

[Type of Document] Specification

[Title of the Invention] Hanging Type Vibration Isolator

[Field of the Invention]

[0001]

The present invention relates to a hanging type vibration isolator assembled with hanging bolts used for hanging up, for instance, vibrating equipment such as an air-conditioner, piping for feeding and draining water, and piping for feeding and exhausting air for prevention of propagation of vibrations caused by the vibrating equipment. More specifically, this invention relates to a mechanism which can prevent the vibration isolation effect from lowering due to contact between a vibration isolation material of a hanging type vibration isolator and a main body of the vibration isolator.

[Background of the Invention]

[0002]

In an architectural structure such as a building, air conditioners, piping for feeding and draining water, and ducts and piping for feeding and exhausting air are installed in the state where such equipments and devices are hanged up from a structural frame body such as a floor slab for an upper floor or a supporting material

for a ceiling with hanging bolts. Each of the air conditioners, piping for feeding and draining water, and ducts and piping for feeding and exhausting air is as a source of vibration, for instance, because a fluid such as water or air flows and sometimes abruptly stops according to a driving force generated by, for instance, a compressor, or because a driving motor turns and stops according to the necessity. In the descriptions below, the equipments and devices generating vibrations including the air conditioners, piping for feeding and draining water, and ducts and piping for feeding and exhausting air as described above are referred to as vibrating equipments.

[0003]

Vibrations generated by the vibrating equipments as described above propagate through hanging bolts to floor slabs or other related sections and disadvantageously generate various troubles due to the vibrations and noises caused by the vibrations throughout a building. Especially, when vertical vibrations propagate to a floor slab for an upper floor, fixtures and furniture such as office desks or cabinets resonate and generate sounds to disadvantageously induce malfunctions of office automation products or the like and cause various

troubles due to vibrations.

[0004]

To overcome the problems as described above, Patent document 1 discloses a hanging type vibration isolator A hung down from a ceiling. This vibration isolator is hung down from a ceiling, which is installed between a ceiling-side hanging bolt 20 and an equipment-side hanging bolt 21 for holding and hanging down the equipment to be provided near the ceiling. The vibration isolator comprises a horseshoe-formed hanger body 10 comprising a brace 11, a hanging and holding section 12 on which a ceiling-side hanging bolt 20 is set, and a load carrying section 13 for hanging down and also carrying an equipment to be provided near the ceiling on which a through-hole 13c is provided; a compression coil spring 14 provided between the hanging and holding section 12 and the load carrying section 13 for carrying a load; a lower-side elastic seat 15 which is provided on the load carrying section 13 and has a mounting cylindrical section 18 with the equipment-side hanging bolt 21 to be inserted therethrough; an upper-side elastic seat 30 which is mounted on the compression coil spring 14 and has an upper-side through-hole 32 having an inner diameter smaller than that of the mounting

cylindrical section 18 with a hooking end of the equipment-side hanging bolt 21 to be inserted therethrough; and a washer 33 provided on the upper-side elastic seat 30 on which a hooking end of the equipment-side hanging bolt 21 is set. Because of the configuration, even when the equipment-side hanging bolt 21 is inclined against the vertical direction, a shaft portion of the equipment-side hanging bolt 21 can be installed within the mounting cylindrical section 18 with a large inclination angle θ without contacting an inner wall of the mounting cylindrical section 18 (Refer to Fig. 1 and other related sections in Patent document 1).

[0005]

With the hanging type vibration isolator A hung down from a ceiling described in Patent document 1, however, although it is possible to prevent contact between the equipment-side hanging bolt 21 and the hanger body 10, a certain distance is required between the hanger body 10 and the compression coil spring 14 by making longer a cantilever portion of the load carrying section 13, which is sensitive to a bending moment, for prevention of contact between the compression coil spring 14 as a vibration isolation material and a hanger body 10 as a vibration isolator body. Because of the feature,

there occurs the problem (1) that the configuration is not suited to the requirements of size reduction and weight reduction of a vibration isolator which is used in a narrow space near a ceiling.

[0006]

With the configuration described above, when it is necessary to turn a nut used to set the compression coil spring 14 to the equipment-side hanging bolt 21, it is impossible to turn the nut with a power tool because the compression coil 14 is present under the nut. Therefore, there occurs also the problem (2) that a work load is large for manually turning the nut for installing the vibration isolator.

[0007]

In addition, when the equipment-side hanging bolt 21 is installed with an inclined posture, also the compression coil 14 moves up and down in the inclined state, and the direction in which the compression coil spring 14 extends or shrinks is off from the vertical direction at a certain angle. Therefore, there occurs also the problem (3) that the harmful vertical vibrations can not be attenuated efficiently and the effect of reducing vibrations becomes disadvantageously lower.

[Prior art document]

[Patent document]

[0008]

[Patent document 1] Japanese Patent Laid-Open Publication
No. 2010-223368

[Summary of the Invention]

[Problems to be Solved by the Invention]

[0009]

The present invention was made to solve the problems in the prior art as described above, and an object of the present invention is to provide a hanging type vibration isolator which satisfies the requirements for reduction of a size and a weight of a vibration isolator and can achieve the excellent vibration isolation effect without fail by preventing contact between a vibration isolation material and a body of a vibration isolator even when the insert position is displaced from the position for installation of the vibrating equipments.

[Means for Solving the Problems]

[0010]

To solve the problems in the prior art as described above, the invention according to claim 1 provides a hanging type vibration isolator comprising a body having an upper edge section and a lower edge section and set on

a hanging bolt for hanging down an vibrating equipment generating vibrations to carry a load of the vibrating equipment; a vibration isolation material provided between the upper edge section and the lower edge section of the body of the vibration isolator and capable of absorbing vibrations generated by the vibrating equipments; and two elastic materials, namely upper and lower elastic materials provided between the vibration isolation material and the vibration isolator body and between the vibration isolation material and the hanging bolt respectively. Because of the configuration, the vibration isolator is capable of preventing propagation of vibrations generated by the vibrating equipment. An external form of the vibration isolation material is a truncated conical one.

[0011]

The invention according to claim 2 also provides the basically same hanging type vibration isolator as that described in claim 1. However, the hanging type a vibration isolator provided by the invention according to claim 2 is characterized in that the body of the a vibration isolator comprises a hollow and rectangular frame body having the upper edge section and the lower edge section as well as a pair of side edge sections.

[0012]

The invention according to claim 3 provides the basically same hanging type vibration isolator as that described in claim 1 or claim 2. However, the hanging type vibration isolator provided by the invention according to claim 3 is characterized in that the vibration isolator is a coil spring in which the coil diameter become smaller as it goes farther from the upper edge section or the lower edge section of the vibration isolator body.

[0013]

The invention according to claim 4 provides the basically same hanging type vibration isolator as that described in claim 3. However, the hanging type vibration isolator provided by the invention according to claim 4 is characterized in that either one or both of the two elastic materials have a bag-form covering the entire coil spring or a portion of the same.

[0014]

The invention according to claim 5 provides the basically same hanging type vibration isolator as that described in claim 4. However, the hanging type vibration isolator provided by the invention according to claim 5 is characterized in that the two elastic materials are a

rubber cap set on the upper edge section of the vibration isolator body and covering an upper portion of the coil spring for restricting displacement of the coil spring in the horizontal direction and a rubber boot set on a bottom edge of the vibration isolation material and covering the entire vibration isolation material from the outside.

[0015]

The invention according to claim 6 provides the basically same hanging type vibration isolator as that described in any of claims 1 to 5. However, the hanging type vibration isolator provided by the invention according to claim 6 is characterized in that the vibration isolation material is fixed to the upper edge section side of the vibration isolator body, a hole having a size allowing insertion of a socket portion of a power tool used for tightening a nut for fixing the vibration isolation material is formed on the lower edge section of the vibration isolator body, and a hanging bolt for jointing the vibrating equipment to the vibration isolator body is passed through this hole and is fixed to the vibration isolator body.

[0016]

The invention according to claim 7 provides the

basically same hanging type vibration isolator as that described in claim 6. However, the hanging type vibration isolator provided by the invention according to claim 7 is characterized in that the upper edge section of the vibration isolator body and the vibration isolation material are fixed just below an insert buried in a structural frame body into which the hanging bolt is screwed.

[Effects of the Invention]

[0017]

Features of the present invention are as described above. The invention according to claim 1 provides a hanging type vibration isolator comprising a body having an upper edge section and a lower edge section and set on a hanging bolt for hanging down an vibrating equipment generating vibrations to carry a load of the vibrating equipment; a vibration isolation material provided between the upper edge section and the lower edge section of the body of the vibration isolator and capable of absorbing vibrations generated by the vibrating equipment; and two elastic materials, namely upper and lower elastic materials provided between the vibration isolation material and the vibration isolator body and between the vibration isolation material and the hanging

bolt respectively. Because of the configuration as described above, the vibration isolator can prevent propagation of vibration generated by the vibrating equipment. Furthermore, an external form of the vibration isolation material is a truncated conical one. Therefore the hanging type vibration isolator provided by the invention according to claim 1 can satisfy the requirements for size reduction and weight reduction, and even when a position of an insert hole and a position at which a vibrating equipment is to be installed are off from each other, the vibration isolator can achieve the vibration isolation effect without fail by preventing contact between the vibration isolation material and the vibration isolator body.

[0018]

The invention according to claim 2 provides the basically same hanging type vibration isolator as that described in claim 1. However, the vibration isolator body comprises a hollow and rectangular frame body having the upper edge section and the lower edge section as well as a pair of left and right side edge sections. Therefore, in addition to the effects as described above, the vibration isolator body does not have the portion of the cantilever support as that in the body as described in

Patent document 1 having the horseshoe form when viewed in the horizontal direction, so that the vibration isolator body is more excellent in the strength, and the possibility is very low that the corner portions subjected to bending or welding undergo plastic deformation as time goes by and the upper edge section or the lower edge section deforms and extends toward the side edge sections. Because of the advantageous features as described above, the hanging type vibration isolator insures the improved durability, and for this reason enables reduction of a thickness and a weight of the vibration isolator.

[0019]

The invention according to claim 3 provides the basically same hanging type vibration isolator as that described in claim 1 or claim 2. In the vibration isolator provided by the invention according to claim 3, the vibration isolation material is a coil spring in which the coil diameter become smaller as it goes farther from the upper edge section or the lower edge section of the vibration isolator body. Because of the feature as described above, the vibration isolator provides, in addition to the effects as described above, the following effect. Namely, the vibration isolation material insures

the higher effect of preventing vertical vibrations as compared to a solid and high density type vibration isolation material that consists of the rubber material etc., and can prevent propagation of vertical vibrations generated by vibrating equipments. Because of the feature described above, vertical vibrations generated by vibrating equipments are not amplified by member materials having a relatively small thickness and easily vibrating in the vertical direction such as a floor slab or a free access floor, thus troubles caused by vibrations being reduced without fail.

[0020]

The invention according to claim 4 provides the basically same hanging type vibration isolator as that described in claim 3. In the vibration isolator provided by the invention according to claim 4, either one or both of the two elastic materials have a bag-form covering the entire coil spring or a portion of the same. Because of the feature as described above, the hanging type vibration isolator, in addition to the effects described above, the following effect. Namely, when a coil spring is installed and a nut is tighten for fixing the coil spring, there is no risk that a finger, a machine tool, or the like is inserted into the coil spring by mistake,

which insures reduction of worker's injuries and the improved safety in the installation work. In addition, a distance between a position where an insert is buried and a position where a vibrating equipment is installed is relatively large, so that, even when the vibration isolator is to be installed in the state where the hanging bolt is set with the extremely inclined posture, the vibration isolator body and the coil spring never contacts each other because the bag-formed elastic materials cover the coil spring. Because of the feature described above, vibrations propagated from the vibration isolator body through the coil spring to the hanging bolt are reduced by the elastic materials, which minimizes inhibition of the vibration isolation effects.

[0021]

The invention according to claim 5 provides the basically same hanging type vibration isolator as that described in claim 4. In the hanging type vibration isolator provided by the invention according to claim 5, the two elastic materials are a rubber cap set on the upper edge section of the vibration isolator body and covering an upper portion of the coil spring for restricting displacement of the coil spring in the horizontal direction and a rubber boot set on a bottom

edge of the vibration isolation material and covering the entire vibration isolation material from the outside. Because of the configuration, the rubber cap can restrict displacement of the coil spring in the horizontal direction and the rubber boot covers the entire coil spring from the outside, thus the vibration isolation effects as described above being achieved.

[0022]

The invention according to claim 6 provides the basically same hanging type vibration isolator as that described in any of claims 1 to 5. In the vibration isolator provided by the invention according to claim 6, the vibration isolation material is attached to the upper edge section side of the vibration isolator body, a large hole through which a socket portion of a power tool for tightening a nut for setting the vibration isolation material can be inserted is formed on the lower edge section of the vibration isolator body, and a hanging bolt jointing the vibrating equipment to the vibration isolator body is inserted through the hole and is arrested to the vibration isolator body. In addition to the effects described above, both the nut used for setting the vibration isolation material to the upper hanging bolt and the nut used for setting the vibration

isolator body to the lower hanging bolt connected to a vibrating equipment can be tightened with a power tool. Because of the features described above, the vibration isolator can solve the problem of the above (2) described in [Background Technology], facilitate the work for setting a hanging type vibration isolator, and reduce the cost required for installation of the vibrating equipments. Furthermore, because a hole provided on the lower edge section is large, a freedom degree for the installation angle against the vertical surface of the hanging bolt suspending a vibrating equipment becomes higher, and even when a distance between a position of an insert and a position at which the vibrating equipment is installed is large, the hanging type vibration isolator can easily be set, thus the vibration isolation effect being achieved.

[0023]

The invention according to claim 7 provides the basically same hanging type vibration isolator as that described in claim 6. In the vibration isolator provided by the invention according to claim 7, the upper edge section of the vibration isolator body and the vibration isolation material are fixed just below the insert buried in a structural frame body into which the hanging bolt is

screwed. Because of the features described above, the vibration isolator provided by the invention according to claim can provide, in addition to the effects described above, the following effect. Namely, at least a hanging bolt screwed into the insert and a vibration isolation material fix to the hanging bolt can be installed in the substantially vertical direction. Therefore, the vibration isolator can solve the problem of the above (3) described in [Background Technology] and achieve the vibration isolation effects without fail.

[Brief Description of the Drawings]

[0024]

Fig. 1 is an explanatory view illustrating the state where the hanging type vibration isolator according to the present invention is used;

Fig. 2 is a front view showing a hanging type vibration isolator according to an embodiment of the present invention;

Fig. 3 is a cross-sectional view showing the hanging type vibration isolator shown in Fig. 2 in the state where the vibration isolator is cut along the vertical surface passing through the center thereof;

Fig. 4 is a front view showing a vibration isolator

body according to the embodiment of the present invention;

Fig. 5 is a front view showing a vibration isolation material in Example 1;

Fig. 6 is a perspective view showing a vibration isolation material in Example 2;

Fig. 7 is a front view showing a rubber cap as a upper elastic material in the embodiment of the present invention;

Fig.8 is a front view showing a rubber boot as a lower elastic material in the embodiment of the prevent invention;

Fig. 9 is an explanatory view illustrating the state where a hanging type vibration isolator according to an embodiment of the present invention is fix when a position of an insert and a position at which a vibrating equipment is installed are displaced from each other;

Fig. 10 is an explanatory view showing step 1 for fixing a hanging type vibration isolator according to an embodiment of the present invention;

Fig. 11 is an explanatory view showing step 2 for fixing the hanging type vibration isolator;

Fig. 12 is an explanatory view showing step 3 for fixing the hanging type vibration isolator; and

Fig. 13 is a view showing another example of the state where piping is hung down with the hanging type vibration isolator according to the embodiment shown in Fig. 1.

[Best Mode for Carrying Out the Invention]

[0025]

A hanging type vibration isolator according to an embodiment of the present invention is described in detail below with reference to the related drawings.

[0026]

<Embodiments of the Present Invention>

A hanging type vibration isolator according to the embodiment is described below with reference to Fig. 1 to Fig. 8.

Fig. 1 is an explanatory view illustrating the state where the hanging type vibration isolator according to the embodiment is used (fix). In Fig. 1, sign AC represents an air conditioner as an example of a vibrating equipment generating vibrations, and reference numeral 1 denotes a vibration isolation hanger as an example of the hanging type vibration isolator according to the embodiment. As shown in Fig. 1, the air conditioner AC is hung down from concrete slab CS with

hanging bolts (each comprising an upper hanging bolt B1 and a lower hanging bolt B2), and the hanging bolts are fixed to the concrete slab CS by being screwed into ceiling inserts TI previously installed on a deck plate DP with a prespecified space (generally 900 mm pitch) before depositing concrete.

[0027]

A vibration isolation hanger 1 is set on this hanging bolt, namely between an upper hanging bolt B1 and a lower hanging bolt B2 and elastically supports the air conditioner AC or piping or the like for the air conditioner AC via a vibration isolation material described hereinafter. Because of the configuration, the vibration isolation hanger can function as a hanging type vibration isolator for preventing propagation of vibrations generated by the air conditioner AC to the concrete slab CS by absorbing mainly the vertical vibration elements. It is to be noted that, because a whole screw bolt with the nominal diameter of 10 is generally used as the hanging bolt, both the upper hanging bolt B1 and the lower hanging bolt B2 shown in Fig. 1 are bolts with the nominal diameter of 10. It is needless to say that also bolts with the nominal diameters of 3/8, 1/2 or other may be used in this

invention.

[0028]

Fig. 2 is a front view showing a vibration isolation hanger, and Fig. 3 is a cross-sectional view showing a cross section of the vibration isolation hanger cut along the vertical surface passing through the center thereof. AS shown in Fig. 2 and Fig. 3, the vibration isolation hanger 1, which is a hanging type vibration isolator according to the embodiment of the present invention, mainly comprises a hanger box 2 which is a body of the vibration isolator supporting a load of the air conditioner AC (Refer to Fig. 1); taper coil spring 3 which is a vibration isolation material set in the hanger box 2 for absorbing vibrations caused by the air conditioner AC; a rubber cap 4 which is a first elastic material mounted between this taper coil spring 3 and the hanger box 2; and a rubber boot 5 which is a second elastic material set between the taper coil spring 3 and the hanging bolt B2.

[0029]

(Main body of vibration isolator)

Fig. 4 is a view showing a component of the vibration isolation hanger 1, namely the hanger box 2 which is an embodiment of the main body of vibration

isolation is shown. As shown in Fig. 3 and Fig. 4, this hanger box 2 comprises a frame body formed by bending a rolled steel sheet for construction work (SS400) into a hollow rectangular form having an upper edge section 21 and a lower edge section 22 and also having a pair of right and left edge sections 23, 24 (namely, a box-like form opened in the front and back sides). This hanger box 2 is used to carry a load of the air conditioner AC (Refer to Fig. 1). In use, the hanging bolt is separated to the upper bolt B1 and the lower bolt B2 (by cutting the edge) and a vibration isolation material described hereinafter is provided between the two bolts B1 and B2, so that the hanger box 2 can elastically support the air conditioner AC. In addition, an entire form of the frame body is slender and compact, so that the vibration isolation hanger 1 can be installed even in a narrow space.

[0030]

A upper hole 21a with a prespecified diameter (the diameter ϕ in the case shown in the figure = 25 mm) is provided on the upper edge section 21 of the hanger box 2, and the upper hanging bolt B1 (a whole screw bolt or a hexagon push-bolt with the nominal diameter of 10) can be inserted through the upper hole 21a with a rubber cap

described hereinafter set inside thereof. On the other hand, a lower hole 22a with a prespecified diameter (the diameter ϕ in the case shown in the figure = 25 mm) is provided on the lower edge section 22, and a socket portion of a power tool for tightening a nut screwed on the upper hanging bolt B1 (Refer to Fig. 10) can be passed through the lower hole 22a.

[0031]

A diameter of each of the through-holes provided on the hanger box 2 (especially the lower hole 22a) is larger than that of the hanging bolt to be set therein, and as shown in Fig. 9, even when a position for installation of a ceiling insert T1 and a position for the air conditioner AC are displaced from each other, the air conditioner AC can be installed with the vibration isolation hanger 1 by installing the lower hanging bolt B2 in the inclined state. Thus, a freedom for installation become higher, and a nut can be tightened with a power tool as described below, so that the time required for installing the vibration isolation hanger and the air conditioner is substantially shorter than that required in the manual work.

[0032]

In the example described above, the hanger box 2

was made from a rolled steel sheet (SS400) generally used for construction work, but the material for the hanger box 2 is not limited to the steel sheet as described above. Any material may be used on the condition that the material has an allowable tensile proof strength sufficient for supporting a quarter of a load to one hanging bolt (in the case where the air conditioner is supported by four hanging bolts).

[0033]

(Vibration isolation material)

Fig. 5 is a front view showing a taper coil spring 3 as a vibration isolation material in Example 1. The vibration isolation material in Example 1 is a taper coil spring made of a steel wire for spring. In the taper coil spring 3, as shown in Fig. 5, a coil diameter of the coil spring becomes gradually smaller to be inscribed in a truncated conical base as it goes farther from the upper edge section 21 of the hanger box 2, namely as it goes downward.

A spring constant of the taper coil spring 3 is set to a range not allowing resonance with the vibrations generated by the air conditioner AC with the frequency of about 20 Hz (for instance, to 14 Hz or below, and preferably to the range from about 3 to 6 Hz).

[0034]

As shown in Fig. 3, this taper coil spring 3 is set under the upper edge section 21 of the hanger box 2 via a rubber cap 4 described hereinafter and is fixed to upper hanging bolt B1 inserted through the upper hole 21a with a bolt screwed onto and with the upper hanging bolt B1. Because of the configuration described above, the taper coil spring 3 can absorb vibrations generated by and propagated from the air conditioner AC (Refer to Fig. 1) via the lower hanging bolt B2 and the hanger box 2 fix to this lower hanging bolt B2, thus the vibration not being propagated to the upper hanging bolt B1. The nut for fixing is a double nut as shown in the figure, which does not loose due to such causes as vibrations.

It is to be noted that a hexagon push-nut may be used as the upper hanging bolt B1 in place of a double nut.

[0035]

Fig. 6 is a perspective view showing a taper rubber spring 3' which is a vibration isolation material used in Exemplified 2. The taper rubber spring 3' used as a vibration isolation material in Example 2 is made of elastic resin (rubber material) such as ethylene propylene diene copolymer rubber (EPDM resin), and has a

truncated conical form in which the diameter becomes gradually smaller as it goes farther from the upper edge section 21 of the hanger box 2, namely as it does downward. A position for and a method of installing the taper rubber spring 3' are the same as those described in Example 1, so that the description is omitted.

[0036]

As described above, each of the vibration isolation materials used in Example 1 and Example 2 has an external form which is a truncated conical one with the diameter becoming gradually smaller as it goes downward, and as shown in Fig. 1. Therefore, even when a position for installing the ceiling insert TI and a position for installing the air conditioner AC are displaced from each other and the lower hanging bolt is forcefully set with an inclined posture and the vibration isolation hanger 1 is fixed in the state where the hanger box 2 is slightly inclined, the taper coil spring 3 and the taper rubber spring 3' each functioning as a vibration isolation material seldom contact with the hanger box 2, thus the vibration isolation effect being achieved without fail.

[0037]

A material for the vibration isolation material is not limited the hard steel wire for spring and the

elastic resin as described above, but if the external form is a truncated conical form and the natural frequency does not resonate with the vibration generated by the air conditioner AC having the frequency of about 20 Hz, it can be used. However, a coil spring form like the taper coil spring 3 in Example 1 is more preferable, because air layers are present above and under the taper coil spring 3 and more effective for attenuating vertical vibrations and preventing propagation of vertical vibrations from the air conditioner AC as compared to a solid and dense vibration isolation material like the taper rubber spring 3' in Example 2 which solid materials such as rubber ones are connected to each other in the vertical direction.

[0038]

(First elastic material)

Fig. 7 is a front view showing a rubber cap 4 as an example of a first elastic material. This rubber cap 4 is made of elastic resin (rubber material) such as ethylene propylene diene copolymer rubber (EPDM resin). As shown in Fig. 7 and Fig. 3, a hooking groove 4b is formed in an upper section 4a thereof, and the lower section 4c has a bag-like (cap-like) form for covering the upper portion of the taper coil spring 3.

[0039]

The rubber cap 4 is fixed between the upper hanging bolt B1 and the hanger box 2 in the state where the hooking groove 4b in the upper section 4a is set inside the upper hole 21a of the hanger box 2 and the upper portion of the taper coil spring 3 is accommodated in a cap-like portion of the lower section 4c. Therefore, the rubber cap 4 can reduce vibrations propagated to the upper hanging bolt B1.

Furthermore, the rubber cap 4 covers the upper portion of the taper coil spring 3, so that can also function to prevent positional displacement of the upper portion of the taper coil spring 3 in the horizontal direction.

[0040]

(Second elastic material)

Fig. 8 is a front view showing a rubber boot 5 as an example of the second elastic material. This rubber boot 5 is made of elastic resin such as ethylene propylene diene copolymer rubber (EPDM resin), and has a reversed truncated conical form with the external diameter of 32 mm at the top portion and the external diameter of 25 mm at the bottom portion as shown in Fig. 8 and Fig. 3. The top is open and has a bag-like (or

boot-like) form for covering the entire taper coil spring 3. Furthermore, the rubber boot 5 has a bellows section 5b from a position below a space 5a for fixing up into the rubber cap 4 to the bottom surface, and the bellows section 5b can extend or shrink according to extension and shrinkage of the taper coil spring 3. A flat washer 5d is fit up with the bottom section 5c of the rubber boot 5 for preventing abrasion caused by contact with metallic parts such as a nut during the sliding motion.

This flat washer 5d has a diameter of 20 mm and a thickness of 2 mm, and also has a hole with the diameter of 10.5 mm through which a whole screw bolt (the hanging bolt B2) with the nominal diameter of 10 can be inserted.

[0041]

This rubber boot 5 accommodates the taper coil spring 3 described above and is fixed into inside of the lower portion 4c of the rubber cap 4, and is fixed to a bottom edge of the upper hanging bolt described above with a nut. Because of the structure as described above, the rubber boot 5 can reduce propagation of vibrations to the upper bolt 1, when set between the upper bolt 1 and the taper coil spring 3, without impeding extension and shrinkage of the taper coil spring 3.

Furthermore, the rubber boot 5 covers the entire

taper coil spring 3 from the outside. Therefore, there is no possibility that a finger of an installation worker is held between spiral coils of the spring, which also contributes to improved safety for the worker.

[0042]

The relative positional relation between the rubber cap 4 and the rubber boot 5 may be reversed in terms of up and down or inside and outside. The structure is not limited to the one described above in which the rubber boot 5 covers the entire taper coil spring 3 from the outside, and also the structure is also allowable in which the rubber cap and the rubber boot cover a half of the taper coil spring 3 respectively.

In brief, the elastic material is not limited to rubber, and any material may be used as the elastic material on the condition that either one or both of the first and second elastic materials cover the entire or a portion of the vibration isolation material, do not impede extension and shrinkage of the vibration isolation material, and have the durability against repetition of extension and shrinkage.

[0043]

<Procedure for fixing the vibration isolation hanger>

Next, the procedure for fixing a vibration

isolation hanger is described with reference to Fig. 10 to Fig. 12.

<Step 1>

At first, a hexagon push-bolt or a whole screw bolt with a double nut previously screwed thereon and cut into a necessary length is inserted into the ceiling insert TI provided in the buried state in concrete slab which is a structural frame body with a power tool (such as, for example, power nut driver) and a socket for setting the vibration isolation hanger 1. In this step, it is better to use a short bolt as the upper bolt B1 to be fixed therein. When the short upper hanging bolt B1 is used, even if a position of the ceiling insert TI buried in the concrete slab and a position for installation of the air conditioner AC are displaced from each other, the positional displacement can be accommodated by placing the vibration isolation material just below the ceiling insert TI and setting the lower hanging bolt and a portion lower from the lower hanging bolt in the inclined state. Therefore, it is possible to install the vibration isolation materials so that the direction in which the vibration isolation materials extend and shrink will become closer as much as possible to the vertical direction. Because of the feature, it is possible to

efficiently prevent propagation of harmful vertical vibrations to the structural frame body and to achieve the vibration isolation effect without fail.

[0044]

The lower hole 22a provided on the lower edge section 22 of the hanger box 2 has the size allowing insertion of a socket of a power tool used for tightening a nut (or a head portion of a hexagon push-bolt) screwed onto the upper hanging bolt B1, so that the vibration isolation hanger 1 can easily be fixed to the upper hanging bolt B1 by using a power tool within a short period of time. Because of the feature, it is possible to substantially shorten the time required for an installation work.

[0045]

(Step 2)

Then, as shown in Fig. 11, the lower hanging bolt B2 comprising a whole screw bolt is inserted into the lower hole 22a of the hanger box 2, and washers having a prespecified diameter larger than an inner diameter of the lower edge section 22 are set on a top surface and a bottom surface of the lower edge section 22 of the hanger box 2, and the nut is tightened for fixing the lower hanging bolt B2 to the vibration isolation hanger 1. Also

in this step, because there is no obstacle under the lower hanging bolt B2, a nut can be tightened with a power tool, which makes it possible to shorten the time required for installation.

[0046]

(Step 3)

Finally, as shown in Fig. 12, a bracket of the air conditioner AC is fixed to the lower edge portion of the lower hanging bolt B2 with a nut screwed onto the lower hanging bolt B2, thus the work for installing the air conditioner AC via the vibration isolation hanger 1 in the state where the air conditioner is hung down from the concrete slave as a structural frame body being completed. Also in this step, the nut can be tightened with a power tool, so that it is possible not only to shorten the time required for the installation work, but also to easily adjust a horizontal level of the air conditioner AC.

[0047]

<Operation advantage of the vibration isolation hanger>

With the vibration isolation hanger 1 as a hanging type vibration isolator according to the embodiment of the present invention described above, because an external form of the vibration isolation material (the taper coil spring 3 or the taper rubber spring 3') is an

inverted truncated conical one, even if a position of the ceiling insert TI and a position at which the air conditioner AC is to be installed are displaced from each other, the hanger box 2 and the vibration isolation material seldom contact each other, thus the vibration isolation effect being achieved without fail.

[0048]

Furthermore, because the rubber boot 5 covers the entire taper coil spring 3, a worker's finger or a tool is never held between coils by accident during the work for installing the taper coil spring 3 and a nut is tightened thereon. Therefore, the possibility for a worker to get injured insures the improved safety. In addition, a position of the ceiling insert TI and a position for installation of the air conditioner AC are substantially large. Therefore, even when it is necessary to install the vibration isolation hanger 1 by extremely inclining the lower hanging bolt B2, because the taper coil spring 3 is covered with the rubber boot 5, the hanger box 2 and the taper coil spring 3 never directly contact each other, so that vibrations propagated from the hanger box 2 via the taper coil spring 3 to the lower hanging bolt are reduced by the rubber boot 5, thus the vibration isolation effect being impeded little.

[0049]

Furthermore, both the nut used for fixing the vibration isolation material to the upper bolt B1 and the nut used for fixing the hanger box 2 to the lower hanging bolt B2 can be tightened with a power tool. Therefore, manual works for installation are reduced, and a work load for fixing the vibration isolation hanger 1 can be reduced. Also the cost for installation can be reduced. In addition, because the lower hole 22a is large, a freedom degree in an installation angle for the lower hanging bolt B2 jointed to the air conditioner AC becomes larger. Therefore, even when a distance between a position at which the ceiling insert TI is buried and a position at which the air conditioner AC is to be installed is large, the vibration isolation hanger 1 can easily be installed with the vibration isolation effect achieved without fail.

[0050]

The hanging type vibration isolator according to an embodiment of the present invention was described above assuming the case where the vibration isolation hanger 1 is used as the vibration isolator. Even if the vibration isolation hanger 1 is installed with a posture inverted from that shown in the figures, the vibration isolation

effect can be achieved. However, when the vibration isolation hanger 1 is installed with an inverted posture, if a position of the ceiling insert TI and a position for installation of the air conditioner AC are displaced from each other, it is required to set, in the inclined state, the lower hanging bolt B2 with the taper coil spring 3 as a vibration isolation material fix thereto, which may impede the effects for reducing vertical vibrations.

In the case described above, the vibrating equipment is the air conditioner AC, but this invention is also applicable to other types of vibrating equipments and equipment such as the piping as shown in Fig. 13.

[0051]

Also it is to be noted that forms and structures of the components and members of the hanging type vibration isolator according to the embodiment of the present invention as shown in the figures are only illustrative, and it is needless to say that the forms and structures can be changed within the scope of the present invention as described in the claims below. Although concrete slab deposited on a deck plate of a steel-made building is described in the case above, but the present invention is also applicable to floor concrete slab in a reinforced concrete building, iron braces and beams in a steel-made

building, and rafters and diagonal bracings for a ceiling, so long as the frame body can support a vibrating equipment in the suspended state.

The bellows section 5b of the rubber boot 5 shown in the figures has a roundish external form, but also a more simple form having a linearly staggered cross section is allowable.

[Description of Signs]

[0052]

- 1: Vibration isolation hanger (hanging type vibration isolator)
- 2: Hanger box (vibration isolator body)
- 3: Taper coil spring (vibration isolation material)
- 3': Taper rubber spring (vibration isolation material)
- 4: Rubber cap (first elastic material)
- 5: Rubber boot (second elastic material)
- AC: Air conditioner (vibrating equipment)
- B1: Upper hanging bolt (hanging bolt)
- B2: Lower hanging bolt (hanging bolt)
- CS: Concrete slab (structural frame body)
- TI: Ceiling insert (insert)
- DP: Deck plate

CLAIMS

WHAT IS CLAIMED IS:

1. A hanging type vibration isolator for preventing vibrations generated by a vibrating equipment or equipment comprising a body having an upper edge section and a lower edge section and set on a hanging bolt for hanging down an vibrating equipment generating vibrations to carry a load of the vibrating equipment; a vibration isolation material provided between the upper edge section and the lower edge section of the body of the vibration isolator and capable of absorbing vibrations generated by the vibrating equipment; and two elastic materials, namely upper and lower elastic materials provided between the vibration isolation material and the vibration isolator body and between the vibration isolation material and the hanging bolt respectively,

wherein the vibration isolation material has an external form of a reversed truncated conical one in which a diameter becomes smaller as it goes farther from the upper edge section of the vibration isolator body and goes downward.

2. The hanging type vibration isolator according to claim 1, wherein the vibration isolator body comprises a hollow and rectangular frame body having the upper edge section and lower edge section as well as a pair of left and right side edge sections.

3. The hanging type vibration isolator according to

claim 1 or claim 2, wherein the vibration isolation material is a coil spring in which a coil diameter becomes smaller as it goes farther from the upper edge section of the vibration isolator body and goes downward.

4. The hanging type vibration isolator according to claim 3, wherein the two elastic materials have a bag-like (cap-like) form and either one or both of the two elastic materials cover the entire or a portion of the coil spring.

5. The hanging type vibration isolator according to claim 4, wherein the two elastic materials are a rubber cap set on the upper edge section of the vibration isolator body and covering an upper portion of the coil spring for restricting displacement of the coil spring in the horizontal direction and a rubber boot set at a bottom edge of the vibration isolation material and covering the entire vibration isolation material from the outside.

6. The hanging type vibration isolator according to claim 1, wherein the vibration isolation material is fixed to the upper edge section side of the vibration isolator body;

a hole having a size allowing insertion of a socket portion of a power tool used for tightening a nut for fixing the vibration isolation material is formed on the lower edge section of the vibration isolator body; and

a hanging bolt for jointing the vibrating equipment to the vibration isolator body is passed through this hole and is fixed to the vibration isolator body.

7. The hanging type vibration isolator according to claim 6, wherein the upper edge section of the vibration isolator body and the vibration isolation material are fixed just below an insert buried in a structural frame body into which the hanging bolt is screwed.