

Vibration Isolation Module

BACKGROUND OF THE INVENTION

This invention relates to the construction of Vibration Isolation Modules (VIM's) which are typically used either side of an acoustic aperture of a towed acoustic array to minimise performance degradation due to transmitted mechanical vibrations.

Conventional towed arrays have consisted of a towing cable (negatively buoyant to achieve suppression to the required depth), a forward Vibration Isolation Modules (to minimise the transmission of mechanical vibration from the tow cable to the acoustic array), an array of acoustic (and non-acoustic) sensors, an aft VIM (to minimise transmission of vibration from the "flapping tail" forward to the acoustic array). To perform the required vibration isolation functions, the VIMS, like the suspension of a motor vehicle must not only provide elastic isolation (the spring function) but must also dissipate the produced vibrational energy (the damping function).

In the past, VIM's have been constructed that have provided adequate elasticity, albeit for a limited range of tow loads and limited damping; their effectiveness has been limited, and restricted to a narrow range of operating conditions.

BRIEF SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a Vibration Isolation Module (VIM) which will overcome or at least reduce the limitations of current art.

Accordingly, the invention provides a Vibration Isolation Module (VIM) comprising:

- a. spring means for providing vibration isolation
- b. visco-elastic damping means for attenuating low frequency vibrations, and
- c. viscous damping means for attenuating high frequency vibrations.

In a preferred embodiment of the present invention there is provided a Vibration Isolation Module of the type suitable for incorporating into a towed acoustic streamer, comprising:

- a fluid-tight enclosure;
- a plurality of masses linked by elastic members for dividing the enclosure into a number of separated sub-enclosures;
- a plurality of 'dash-pot' type dampers linking the separate sub-enclosures;

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a central core of viscoelastic damping material;
 a plurality of open cell foam spacers filling voids in the
 separate sub-enclosures; and
 a low density, high viscosity fluid filling the enclosure.

5 In the above embodiment the three identified performance aspects:
 spring-mass isolation, viscous damping and viscoelastic damping, are
 all provided.

Preferably, the fluid-tight enclosure is provided by a jacket and
 associated end caps. The masses are preferably cylindrical and are
 10 preferably linked by snubbed elastic members. In a preferred
 embodiment, power and data cables run spirally within the jacket.

Thus, the measures here proposed increase both the elastic
 isolation and the damping, and significantly extend the operating range
 of both tow speeds and vibrational frequency over which the VIM will
 15 provide effective operation.

BRIEF DESCRIPTION OF THE DRAWINGS

Two embodiments of the invention will be described more fully, by
 way of example, with reference to the drawings, of which

Figure 1 schematically illustrates the 'classical' implementation
 20 of the three aspects of the invention, by way of a longitudinal section
 through the module, and

Figure 2 schematically illustrates a preferred embodiment, by way
 of a longitudinal section through the module, whereby the 'classical'
 viscous damping measure is replaced by a more cost effective solution.

25 DETAILED DESCRIPTION

As shown in Figure 1, one aspect of the preferred embodiment
 involves the provision of cylindrical masses 1 attached at regular
 spacing to a central core of viscoelastic damping material 2, which may
 be extruded over a snubbed elastic strength member 3. Further snubbed
 30 elastic strength members 4 may be attached around the outer diameter of
 the masses 1. Viscous 'dash-pot' type dampers 5 are installed within
 the masses 1. The space between the masses is filled with open cell
 plastic foam 6, around which is wrapped a layer of power and data
 cables 7. A jacket of damped thermoplastic 8 is extruded over this
 35 cable layer 7 and caps 9 containing a fluid filling valve 10 are
 attached at each end of the module, and the interior void is filled
 with a low density, high viscosity fluid 11.



In the repetitive cyclic extension, the multiple spring mass system as obtained provides vibration isolation, the cyclic distortion of the viscoelastic core provides low frequency damping, and the repetitive transfer of fill fluid through the 'dash-pot' orifices
5 provides the high frequency damping.

In an alternative preferred embodiment, is shown in Figure 2, the general arrangement is as before, except that the dash-pot dampers (item 5 of Figure 1) are removed. In their place is a braided flexible, open-weave stocking 12 surrounds the open cell foam spacers
10 6, and is damped to the central core 2 by the masses 1. Under repetitive cyclic extension the braided stocking 12 pulls down, compressing the foam spacers and forcing fluid out through the foam pores. This action simulates that of the classic dashpot damper of the first embodiment, and hence provides the required visco damping: it is
15 however, a much more cost-effective implementation.

The foregoing describes only some aspects of an embodiment of the present invention, and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

Claims

1. A Vibration Isolation Module (VIM) comprising:
 - a) spring means for providing vibration isolation
 - b) visco-elastic damping means for attenuating low frequency
5 vibrations, and
 - c) viscous damping means for attenuating high frequency vibrations.
2. A Vibration Isolation Module (VIM) for incorporating into a towed acoustic streamer, comprising:
 - 10 a fluid-tight enclosure;
 - a plurality of masses linked by elastic members for dividing the enclosure into a number of separated sub-enclosures;
 - a plurality of 'dash-pot' type dampers linking the separate sub-enclosures;
 - 15 a central core of viscoelastic damping material;
 - a plurality of open cell foam spacers filling voids in the separate sub-enclosures; and
 - a low density, high viscosity fluid filling the enclosure.
3. A Vibration Isolation Module according to claim 2, wherein
20 the fluid-tight enclosure is provided by a jacket and associated end caps.
4. A Vibration Isolation Module according to either claim 2 or claim 3, wherein the masses are cylindrical.
5. A Vibration Isolation Module according to any one of claims
25 2 to 4, wherein the masses are linked by snubbed elastic members.
6. A Vibration Isolation Module according to any one of claims 2 to 5, wherein power and data cables run spirally within the jacket.

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