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(54) **STRUCTURAL BEARING FOR PROTECTING STRUCTURES AGAINST SHOCKS**

BAUWERKSLAGER ZUM SCHUTZ VON BAUWERKEN GEGEN ERSCHÜTTERUNGEN

PALIER STRUCTURAL POUR PROTÉGER DES STRUCTURES CONTRE LES CHOCS

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(73) Proprietor: **Maurer Engineering GmbH
80807 München (DE)**

(72) Inventors:

• **DISTL, Johann
81543 München (DE)**

• **WEBER, Felix
8118 Pfaffhausen (CH)**

(74) Representative: **von Hirschhausen, Helge
Grosse - Schumacher -
Knauer - von Hirschhausen
Patent- und Rechtsanwälte
Nymphenburger Straße 14
80335 München (DE)**

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Description

[0001] The present invention relates to a structural bearing for protecting structures against shocks.

[0002] Such structural bearings are widely known from the prior art. On the one hand, structural bearings designed for earthquake protection are used herein. Earthquake isolators protect structures, such as buildings and bridges, which lie in the frequency range of high earthquake energy with respect to their first inherent frequency, against the effects of earthquakes by their very low coupling force in the horizontal direction. Typical earthquake isolators are sliding pendulum bearings and reinforced elastomeric bearings.

[0003] Sliding pendulum bearings reduce the thrust forces on the structures by decoupling the structures from the earthquake accelerations in the horizontal direction by their deep horizontal coupling stiffness. In the vertical direction, sliding pendulum bearings do not create isolation of the structure against the vertical acceleration component of the earthquakes because the coupling stiffness of the sliding pendulum bearing in the vertical direction is too high. Most of the time, the sliding pendulum bearing does not act as an earthquake isolator because earthquakes occur very rarely. Instead, it performs the functions of a conventional structural bearing (absorbing the vertical load, transferring the wind load in the horizontal direction, absorbing non-earthquake horizontal displacements, absorbing the rotation of the structure).

[0004] Reinforced elastomeric bearings with lead core (Lead Rubber Bearing (LRB)), without lead core (Low Damping Rubber Bearing (LDRB)), without lead core but with high elastomeric damping (High Damping Rubber Bearing (HDRB)) and flat sliders (flat surface slider (FSS)) together with a recentering spring element are also used for the horizontal earthquake isolation of structures. Just as with the sliding pendulum bearing, the horizontal earthquake isolation is also based on the deep horizontal coupling stiffness of the LRB, LDRB, HDRB or the FSS with recentering spring element. Likewise, these earthquake isolators increase the damping of the structure. The sliding pendulum bearing and the FSS increase the damping of the structure via the friction on the primary sliding surface. The LRB increases the structure damping via the hysteretic damping primarily of the lead core and secondarily of the elastomer. With a LDRB, the damping increase is naturally smaller. The difference between a sliding pendulum bearing and a LRB, LDRB, HDRB or FSS with recentering spring element is that the sliding pendulum bearing determines the pendulum period of the structure independently of the structure mass by its effective pendulum radius, whereas the LRB, LDRB, HDRB or FSS with recentering spring element determines the coupling stiffness by its stiffness. Thus, the coupling stiffness of the sliding pendulum bearing is determined by the structure mass and the pendulum period, while the pendulum period of the LRB, LDRB, HDRB or FSS with recentering spring element is determined by

the structure mass and the stiffness of the LRB, LDRB, HDRB or FSS with recentering spring element.

[0005] On the other hand, structural bearings are also used for structure-borne sound and shock protection. For the three-dimensional vibration protection of structures with regard to structure-borne sound and shock input, which affects the use of the structure, elastomeric bearings are generally used as point and strip bearings or as full-surface mounting or spring assemblies with viscous damper. The elastomeric bearings are either laid flat as mats between the structure and the ground (below and at the side) or arranged as point and strip bearings between walls and ceilings, wherein in both cases a continuous elastic separation joint is created between the upper part of the structure and the underlying part of the structure or the ground. Thereby, the entire separation joint does not necessarily have to be filled with elastomeric bearings. Even partial-surface mountings are possible. This arrangement of the bearings considerably reduces the transmission of vibrations in the audible and perceptible frequency range from the ground to the structure or from the lower to the upper floors. The elastomeric mats or bearings can be made of foamed polyurethane, for example.

[0006] In the vibration isolation using spring assemblies with viscous damper, a horizontal separation joint is arranged in the structure in a similar way to point and strip bearings made of elastomer, by which the loads are transmitted by the elastic spring assemblies. Usually, the spring assemblies are not arranged over the entire surface of the joint, but rather at specific points. The spacing of the spring assemblies depends on the static conditions and can be, for example, 2 to 4 meters. Typically, the spring assemblies are made with parallel spiral springs and the viscous damper is designed as a pot damper.

[0007] Such a vibration damper for a system for vibrationally isolating objects of large mass using a viscous or visco-elastic medium is disclosed, for example, in EP 0 580 272 B1.

[0008] The vibration isolation is created by the stiffness jump between the ground and the bearings, for example, between the lower part of the structure and the bearing, as well as between the bearing and the upper part of the structure. As a result of the stiffness jump, a part of the vibration energy is reflected at the joint and, thus, cannot reach the upper part of the structure. Due to the much higher dynamic stiffness of earthquake bearings in the vertical direction, this vibration isolation cannot be provided by the earthquake bearings. The lower the dynamic stiffness of the vibration isolation bearings compared to the ground and structure stiffness, the greater the isolation effect of the elastic mounting.

[0009] The dynamic stiffness of the vibration isolation bearings necessary for a required isolation effect can be defined via the so-called tuning frequency of the mounting or also isolation frequency. The tuning frequency refers to the theoretical, vertical inherent frequency, which is determined by the part of the structure assumed to be

a rigid mass above the bearing joint and the dynamic stiffness and damping of the elastic bearing joint. This simplified model approach is referred to as a single-mass oscillator. The ground is assumed to be infinitely stiff in this simplified consideration. The choice of the tuning frequency determines the vertical dynamic stiffness of the bearing joint per unit mass of the structure and is therefore the decisive parameter for dimensioning the elastic bearing joint.

[0010] Usual values of the tuning frequency of the vibration isolations of buildings against structure-borne sound and micro shocks are in the range of about 8 Hz to about 15 Hz. These vibration isolation bearings must be able to absorb vertical amplitudes in the range of 1/100 mm and horizontal deformations of a few centimeters at most. In contrast, earthquake bearings generate a horizontal isolation frequency in the range of 0.2 Hz (isolation period duration 5 s) to 0.4 Hz (isolation period duration 2.5 s). Such earthquake bearings absorb horizontal displacements with amplitudes ranging from a few centimeters to more than one meter. The vertical stiffness of the earthquake bearings is many times greater than the stiffness of vibration isolation bearings with respect to structure-borne sound and micro shocks.

[0011] Thus, if a structure is located in an earthquake-endangered region and structure-borne sound protection is also required, two isolation levels separated from each other by an intermediate plate must be provided in an expensive way due to these strongly different requirements regarding the stiffnesses and deformation capacities. Namely, one level for the horizontal earthquake isolation by means of sliding pendulum bearings, LRB, LDRB, HDRB or FSS with recentering spring element and one level for the three-dimensional structure-borne sound isolation by means of elastomeric bearings or spring assemblies with viscous damper. CN 109 854 053 A discloses an example of a system with two isolation levels separated by an intermediate plate.

[0012] Thus, the object of the present invention is to provide an improved structural bearing which can isolate a wide range of shocks and at the same time is as simple as possible in design.

[0013] According to the invention, the problem can be solved with a structural bearing according to claim 1. Advantageous further embodiments of the invention can be derived from dependent claims 2 to 25.

[0014] Thus, the structural bearing according to the invention for protecting structures against shocks has a first damping device and a second damping device. Thereby, the first damping device is designed for vibration isolation of shocks of a first type and the second damping device is designed for vibration isolation of shocks of a second type, wherein the shocks of the first type differ significantly from the shocks of the second type.

[0015] With the structural bearing according to the invention, the functions of the two structural bearings, which have been designed and installed separately up

to now, are combined in one device. On the one hand, this considerably simplifies the design of the overall construction with regard to the mounting and the protection of the structure against correspondingly different shocks.

This applies in particular to the number and spatial dimensions of the components used for this purpose. On the other hand, a compact structural bearing is provided that can be installed in a single operation. Previously costly measures for separate successive installation of the different structural bearings with their corresponding damping functions can thus be avoided. In the end, a single structural bearing is provided that can cover a particularly wide range of shocks for protecting the structure.

[0016] The first damping device and the second damping device can in principle be of any type. The decisive factor, however, is that the shocks of the first type to be isolated significantly differ from the shocks of the second type. In the present disclosure, the term "significantly" is understood as further defined by the dependent claims and in the following. The first damping device may be designed as, for example, a sliding pendulum bearing, a flat sliding bearing with recentering spring element or a reinforced earthquake elastomeric bearing. However, other types of structural bearings designed for load cases other than the earthquake load case are also conceivable. The second damping device, on the other hand, may include, for example, one or more elastomeric bearings that are used for various vibrations in the service condition load case of the structural bearing.

[0017] The first damping device is an earthquake isolator and the second damping device is a structure-borne sound isolator. Thus, the first damping device isolates macro shocks. The second damping device, on the other hand, isolates micro shocks. By designing the first damping device as an earthquake isolator, large movements and corresponding shocks can be specifically isolated in an earthquake load case of the structural bearing. At the same time, the second damping device as a structure-borne sound protection enables particularly small and thus a significantly different type of shocks to be isolated in the service condition load case of the structural bearing. Thus, a particularly wide range of shocks can be isolated by the structural bearing.

[0018] The second damping device is arranged in a component of the first damping device. With the arrangement of the second damping device in a component of the first damping device, a particularly compact structural bearing can be provided. Thereby, the previous functional principle of the first damping device is not affected. The second damping device is merely integrated into the first damping device and additional functions are added to the entire structural bearing. Moreover, the spatial dimensions of the second damping device can be reduced to a minimum. A separation of both damping devices in different isolation levels by further components is also no longer necessary. As a result, the structural bearing has a particularly simple design and at the same time can isolate a particularly wide range of shocks.

[0019] Preferably, the second damping device has an isolation frequency that is greater by the factor of 10 or at least the factor of 10 than an isolation frequency of the first damping device. Due to the difference in magnitude by at least the factor of 10, the shocks of the first type differ from the shocks of the second type by at least one order of magnitude. Thus, significantly different shocks are isolated by the first damping device and the second damping device. Thus, a particularly wide range of shocks can be isolated by the structural bearing.

[0020] Preferably, the isolation frequency of the first damping device is in the range of 0.2 Hz to 0.4 Hz and/or the isolation frequency of the second damping device is in the range of 8 Hz to 15 Hz. With the specified ranges, significantly different shocks are isolated by the first damping device and the second damping device. Thus, a particularly wide range of shocks can be isolated by the structural bearing.

[0021] Preferably, the structural bearing is designed to isolate shocks three-dimensionally, preferably such that the first damping device isolates substantially horizontal shocks and the second damping device isolates substantially horizontal and vertical shocks. The three-dimensional vibration isolation or different design of the first damping device and the second damping device allows significantly different shocks to be isolated by the first damping device and the second damping device. Thus, a particularly wide range of shocks can be isolated by the structural bearing.

[0022] Preferably, the first damping device is designed for vibration isolation of shocks from an earthquake load case, and the second damping device is designed for vibration isolation of shocks from a service condition load case of the structural bearing. With this design, the structural bearing can isolate the corresponding shocks in both an ordinary load case and an extraordinary load case. Thus, significantly different shocks are isolated by the first damping device and the second damping device. Thus, a particularly wide range of shocks can be isolated by the structural bearing.

[0023] Preferably, the second damping device is arranged between two spatially spaced components of the first damping device. In this case, for example, the second damping device can be arranged between two previously separate components of the first damping device. However, a previously single component of the first damping device can also be divided into two components in order to arrange the second damping device therebetween. The spatial spacing ensures that there is no continuous sound bridge between the two spaced components of the first damping device. Both components are only connected via the intermediate second damping device. Thus, the second damping device or the structural bearing can isolate shocks of the second type particularly effectively.

[0024] Advantageously, the first damping device is a sliding pendulum bearing, preferably a double sliding pendulum bearing. The sliding pendulum bearing can be

particularly effective in isolating the corresponding horizontal shocks in an earthquake load case, see the above description of the prior art. The sliding pendulum bearing may be of any type. For example, the sliding pendulum bearing can be designed as a single sliding pendulum bearing, a double sliding pendulum bearing or an adaptive sliding pendulum bearing. These types of sliding pendulum bearings are widely known from the prior art, cf. corresponding solutions of the company Maurer Engineering GmbH.

[0025] Preferably, the sliding pendulum bearing has an upper bearing plate, a lower bearing plate and a slider located therebetween, wherein the second damping device is arranged in the slider of the sliding pendulum bearing. This embodiment guarantees that the vertical load by the structure is always transferred centrally through the slider into the underlying foundation, regardless of the position of the slider on the main sliding surface. Thus, this also applies to the earthquake load case of the structural bearing, in which the slider may be fully deflected. Therefore, the surface pressure and thus the decisive dimensions, such as diameter and thickness, of the second damping device can be optimally adapted to the intended tuning frequency or isolation frequency of the second damping device. The non-centric load on the second damping device, especially in the earthquake load case, is only small in this solution, which avoids an uneven distribution of pressure in the second damping device or a gaping joint between the second damping device and the adjacent components. In addition, the slider generally represents the connection point with the smallest circumference in the vertical direction within the sliding pendulum bearing. Thus, the dimensions of the second damping device can also be reduced to a minimum. Hence, the structural bearing has a particularly compact and simple design.

[0026] Preferably, the slider is divided into two parts and the second damping device is arranged between these two components of the slider. Advantageously, the slider is designed in such a way that the diameter of each of the two components of the slider increases towards the second damping device. As a result, the surface pressure in the second damping device can be reduced relative to the surface pressure in the sliding surfaces between the slider and the bearing plates.

[0027] Preferably, the second damping device directly adjoins the first damping device. Due to the direct connection between the first damping device and the second damping device, the structural bearing has a particularly simple design. In particular, any separation or foundation plates to create two separate isolation levels for the first damping device and the second damping device are no longer necessary. Thus, the effort involved in manufacturing and installing the structural bearing can be considerably reduced.

[0028] Preferably, the structural bearing has a load spreading plate which is arranged above the second damping device and preferably directly adjoins the sec-

ond damping device. By means of the load spreading plate, the loads of the structure introduced vertically from above can be distributed over the entire surface of the second damping device in the service condition load case as well as in the earthquake load case of the structural bearing. Thus, the risk of too high local pressures and thrust stresses on the second damping device is also considerably reduced in this case. Likewise, even in the earthquake load case of the structural bearing, the occurrence of a gaping joint between the second damping device and the components adjoining it can be avoided. For example, the load spreading plate is made of concrete, steel or reinforced concrete.

[0029] Advantageously, the second damping device has a V-shaped cross-section. In this case, preferably, the components arranged above and below the second damping device are complementary in shape thereto. Also in this case, due to the V-shaped design of the cross-section of the second damping device, too high local pressures and thrust stresses on the second damping device in the earthquake load case of the structural bearing can be avoided. In addition, the risk of a gaping joint between the second damping device and the components adjoining it is significantly reduced. The V-shaped design also includes variants in which only a portion of the cross-section is V-shaped. The second damping device may also be conical in shape.

[0030] Preferably, the second damping device is an elastomeric bearing. Elastomeric bearings are particularly suitable for isolating structure-borne sound and shocks in the service condition load case of the structural bearing in the horizontal and vertical direction, this means three-dimensionally, see the above description of the prior art. In principle, the elastomeric bearing can be of any type. However, it must be designed for the service condition load case of the structural bearing. The use of several elastomeric bearings is also conceivable.

[0031] Preferably, the elastomeric bearing has an elastomeric layer. Advantageously, the elastomeric bearing is an elastomeric layer. The elastomeric layer preferably includes polyurethane, particularly preferably the material HRB HS 12000. The material HRB HS 12000 of the company Getzner is particularly suitable for high permanent pressures. In corresponding tests, a permissible short-term pressure of up to 52.9 MPa was determined. This means that damage to the elastomeric bearing can be avoided in the event of an earthquake load case of the structural bearing. The elastomeric bearing remains operational even after exceptionally large shocks, which are basically isolated by the first damping device.

[0032] Advantageously, the elastomeric layer is reinforced. The reinforcement additionally stabilizes the elastomeric layer. Further, the force distribution within the elastomeric bearing can be controlled in a targeted manner. This means that damage to the elastomeric bearing can be avoided in the earthquake load case of the structural bearing. The elastomeric bearing remains operational even after exceptionally large shocks, which are

basically isolated by the first damping device.

[0033] Advantageously, the elastomeric layer has an elastomeric plate. Preferably, the elastomeric layer is an elastomeric plate. Particularly, the elastomeric plate is circular, rectangular, square and/or annular in shape. Elastomeric plates are particularly easy to manufacture and can be installed on site without great effort. Further, this makes the structural bearing compact and simple in design. By choosing the right shape, the elastomeric plate is optimally adapted to the spatial conditions in the structural bearing and corresponding requirements.

[0034] In the following, advantageous embodiments of the present invention are schematically described with reference to the figures, wherein

Fig. 1 is a lateral cross-sectional view of a structural bearing according to the invention in the service condition load case according to a first embodiment; and

Fig. 2 is a lateral cross-sectional view of the structural bearing of Fig. 1 according to the invention in the earthquake load case.

[0035] Figs. 1 and 2 each show a lateral cross-section of a structural bearing 1 for protecting structures against shocks according to the invention in accordance with a first embodiment. The structural bearing 1 has a first damping device 2 and a second damping device 3. The first damping device 2 is designed for vibration isolation of shocks of a first type and the second damping device 3 is designed for vibration isolation of shocks of a second type. Thereby, the shocks of the first type differ significantly from the shocks of the second type.

[0036] In the present example, the first damping device 2 is an earthquake isolator in the form of a sliding pendulum bearing, in this case in particular a double sliding pendulum bearing. Thus, the first damping device 2 isolates macro shocks. The sliding pendulum bearing has a lower bearing plate 4, an upper bearing plate 5 and a slider 6 located therebetween. The lower bearing plate 4 and the upper bearing plate 5 each include a main sliding surface on which the slider 6 can be deflected. The two main sliding surfaces are each concave in shape towards the slider 6. Furthermore, sliding sheets 7 are arranged on the respective main sliding surfaces so that the slider 6 can move along the main sliding surface in accordance with the required friction values. Towards the lower bearing plate 4 and the upper bearing plate 5, the slider 6 has a convexly shaped sliding surface, respectively, which is substantially complementary in shape to the respective main sliding surface of the lower bearing plate 4 and the upper bearing plate 5. The sliding surfaces of the slider 6 have a sliding material 8, so that the friction between the slider 6 and the lower bearing plate 4 and upper bearing plate 5 can be further reduced.

[0037] The sliding pendulum bearing is designed for vibration isolation of substantially horizontal shocks from

an earthquake load case of the structural bearing 1, see Fig. 2. In such a load case, the slider 6 is deflected along the main sliding surfaces of the lower bearing plate 4 and the upper bearing plate 5. This allows the lower bearing plate 4 to move horizontally relative to the upper bearing plate 5. Due to the vibration isolation of relatively large earthquake shocks, the isolation frequency of the sliding pendulum bearing is in a range of 0.2 Hz to 0.4 Hz.

[0038] The second damping device 3 is designed as a structure-borne sound isolator. Thus, the second damping device 3 isolates micro shocks. In the present example, the second damping device 3 is an elastomeric bearing. The elastomeric bearing is an elastomeric layer in the form of an elastomeric plate, which preferably includes polyurethane. In this case, the material HRB HS 12000 is used, which is suitable for particularly high permanent pressures. Advantageously, the elastomeric layer can also be reinforced so that the elastomeric bearing is additionally stabilized.

[0039] The elastomeric bearing is designed for vibration isolation of shocks from a service condition load case of the structural bearing 1, see Fig. 1. This applies to both essentially horizontal and vertical shocks. In other words, shocks can be isolated three-dimensionally. Due to the vibration isolation of relatively small shocks, the elastomeric bearing has an isolation frequency that is greater by at least the factor of 10 than the isolation frequency of the sliding pendulum bearing. In this case, the isolation frequency of the elastomeric bearing is in the range of 8 Hz to 15 Hz.

[0040] As can be seen from Figs. 1 and 2, the elastomeric bearing is arranged in the slider 6 of the sliding pendulum bearing. In particular, the slider 6 has an upper component 6a and a lower component 6b between which the elastomeric bearing is arranged. Further, the upper component 6a and the lower component 6b are spatially spaced apart, so that there is no sound bridge between the upper component 6a and the lower component 6b. Thus, the elastomeric bearing forms a horizontal separation joint within the structural bearing 1 and, thus, can effectively minimize transmission of vibrations in the structure-borne sound and micro range from the lower structural bearing member to the upper structural bearing member. The upper component 6a and the lower component 6b are designed such that the respective diameter increases toward the elastomeric bearing. Thereby, the surface pressure in the elastomeric bearing can be reduced relative to the surface pressure in the sliding surfaces between the slider 6 and the lower bearing plate 4 as well as upper bearing plate 5. Furthermore, the upper component 6a and the lower component 6b each have two lateral protrusions 9 to fix the elastomeric bearing between the protrusions 9. Alternatively or additionally, the elastomeric bearing may also be bonded to the upper and/or lower component 6a, 6b in order to achieve the desired fixation within the structural bearing 1.

[0041] By integrating the elastomeric bearing into the slider 6 of the sliding pendulum bearing, the dimensions

of the elastomeric bearing can be reduced to a minimum. Furthermore, a separation plate dividing the elastomeric bearing and the sliding pendulum bearing into two isolation levels is no longer necessary. In addition, even in the earthquake load case of the structural bearing 1 or in a deflected position of the slider 6, the elastomeric bearing is always evenly loaded, since the acting superimposed load of the structure is transferred at all times via the slider 6 from the upper bearing plate 5 to the lower bearing plate 4. Thus, too high local pressures and thrust stresses on the elastomeric bearing as well as a gaping joint in the area of the elastomeric bearing can be avoided. By using the HRB HS 12000 material, the elastomeric bearing can withstand even high force loads for a short period of time during the earthquake load case and remains operational. In the end, a single and simply designed structural bearing is provided that performs the functions of the structure-borne sound and shock protection during the service condition load case as well as the functions of the earthquake protection during the earthquake load case.

REFERENCE SIGNS

[0042]

- 1 Structural bearing
- 2 First damping device
- 3 Second damping device
- 4 Lower bearing plate
- 5 Upper bearing plate
- 6 Slider
- 6a Upper component
- 6b Lower component
- 7 Sliding sheet
- 8 Sliding material
- 9 Protrusion
- 11 Load spreading plate

Claims

1. Structural bearing (1) for protecting structures against shocks, having
 - a first damping device (2) and a second damping device (3),
 - wherein the first damping device (2) is designed for vibration isolation of shocks of a first type and the second damping device (3) is designed for vibration isolation of shocks of a second type, wherein the shocks of the first type differ significantly from the shocks of the second type, wherein the first damping device (2) is an earthquake isolator and the second damping device (3) is a structure-borne sound isolator,
 - characterized in that**
 - the second damping device (3) is arranged in a

component of the first damping device (2).

2. Structural bearing (1) according to claim 1,
characterized in that
the second damping device (3) has an isolation frequency which is greater by at least the factor of 10 than an isolation frequency of the first damping device (2).
3. Structural bearing (1) according to claim 2,
characterized in that
the isolation frequency of the first damping device (2) is in the range from 0.2 Hz to 0.4 Hz and/or the isolation frequency of the second damping device (3) is in the range from 8 Hz to 15 Hz.
4. Structural bearing (1) according to one of the preceding claims,
characterized in that
the structural bearing (1) is designed to isolate shocks three-dimensionally, preferably such that the first damping device (2) isolates substantially horizontal shocks and the second damping device (3) isolates substantially horizontal and vertical shocks.
5. Structural bearing (1) according to one of the preceding claims,
characterized in that
the first damping device (2) is designed for vibration isolation of shocks from an earthquake load case, and the second damping device (3) is designed for vibration isolation of shocks from a service condition load case of the structural bearing (1).
6. Structural bearing (1) according to one of the preceding claims,
characterized in that
the second damping device (3) is arranged between two spatially spaced components of the first damping device (2).
7. Structural bearing (1) according to one of the preceding claims,
characterized in that
the first damping device (2) is a sliding pendulum bearing, preferably a double sliding pendulum bearing.
8. Structural bearing (1) according to claim 7,
characterized in that
the sliding pendulum bearing has an upper bearing plate (4), a lower bearing plate (5) and a slider (6) located therebetween, wherein the second damping device (3) is arranged in the slider (6) of the sliding pendulum bearing.
9. Structural bearing (1) according to one of the preceding claims,

characterized in that

the second damping device (3) directly adjoins the first damping device (2).

10. Structural bearing (1) according to one of the preceding claims,
characterized in that
the structural bearing (1) has a load spreading plate (11) which is arranged above the second damping device (3) and preferably directly adjoins the second damping device (3).
11. Structural bearing (1) according to one of the preceding claims,
characterized in that
the second damping device (3) has a V-shaped cross-section.
12. Structural bearing (1) according to one of the preceding claims,
characterized in that
the second damping device (3) is an elastomeric bearing.
13. Structural bearing (1) according to claim 12,
characterized in that
the elastomeric bearing has an elastomeric layer, which preferably includes polyurethane, particularly preferably the material HRB HS 12000.
14. Structural bearing (1) according to claim 13,
characterized in that
the elastomeric layer is reinforced.
15. Structural bearing (1) according to claim 13 or 14,
characterized in that
the elastomeric layer has an elastomeric plate, which is particularly circular, rectangular, square and/or annular in shape.

Patentansprüche

1. Bauwerkslager (1) zum Schutz von Bauwerken gegen Erschütterungen mit

einer ersten Dämpfungsvorrichtung (2) und einer zweiten Dämpfungsvorrichtung (3),
wobei die erste Dämpfungsvorrichtung (2) für die Schwingungsisolation von Erschütterungen einer ersten Art ausgelegt ist und die zweite Dämpfungsvorrichtung (3) für die Schwingungsisolation von Erschütterungen einer zweiten Art ausgelegt ist,
wobei sich die Erschütterungen der ersten Art signifikant von den Erschütterungen der zweiten Art unterscheiden,
wobei die erste Dämpfungsvorrichtung (2) ein

- Erdbebenisolator ist und die zweite Dämpfungs-
vorrichtung (3) ein Körperschallisolator ist,
dadurch gekennzeichnet, dass
die zweite Dämpfungs-
vorrichtung (3) in einem Bauteil der ersten Dämpfungs-
vorrichtung (2) angeordnet ist. 5
2. Bauwerkslager (1) nach Anspruch,
dadurch gekennzeichnet, dass
die zweite Dämpfungs-
vorrichtung (3) eine Isola-
tionsfrequenz aufweist, die um wenigstens den Faktor
10 größer ist als eine Isola-
tionsfrequenz der ersten
Dämpfungs-
vorrichtung (2). 10
3. Bauwerkslager (1) nach Anspruch 2,
dadurch gekennzeichnet, dass
die Isola-
tionsfrequenz der ersten Dämpfungs-
vorrichtung (2) im Bereich von 0,2 Hz bis 0,4 Hz
und/oder die Isola-
tionsfrequenz der zweiten Dämpfungs-
vorrichtung (3) im Bereich von 8 Hz bis 15 Hz
liegt. 15 20
4. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
das Bauwerkslager (1) so ausgelegt ist, dass es Er-
schütterungen dreidimensional isoliert, vorzugswei-
se so, dass die erste Dämpfungs-
vorrichtung (2) im Wesentlichen horizontale Erschüt-
terungen isoliert und die zweite Dämpfungs-
vorrichtung (3) im We-
sentlichen horizontale und vertikale Erschüt-
terungen isoliert. 25 30
5. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
die erste Dämpfungs-
vorrichtung (2) für die Schwin-
gungsisolation von Erschüt-
terungen aus einem Erd-
beben-Lastfall, und die zweite Dämpfungs-
vorrichtung (3) für die Schwin-
gungsisolation von Erschüt-
terungen aus einem Gebrauchszustands-Lastfall
des Bauwerkslagers (1) ausgelegt ist. 35 40
6. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
die zweite Dämpfungs-
vorrichtung (3) zwischen zwei
räumlich beabstandeten Bauteilen der ersten Dämpfungs-
vorrichtung (2) angeordnet ist. 45 50
7. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
die erste Dämpfungs-
vorrichtung (2) ein Gleitpendel-
lager ist, vorzugsweise ein Doppelgleitpendel-
lager ist. 55
8. Bauwerkslager (1) nach Anspruch 7,
- dadurch gekennzeichnet, dass**
das Gleitpendellager eine obere Lagerplatte (4), ei-
ne untere Lagerplatte (5) und einen dazwischen lie-
genden Gleiter (6) aufweist, wobei die zweite Dämpfungs-
vorrichtung (3) im Gleiter (6) des Gleitpendel-
lagers angeordnet ist.
9. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
die zweite Dämpfungs-
vorrichtung (3) direkt an der
ersten Dämpfungs-
vorrichtung (2) anschließt.
10. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
das Bauwerkslager (1) eine Lastausbreitungsplatte
(11) aufweist, die oberhalb der zweiten Dämpfungs-
vorrichtung (3) angeordnet ist und vorzugsweise di-
rekt an der zweiten Dämpfungs-
vorrichtung (3) an-
schließt.
11. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
die zweite Dämpfungs-
vorrichtung (3) einen V-förmi-
gen Querschnitt aufweist.
12. Bauwerkslager (1) nach einem der vorhergehenden
Ansprüche,
dadurch gekennzeichnet, dass
die zweite Dämpfungs-
vorrichtung (3) ein Elastomer-
lager ist.
13. Bauwerkslager (1) nach Anspruch 12,
dadurch gekennzeichnet, dass
das Elastomerlager eine Elastomerschicht aufweist,
die vorzugsweise Polyurethan, besonders bevor-
zugt den Werkstoff HRB HS 12000, beinhaltet.
14. Bauwerkslager (1) nach Anspruch 22,
dadurch gekennzeichnet, dass
die Elastomerschicht bewehrt ist.
15. Bauwerkslager (1) nach Anspruch 22 oder 23,
dadurch gekennzeichnet, dass
die Elastomerschicht eine Elastomerplatte aufweist,
welche insbesondere kreisförmig, rechteckig, qua-
dratisch und/oder ringförmig ausgebildet ist.

Revendications

1. Appareil d'appui structurel (1) pour protéger des
structures contre les chocs, comprenant

un premier dispositif d'amortissement (2) et un
deuxième dispositif d'amortissement (3),

- le premier dispositif d'amortissement (2) étant conçu pour une isolation vibratoire de chocs d'un premier type et le deuxième dispositif d'amortissement (3) étant conçu pour une isolation vibratoire de chocs d'un deuxième type, les chocs du premier type se différenciant considérablement des chocs du deuxième type, le premier dispositif d'amortissement (2) étant un isolateur de tremblement de terre et le deuxième dispositif d'amortissement (3) étant un isolateur de bruit de structure,
caractérisé en ce que
le deuxième dispositif d'amortissement (3) est disposé dans un composant du premier dispositif d'amortissement (2).
2. Appareil d'appui structurel (1) selon la revendication 1,
caractérisé en ce que
le deuxième dispositif d'amortissement (3) a une fréquence d'isolement supérieure d'au moins un facteur 10 à la fréquence d'isolement du premier dispositif d'amortissement (2).
3. Appareil d'appui structurel (1) selon la revendication 2,
caractérisé en ce que
la fréquence d'isolement du premier dispositif d'amortissement (2) est comprise dans la plage de 0,2 Hz à 0,4 Hz et la fréquence d'isolement du deuxième dispositif d'amortissement (3) est comprise dans la plage de 8 Hz à 15 Hz.
4. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
ledit appareil d'appui (1) est conçu pour isoler des chocs en trois dimensions, de préférence de façon que le premier dispositif d'amortissement (2) est destiné à isoler des chocs sensiblement horizontaux et le deuxième dispositif d'amortissement (3) est destiné à isoler des chocs sensiblement horizontaux et verticaux.
5. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
le premier dispositif d'amortissement (2) est conçu pour une isolation vibratoire de chocs dus à un cas de charge de tremblement de terre, et le deuxième dispositif d'amortissement (3) est conçu pour une isolation vibratoire de chocs dus à un cas de charge d'état de service de l'appareil d'appui (1).
6. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
le deuxième dispositif d'amortissement (3) est disposé entre deux composants espacés du premier dispositif d'amortissement (2).
7. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
le premier dispositif d'amortissement (2) est un appareil d'appui sphérique pendulaire à glissement, de préférence un appareil d'appui sphérique pendulaire à glissement double.
8. Appareil d'appui structurel (1) selon la revendication 7,
caractérisé en ce que
l'appareil d'appui sphérique pendulaire à glissement comprend une plaque d'appui supérieure (4), une plaque d'appui inférieure (5) et un glisseur (6) situé entre celles-ci, le deuxième dispositif d'amortissement (3) étant disposé dans le glisseur (6) de l'appareil d'appui sphérique pendulaire à glissement.
9. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
le deuxième dispositif d'amortissement (3) est situé directement adjacent au premier dispositif d'amortissement (2).
10. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
l'appareil d'appui (1) comprend une plaque de dispersion de charge (11) qui est disposée au-dessus du deuxième dispositif d'amortissement (3) et de préférence est situé directement adjacent au deuxième dispositif d'amortissement (3).
11. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
le deuxième dispositif d'amortissement (3) a une section transversale en forme de V.
12. Appareil d'appui structurel (1) selon l'une quelconque des revendications précédentes,
caractérisé en ce que
le deuxième dispositif d'amortissement (3) est un appareil d'appui élastomère.
13. Appareil d'appui structurel (1) selon la revendication 12,
caractérisé en ce que
l'appareil d'appui élastomère comprend une couche élastomère qui de préférence comporte polyuréthane, de façon particulièrement préférée le matériau HRB HS 12000.
14. Appareil d'appui structurel (1) selon la revendication

13,

caractérisé en ce que

la couche élastomère est renforcée.

15. Appareil d'appui structurel (1) selon la revendication 5

13 ou 14,

caractérisé en ce que

la couche élastomère comprend une plaque élastomère qui est en particulier de forme circulaire, rectangulaire, carrée et/ou annulaire.

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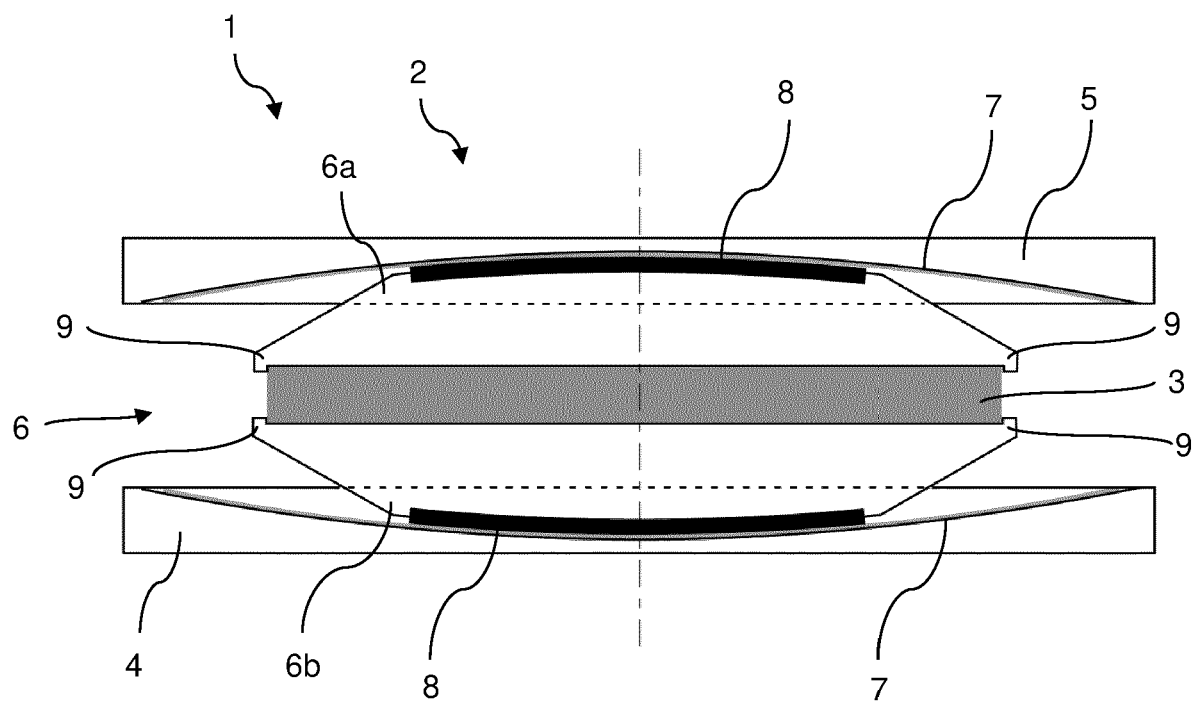


Fig. 1

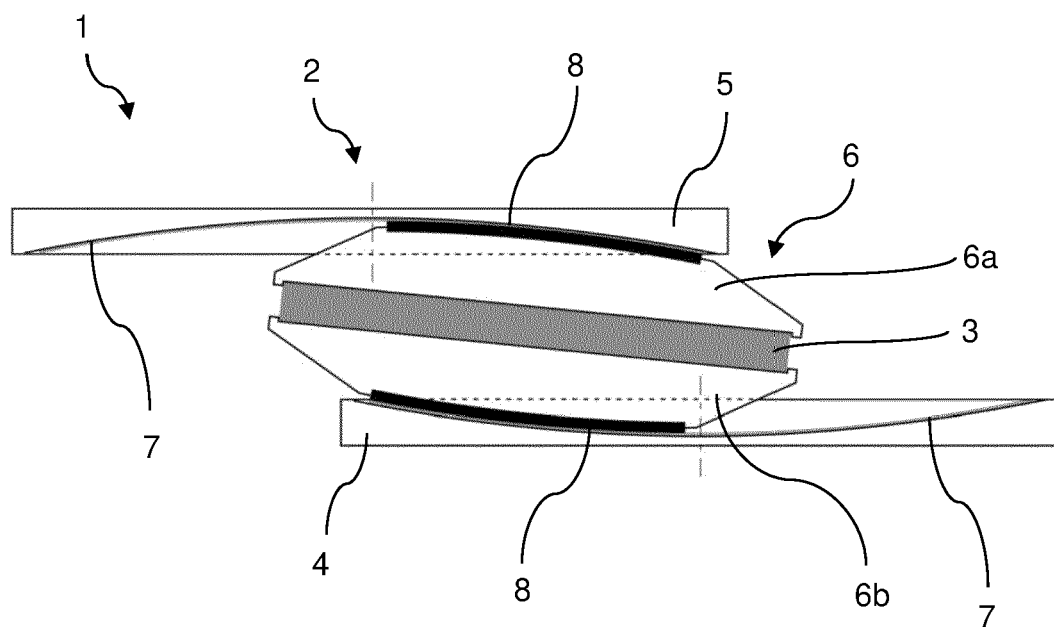


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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