

A VIBRATION INHIBITING ASSEMBLY

5 FIELD OF INVENTION

The present invention relates to a vibration inhibiting assembly.

DESCRIPTION OF THE PRIOR ART

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A vibration isolating system is designed reduce or remove the adverse effect of oscillations generated by machinery with oscillating parts (engines, compressors), or forces of nature (earthquake, wind and gust) on the object being isolated. Vibration isolation systems can be generally categorised into active systems or passive systems. Active systems rely on sensors and actuators to generate an opposite force to that generated by the source in an attempt to null the vibrations being experienced by the equipment being isolated. Passive systems, on the other hand, depend on the ability of the isolators to dissipate the kinetic energy of the vibrations by converting it to heat through internal friction or movement.

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Vibration isolators are used in many applications ranging from car engine mounts (these are usually passive, use to isolate vibrations from the cabin) to giant isolators found at the base of tall buildings (these are sometimes active, to prevent excessive damage to the structure during an earthquake).

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Another example of prior art vibration isolation is in the mounting of a printed circuit boards (PCB). The need arises in some applications where vibration or shock may otherwise degrade the performance of electronic components on the PCB. For example delicate electronic equipment installed in an aircraft must be isolated from the vibration or shock caused by the engine or airflow around the external surface of the fuselage or wings.

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Prior art vibration isolators for light loads such as a PCB may involve a spring or a damping material, most commonly in a membrane configuration. Due to the need for durability, the membrane of the prior art isolator must to be of a certain thickness as thin membranes are prone to tearing. As a result of this limitation, the minimum isolated mass

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that prior art isolators will be effective for, is around 150g. Prior art membrane isolators are not effective for masses less than 150g because the stiffness of the membrane will excessively retard the necessary movement, such that an inadequate level of energy is dissipated for effective isolation. Typically prior art membrane isolators have a stiffness or spring rate (k) of 9 N/mm or above.

Prior art membrane isolators typically cannot be customised to support multiple loads or loads of different masses. It has therefore proven difficult to mass-produce a single durable isolator that can be customised for various configurations.

A need therefore exists to address at least one of the above problems.

SUMMARY

According to a first aspect of the invention there is provided an assembly including:
a body;

an object having a mass of less than 150 grams supported on the body; and

at least one cantilever mounting(s) securing the object to the body so as to inhibit the transmission of vibration and/or shock from the body to the object by resilient deformation of said mountings, and

wherein each of said mountings has a first portion attached to the object and a second portion attached to the body, said first portion being spaced and extending in a cantilever manner from said second portion so as to be movable relative to the body.

Said mounting may have a spring rate (k) of less than 9N/mm so as to resiliently deform to inhibit transmission of vibration to the object.

The body may be an aircraft and the object may be a printed circuit board.

The body may be an Unmanned Aerial Vehicle (UAV) or drone.

The assembly may further comprise:

a base including said second portion,
an arm including said first portion extending from said base in a cantilevered manner, said arm having a longitudinal axis, and
wherein said arm adapted to resiliently deform by bending about a perpendicular axis, said perpendicular axis being perpendicular to said longitudinal axis of said arm.

Said arm may include at least a portion being square or rectangular in transverse cross section with respect to said longitudinal axis of said arm.

Said base may have a longitudinal axis, and said base may be square or rectangular in transverse cross section with respect to said longitudinal axis of said base.

Said longitudinal axis of said arm may be perpendicular to said longitudinal axis of said base.

Said arm and said base may form an "L" configuration.

The assembly may alternatively further comprise
a second arm extending from said base in a cantilevered manner, said second arm having a longitudinal axis coaxial and opposite with said longitudinal axis of said arm, wherein said arm, said second arm and said base form a "T" configuration.

The assembly may alternatively further comprise
a second arm extending from said base in a cantilevered manner, said second arm having a longitudinal axis spaced and parallel with said longitudinal axis of said arm, wherein said arm, said second arm and said base form an "F" configuration.

Said arm may be integrally formed with said base.

BRIEF DESCRIPTION OF THE DRAWINGS

Example embodiments of the invention will be better understood and readily apparent to one of ordinary skill in the art from the following written description, by way of example only, and in conjunction with the drawings, in which:

Figure 1 shows an isometric view of a drone aircraft.

Figure 2 shows a side view of the drone aircraft.

5 Figure 3 shows a PCB mounted onto the arms of four cantilever isolators.

Figure 4 shows a hidden detail side view of the PCB mounted onto the cantilever isolator.

10 Figure 5 shows the PCBs mounted onto a T-shaped cantilever isolator.

Figure 6 shows the PCBs mounted onto a multi-layer cantilever isolator.

15 Figure 7 shows the PCBs mounted onto a variable length cantilever isolator.

DETAILED DESCRIPTION

20 Figures 1 shows an aircraft 1 including an engine 2 mounted on the upper portion of the aircraft 1. In Figure 2 avionics or electrical components, such as a printed circuit board (PCB) 5, are mounted internally to the body 6 of the aircraft 1. The printed circuit board 5 may be used for control and/or monitoring of the aircraft 1. The aircraft may be an Unmanned Aerial Vehicle (UAV) or drone.

25 Figure 3 shows the printed circuit board according to an example embodiment. Each corner 11 of the printed circuit board is secured via a mounting 3 to the body 6 of the aircraft 1. Each mounting 3 will therefore support a portion of the mass of the printed circuit board 5. The printed circuit board 5 is spaced from the body 6 such that each mounting may resiliently deform or bend to inhibit transmission of vibration. One skilled in the art will appreciate the mounting 3 may be used in a range of applications, such as
30 other aircraft, sea going vessels and land based vehicles and is not intended to be limited to the examples described herein.

In Figure 4, the mounting 3 according to the example embodiment is more fully depicted. As can be seen the mounting 3 attaches the printed circuit board 5 to the body

6 of the aircraft 1. The mounting 3 is formed of a resilient plastics or rubber type material that may also have high damping characteristics. The mounting 3 is of an "L" configuration so as to have a base 7 and an arm 8, the arm 8 being integrally formed with the base 7. The base 7 is fixed to the body 6 by means of a fastener 9 fixed in an aperture 10 of the base 7, and anchored in the body 6.

The arm 8 has a first portion 11 fixed to the base 7, and a second portion 12 that supports the printed circuited board 5. The portions 11 and 12 are spaced so that the arm 8 extends from the base 11 in a cantilever manner to support the printed circuit board 5.

At the portion 12 there is attached to the arm 8 a fastener 13 that engages within an aperture 14 of the printed circuit board 5 to secure the printed circuit board 5 to the mounting 3.

During operation of the engine 2, the body 6 vibrates. The transmission of vibration from the body 6 to the board 5 is attenuated by each of the mountings 3. More particularly each mounting 3 will resiliently deform and more particularly the arm 8 thereof will resiliently deform by bending about a perpendicular axis, the perpendicular axis being perpendicular to the longitudinal axis 15 of the arm 8.

Preferably, the portion 12 of the arm 8 is square or rectangular in transverse cross section while the base 7 adjacent the body 6 is also square or rectangular in transverse cross section relative to the longitudinal axis 16 of the base 7.

The length and cross sectional dimensions of the arm 8 are chosen according to the weight and/or attenuation requirements of the printed circuit board 5. For example in order to attenuate the vibration, the natural frequency (F_n) of the combination of the mountings and printed circuit board may be sufficiently lower than the disturbing frequency (F_d). The disturbing frequency is the number of oscillations per unit time of an external force or displacement applied to a vibrating system. The natural frequency is defined by the following formula:

$$F_n = (1/2\pi) (k/M)^{1/2} \quad (1)$$

where M is the mass of the item to be isolated, and

k is the stiffness or spring rate of the mounting, and is defined by the following formula:

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$$k = 3EI / L^3 \quad (2)$$

where E is the Young's modulus,

I is the area of moment of inertia, and

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L is the length of the arm.

Therefore the length of the arm 8 should be longer for lower mass loads. While the mass of a printed circuit board may be less than 150 grams, appropriate dimensions of the arm 8 may be selected to support loads of any given mass. The number, configuration and orientation of mountings may be varied depending on the load requirements.

Typically the printed circuit board 5 will have a mass of less than 150 grams, with each mounting 3 having a stiffness or spring rate (k) of less than 9N/mm. In an example embodiment a typical PCB having a mass upwards of 10g may be effectively isolated by configuring each isolator with a stiffness or spring rate (k) of 1N/mm.

Figure 5 shows an alternative embodiment of the mounting 500. The mounting 500 secures 2 PCBs simultaneously to the body 6. The mounting is in a "T" configuration, having a base 510, and two arms 506, 508 integrally formed with the base 510. The base 510 is anchored 512 to the body 6.

The first arm 506 and the second arm 508 extend oppositely from the base 510 in a cantilever manner to form the T configuration. The attachment of each arm to the first printed circuit board 502 and the second printed circuit board 504 and their operation are similar to the manner previously described. In operation a printed circuit board may be mounted at more than one orientation and/or attenuation of vibrations or shock for multiple printed circuit boards is possible, with a reduced number of mountings.

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Figure 6 shows a further alternative embodiment of the mounting 600. Again the mounting 600 secures 2 printed circuit boards 602,604 simultaneously to the body 6. The mounting is in a "F" configuration, or multilayered, so as to have a base 610, and two arms 606,608 integrally formed with the base 610. The base 610 is anchored 612 to the body 6.

The first arm 606 is above and vertically spaced from the second arm 608, both extending from the base 610 in a cantilever manner to support a respective printed circuit board 602,604. The spacing is sufficient for the mounting of the second printed circuit board 604 and movement due to vibration or shock. In operation more than one PCB can be mounted on a single isolator in a multi layer configuration.

Figure 7 shows a still further alternative embodiment of the mounting 700. The mounting 700 includes a base 710 and an integrally formed arm 706 extending from the base 710 in a cantilever manner. The base 710 is anchored 712 to the body 6.

The arm 706 may include a 2 or more attachment points 704,708 for the printed circuit board 702 spaced at different lengths. A shorter attachment 708 can be used for a higher mass printed circuit board, and a longer attachment 704 for lower mass printed circuit board. In operation variable/unknown mass printed circuit boards can be mounted using a single configuration mounting.

One or more embodiments allow lightweight components to be effectively isolated from vibration and shock and/or all mass production of a lightweight durable isolator that can be customised for various configurations.

It will be appreciated by a person skilled in the art that numerous variations and/or modifications may be made to the present invention as shown in the example embodiments without departing from the spirit or scope of the invention as broadly described. The example embodiments are, therefore, to be considered in all respects to be illustrative and not restrictive.

CLAIMS:

1. An assembly including:
 - a body;
 - an object having a mass of less than 150 grams supported on the body; and
 - at least one of cantilever mounting(s) securing the object to the body so as to inhibit the transmission of vibration and/or shock from the body to the object by resilient deformation of said mountings, andwherein each of said mountings has a first portion attached to the object and a second portion attached to the body, said first portion being spaced and extending in a cantilever manner from said second portion so as to be movable relative to the body.
2. The assembly as claimed in claim 1 wherein said mounting having a spring rate (k) of less than 9N/mm so as to resiliently deform to inhibit transmission of vibration to the object.
3. The assembly as claimed in claim 1 or 2 wherein the body is an aircraft and the object is a printed circuit board.
4. The assembly as claimed in claim 3 wherein said body is an Unmanned Aerial Vehicle (UAV) or drone.
5. The assembly as claimed in any of claims 1 to 4 further comprising:
 - a base including said second portion,
 - an arm including said first portion extending from said base in a cantilevered manner, said arm having a longitudinal axis, andwherein said arm adapted to resiliently deform by bending about a perpendicular axis, said perpendicular axis being perpendicular to said longitudinal axis of said arm.

6. The assembly as claimed in claim 5 wherein said arm including at least a portion being square or rectangular in transverse cross section with respect to said longitudinal axis of said arm.

7. The assembly as claimed in claim 6 wherein said base having a longitudinal axis, and said base being square or rectangular in transverse cross section with respect to said longitudinal axis of said base.

8. The assembly as claimed in claim 7 wherein said longitudinal axis of said arm is perpendicular to said longitudinal axis of said base.

9. The assembly as claimed in claim 8 wherein said arm and said base form an "L" configuration.

10. The assembly as claimed in claim 8 further comprising
a second arm extending from said base in a cantilevered manner, said second arm having a longitudinal axis coaxial and opposite with said longitudinal axis of said arm,
wherein said arm, said second arm and said base form a "T" configuration.

11. The assembly as claimed in claim 8 further comprising
a second arm extending from said base in a cantilevered manner, said second arm having a longitudinal axis spaced and parallel with said longitudinal axis of said arm,
wherein said arm, said second arm and said base form an "F" configuration.

12. The assembly as claimed in any of claims 5 to 11 wherein said arm is integrally formed with said base.