hand, the ability to decouple the MEMS sensor from external movements can also be lost as a result.

Both micromechanical structures and elastomers cannot be easily removed from the sensor and replaced, e.g., in case of a defect or malfunction, or prevent the replacement of other defective components. In case of micromechanical structures, this is due to the fact that they are permanently installed with the sensor. When elastomers are used, this difficulty results from the fact that the elastomers are connected to the other components in a material-to-material bond. This makes it necessary to first dissolve the existing connections and then rejoin them, which is very time-consuming.

Embodiments of the present invention disclose an apparatus for carrying a MEMS sensor, which reliably and simply decouples the MEMS sensor from movements and/or deformations of neighboring components. Furthermore, embodiments of the present invention disclose a sensor, which includes the apparatus for carrying a MEMS sensor and the MEMS sensor.

According to an aspect of the present invention, there is provided a sensor apparatus, including a microelectromechanical, MEMS, sensor; a carrying apparatus, which carries the MEMS sensor; and a housing structure, which encloses the carrying apparatus and the MEMS sensor carried thereon; wherein the carrying apparatus includes: a carrier platform, which carries the MEMS sensor; and a coupling structure, which has individual, macroscopic springs connected to the carrier platform and is connected to the housing structure.

The carrying apparatus is therefore suitable for connecting a MEMS sensor, which is attached to the carrier platform, to a housing structure or a housing of the overall sensor. For this purpose, the carrying apparatus has macroscopic springs, i.e., no micromechanical springs, as, for example, known from US 2018/252739 A1, and also no elastomer couplings, as, for example, described in US 2008/264169 A1. The macroscopic springs are, in this case, suitable for supporting the carrier platform relative to the housing structure and absorbing movements and deformations of the housing structure, so that the carrier platform - and with it the MEMS sensor - remains sufficiently at rest and undeformed for reliable operation.

As the springs are of macroscopic design, e.g., in case of bending beams with a material thickness of at least 0.3mm, it is possible to manufacture them comparatively easily, in particular using common macroscopic fabrication processes such as machining, eroding and the like. In addition, the use of mechanical springs instead of elastomers prevents the occurrence of fluctuations in the coupling properties of the carrying apparatus due to aging or temperature dependence.

The use of a carrying apparatus with macroscopic springs thus makes it possible to decouple a MEMS sensor from the movements of the surrounding components in a simple and reliable manner.

In this process, at least the springs, preferably the entire coupling structure, can be made of a metal. On one hand, this simplifies fabrication, as the manufacture of metal structures is comparatively simple. In addition, metal springs make it possible to achieve low self-damping, whereby movements in the surrounding environment are better absorbed by the springs. As a result, the decoupling of the carrier platform carrying the MEMS sensor from such movements is improved, which, in turn, increases the reliability of the MEMS sensor's measurement data. Low self-damping generally also results in vibrations of the carrying apparatus in the range of the typical operating frequencies of the MEMS sensor being suppressed/insulated to a greater extent than with a comparable carrying apparatus with greater self-damping (for example, due to an elastomer).

The coupling structure can be suitable for being connected to the housing structure by means of screw connections. As the coupling structure and, in particular, the springs are of macroscopic design, they can be easily attached by means of screw connections. This further simplifies manufacture. In addition, the screw connections can also be easily loosened again, making it easier to replace the carrying apparatus or the coupling structure and the MEMS sensor attached thereto.

The coupling structure can be suitable for thermally insulating the MEMS sensor and the housing structure from each other, preferably in that the springs have a small cross section compared to their length, and the springs are the only continuous connection consisting of one material between the housing structure and the carrier platform and/or in that the thermal mass of the coupling structure is less than the thermal mass of the carrier platform. External

temperature fluctuations therefore only reach the MEMS sensor in a highly damped form or not at all. In any case, the MEMS sensor will only change its temperature very slowly and evenly. This improves the reliability of the sensor data.

The carrier platform can be designed as a plate and the springs formed as pairs of bending beam springs, wherein the bending beam springs of a pair are connected to a point on the circumference of the plate at their first end and to each other at their second end, and each bending beam spring is curved in such a way that there is an interspace between each pair of bending beam springs. The pairs of bending beam springs can then each be connected to the housing structure via their second end, preferably by means of screw connections. As a result, a specific embodiment of the carrying apparatus is provided.

Disclosed herein is a sensor apparatus that has a MEMS sensor, a carrying apparatus as described above, wherein the MEMS sensor is attached to the carrier platform of the carrying apparatus, and a housing structure, which encloses the carrying apparatus and the MEMS sensor carried thereon and which is connected to the MEMS sensor via the coupling structure of the carrying apparatus. As a result, the disclosed sensor apparatus has a MEMS sensor that is decoupled from movements of the sensor in a simple and reliable manner.

In this case, the coefficients of thermal expansion of at least two interconnected elements from the list of springs, carrier platform, MEMS sensor can be matched to each other and preferably have a deviation of less than 300%, 200%, 100% or 50% from each other. This allows reducing or eliminating deformations due to different length expansions in case of temperature changes. In particular, an advantage can be achieved here compared to sensors that use elastomers or silicones for decoupling, since these materials typically have coefficients of thermal expansion that cannot be reconciled with the coefficients of thermal expansion of the materials from which MEMS sensors are made, in particular not with the coefficient of thermal expansion of silicon.

In particular, the springs and the carrier platform can be made of the same material, the coefficient of thermal expansion of which is adapted to the material of the MEMS sensor or its