly including only

a heat exchanger core encapsulated by a housing; **FIGURE 2** illustrates a schematic representation of the prior art heat exchanger assembly of **FIGURE 1a** and **FIGURE 1b**, wherein the heat exchanger core is housed within the housing and the housing in turn is mounted on a vehicle body or frame via mounting elements and rubber dampers;

FIGURE 3a illustrates a schematic representation of a heat exchanger assembly in accordance with an embodiment of the present invention, wherein a heat exchanger core is housed within a housing and a resilient material fills at least part of the space between the housing and the heat exchanger core so as to surround the heat exchanger core from all sides except top side; and

FIGURE 3b illustrates schematic representation of a heat exchanger assembly in accordance with another embodiment, wherein resilient material surrounds the heat exchanger core from all sides; and **FIGURE 3c** illustrates schematic representation of a heat exchanger assembly of **FIGURE 3a**, wherein resilient material acting as rubber dampers is disposed between the housing and the heat exchanger core.

[0016] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, said figures helping to better define the invention if needs be. The invention should however not be limited to the embodiment disclosed in the description.

[0017] Referring to **FIGURE 1a**, isometric view of a prior art heat exchanger assembly **10** that includes a housing **1** enclosing a heat exchanger core **2** and an auxiliary element such as for example, a receiver drier bottle **3** is illustrated. In the Figure **1a**, the heat exchanger core **2** and the receiver drier bottle **3** are depicted with broken lines, while the housing **1** is depicted with solid lines. The heat exchanger core **2** often vibrates during operation - in case of condensers, this may be due to operation of a compressor also attached in the AC loop. In this example, a condenser is housed inside a housing **1** that in turn is mounted on a vehicle body or frame (not illustrated in **FIGURE 1a**) via mounting elements **4** and a plurality of rubber dampers (rubber dampers not illustrated in these drawings). The mounting elements **4** may be for example flanges extending from the housing **1** for facilitating mounting of the housing **1**. Referring to **FIGURE 1b**, schematic representation of another prior art heat exchanger assembly **20** including only a heat exchanger core **12** encapsulated by a housing **11** is depicted. In the Figure **1b**, the heat exchanger core **12** is depicted with broken lines, while the housing **11** is depicted with solid lines. The housing **11** in turn is mounted on a vehicle body or frame (not illustrated in **FIGURE 1b**) via mounting elements **14** and a plurality of rubber dampers (not illustrated in the **FIGURE 1b**).

[0018] **FIGURE 2** illustrates schematic representation of the prior art heat exchanger assembly **10**, **20**, wherein

the heat exchanger core **2**, **12** either alone as illustrated in **FIGURE 1b** or along with the receiver drier **3** as illustrated in **FIGURE 1a** is housed within the housing **1**, **11** and the housing **1**, **11** in turn is mounted on the vehicle body or frame (not illustrated in **FIGURE 2**), via mounting elements **4**, **14** (not illustrated in **FIGURE 2**) configured on the housing **1**, **11** and the rubber dampers **5** disposed between the housing **1**, **11** and the vehicle body or frame. However, such configurations of using the rubber dampers **5** between the housing **1**, **11** and the vehicle body or frame may not be effective enough in some cases. In such arrangement, as the heat exchanger core **2**, **12** is in direct contact with interior walls **1a**, **11a** of the housing **1**, **11**, the noise produced due to vibrations of the heat exchanger core **2**, **12** in the housing **1**, **11** will reach the vehicle cabin in spite of the presence of the rubber dampers **5**. Further, the rubber dampers **5** also require additional elements such as compression limiters for preventing excessive deformation of the rubber dampers **5**.

[0019] Referring to **Figure 3a**, it depicts schematic representation of a heat exchanger assembly **100** for an air conditioning system of a vehicle in accordance with an embodiment of the present invention, wherein a housing **110** encloses a heat exchanger core **120**, such that interior walls **112** of the housing **110** are spaced from corresponding exterior walls **122** of the heat exchanger core **120**. A resilient material **130**, for example, rubber foam fills at least part of the space between the housing **110** and the heat exchanger core **120** as illustrated in **FIGURE 3a** and constitutes exclusive connection between the housing **110** and the heat exchanger core **120**. Thanks to such arrangement, it dampens and prevents heat exchanger core **120** vibrations from reaching the housing **110**, thereby mitigating to a substantial degree the noise which might be produced. The resilient material **130** can fill all of the space between the housing **110** and the heat exchanger core **120** as illustrated in **FIGURE 3b**. Further, the elements mounted on the vehicle body and inside vehicle cabin are protected against vibrations from the heat exchanger core **120** and service life thereof is increased. Also, the housing **110** protects the heat exchanger core **120** against damage from impacts and unfavorable environment conditions such as corrosion, dust, moisture and stone impact. This may be also the case for other components of the heat exchanger assembly, which might be located within the housing and be encapsulated in the resilient material. **FIGURE 3c** illustrates schematic representation of the heat exchanger assembly **100**, **200**, wherein the resilient material **130** acting as rubber dampers is disposed between the housing **110** and the heat exchanger core **120**. The configuration and placement of the resilient material **130** between the housing **110** and the heat exchanger core **120** is based on vibration isolation requirements at different regions between the housing **110** and the heat exchanger core **120** of the heat exchanger assembly **100**. Further, the heat exchanger assembly is simple in construction. Still further, the heat exchanger assembly can be con-

veniently retrofitted on existing air conditioning systems by carrying out minor modifications.

[0020] Several variations are possible in relation with configuration of the resilient material **130** with respect to the heat exchanger core **120**, for example, in a first embodiment as illustrated in **FIGURE 3a**, the resilient material **130** surrounds the heat exchanger core **120** from all sides except one side, for example, resilient material **130** surrounds all sides of the heat exchanger core **120** except the top of the heat exchanger core **120**. Particularly, the space between at least one exterior wall **122** of the heat exchanger core **120** and corresponding interior walls **112** of the housing **110** is unfilled. In case of the first embodiment, the space between the top wall and the core is not filled, due to gravity. In a second embodiment as illustrated in **FIGURE 3b**, the resilient material **130** surrounds the heat exchanger core **120** from all sides. Depending on the nature of vibration which are foreseen in specific applications, the material may be absent on other sides.

[0021] The housing **110** usually includes mounting means, such as for example a plurality of flanges with holes configured thereon, such that holes configured on the flanges of the housing **110** match with corresponding holes configured on either one of main body and flanges extending from the main body for facilitating secure mounting of the housing **110** on the main body by using fasteners. With such configuration of the resilient material **130** between the heat exchanger core **120** and the housing **110**, the need for rubber dampers and compression limiters disposed between the housing and the vehicle body is eliminated.

[0022] The housing **110** can be of plastic material. The resilient material can be any foam that exhibits stiffness in the range of 5-500 N/mm. The resilient material **130** can be for example, Ethylene Propylene Diene Monomer (EPDM) foam of closed or semi closed structure or different kind of rubber foam. Further, the resilient material **130** can be for example, polyurethane foam. The heat exchanger core is for example condenser.

[0023] The heat exchanger can further comprise further auxiliary elements, like a receiver drier bottle. In such case, the auxiliary elements are also connected to the housing exclusively through the resilient material **130**, analogously to the relation between the heat exchanger core **120** and the housing **110**.

[0024] Although, the heat exchanger assembly **100** in accordance with the present invention is used for achieving vibration and thermal isolation of elements such as condensers, chillers used in vehicle air conditioning applications, however, the heat exchanger assembly **100** can also be used for vibration isolation of variety of elements used presently or developed in future for use in air conditioning applications and other applications.

[0025] In any case, the invention cannot and should not be limited to the embodiments specifically described in this document, as other embodiments might exist. The invention shall spread to any equivalent means and any

technically operating combination of means.

Claims

1. A heat exchanger assembly (100) comprising a heat exchanger core (120) and a housing (110) with walls (112) adapted to enclose the heat exchanger core (120), **characterized in that** the walls (112) of said housing (110) are spaced from the heat exchanger core (120); wherein the created space is filled at least partly by a resilient material (130) so that the resilient material (130) constitutes an exclusive connection between the housing (110) and the heat exchanger core (120).
2. A heat exchanger assembly (100) according to claim 1, wherein the resilient material (130) fills the whole space between the housing (110) and the heat exchanger core (120).
3. The heat exchanger assembly (100) according to any preceding claims, wherein the housing (110) is of plastic material.
4. The heat exchanger assembly (100) according to any preceding claims, wherein the resilient material (130) is foam.
5. The heat exchanger assembly (100) according to any preceding claims, wherein the resilient material (130) is rubber.
6. The heat exchanger assembly (100) according to claim 4, wherein the resilient material (130) is polyurethane foam.
7. The heat exchanger assembly (100) according to claim 4, wherein the resilient material (130) is Ethylene Propylene Diene Monomer (EPDM) foam.
8. The heat exchanger assembly (100) according to any preceding claims, wherein the resilient material (130) has stiffness in the range of 5-500 N/mm.
9. The heat exchanger assembly (100) according to any preceding claims, wherein the heat exchanger core is a condenser.
10. The heat exchanger assembly (100) according to any preceding claims, wherein it further comprises auxiliary elements, which are located inside the housing (110) and connected with it exclusively through the resilient material (130).

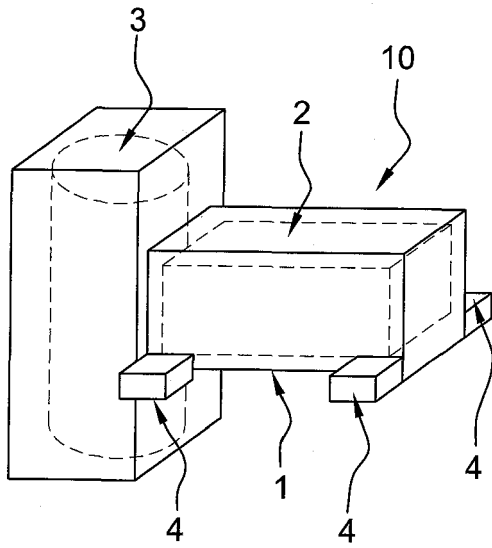


Fig. 1a

(PRIOR ART)

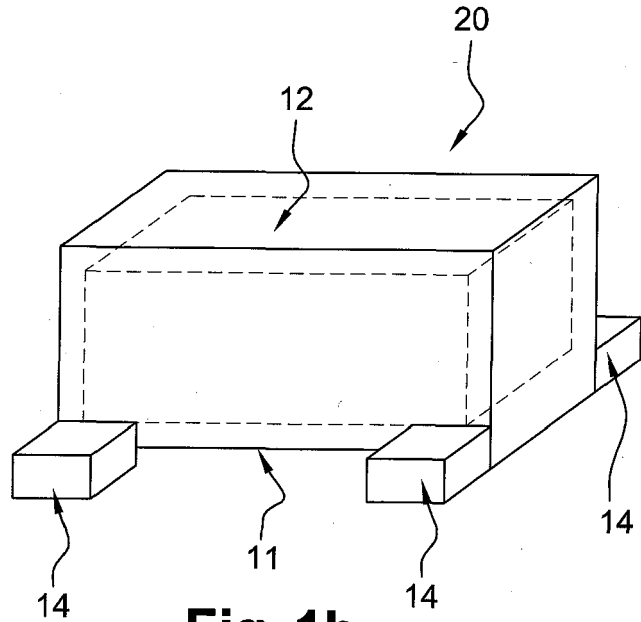


Fig. 1b

(PRIOR ART)

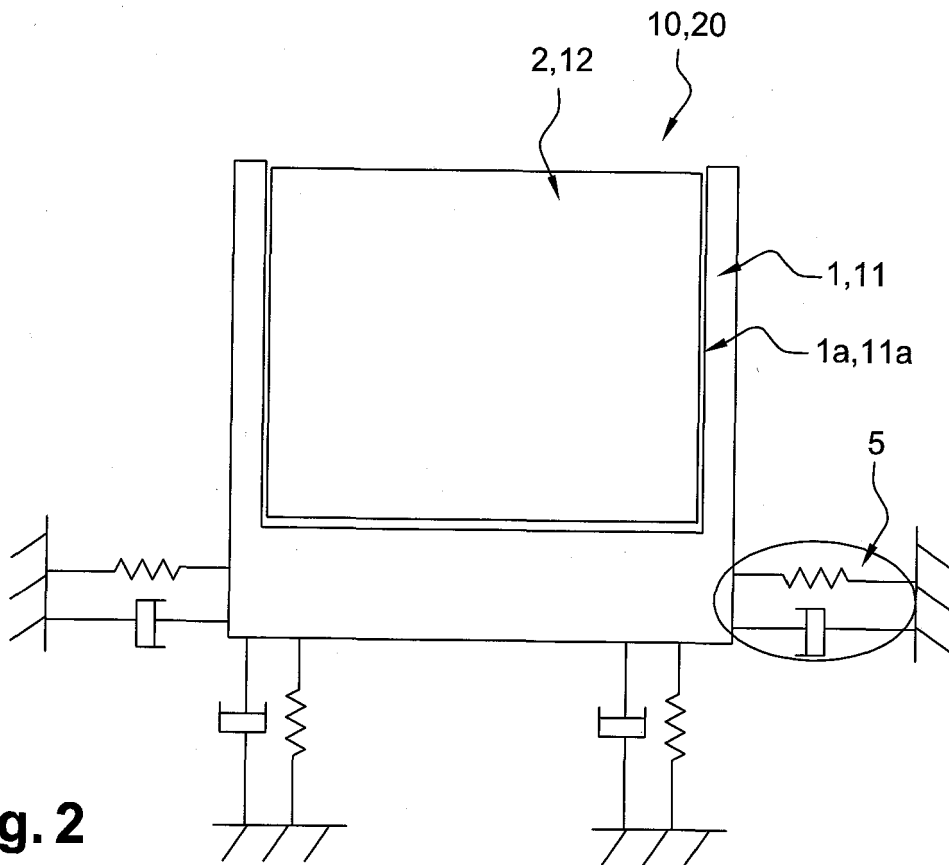


Fig. 2

(PRIOR ART)

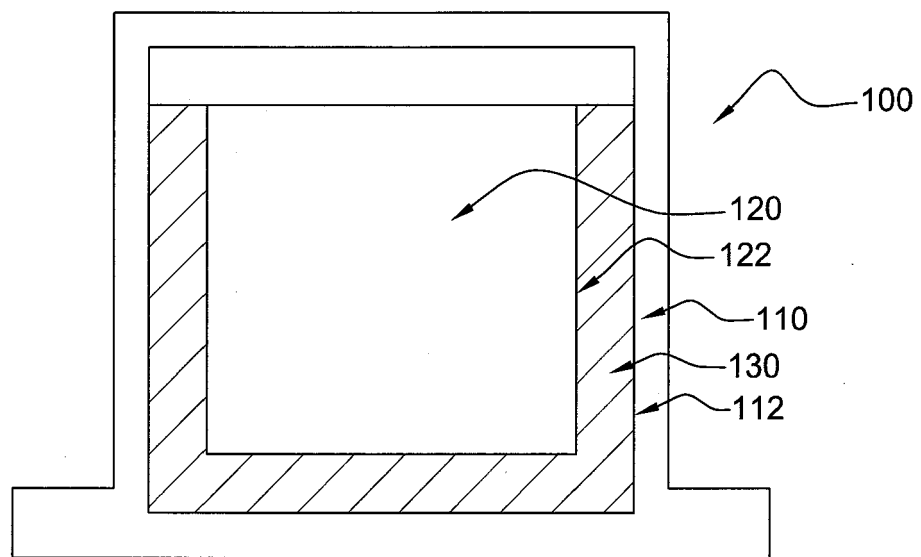


Fig. 3a

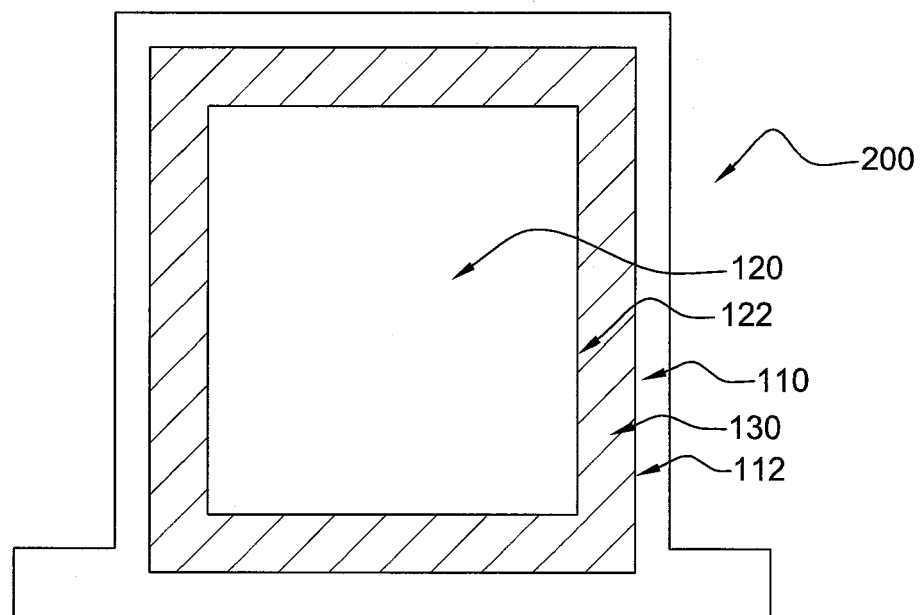


Fig. 3b

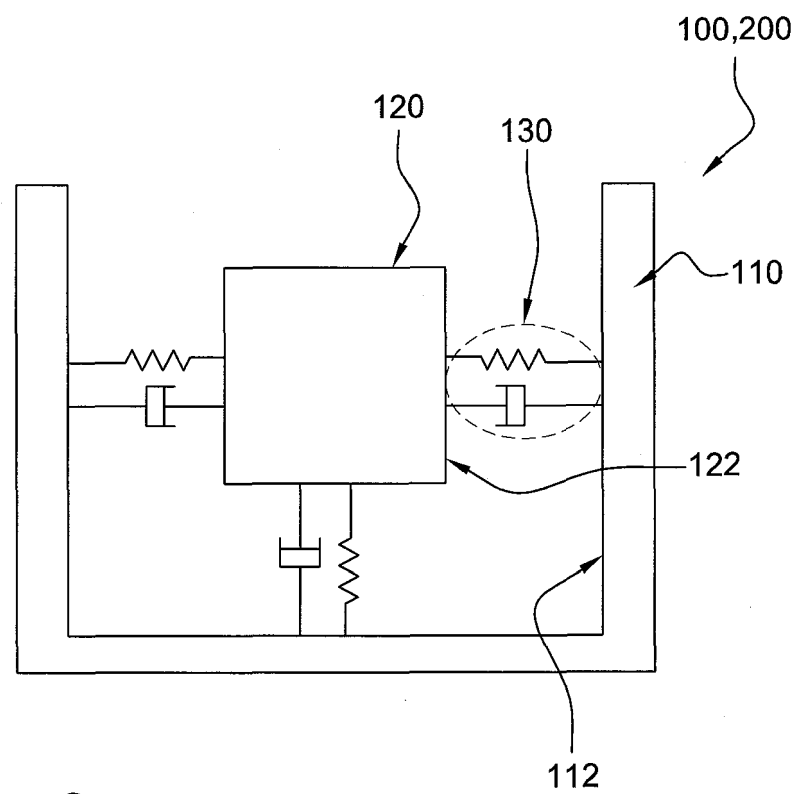


Fig. 3c



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 Application Number
 EP 18 46 1554

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 5 October 2018	Examiner Bloch, Gregor
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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