

ACCELEROMETER

TECHNOLOGICAL FIELD

The presently disclosed subject matter relates to sensing instruments, in particular to accelerometers.

5 BACKGROUND

Devices for sensing accelerations are well known and have many uses.

One class of such devices, referred to herein as accelerometers, includes a proof mass mounted to a support by flexures via a support ring, and further includes capacitors. The proof mass is displaced from a datum position by an acceleration applied to the device
10 along its sensing axis, and the resulting differential capacitance is sensed by a feedback circuit which in turn generates a current that can be applied to force balancing coils to return the proof mass to the datum position. The acceleration can thus be related to the magnitude of this current.

The support ring is clamped in position in the device, which can lead to thermal
15 strains as well as mounting strains being coupled to the flexures, which in turn can lead to bias sensitivity to temperature and to mounting, respectively, which can cause bias error and thus degrade the sensitivity and performance of the device.

By way of general background, the following publications disclose various accelerator configurations: US 3,702,073, US 4,250,757, US 4,498,342, US 4,932,258,
20 US 5,111,694, US 5,182,949, US 5,287,744, and US 5,763,779.

GENERAL DESCRIPTION

According to a first aspect of the present presently disclosed subject matter there is provided an accelerometer for sensing acceleration along a sensing axis, comprising:
25 a flexure member, comprising a pendulum member pivotably connected to a support member via a hinge arrangement;

a housing;

at least one mounting structure, for example a plurality of mounting structures, configured for clamping the support member to the housing in load bearing contact while concurrently allowing for differential movement
5 between the support member and the housing, for example in a direction orthogonal to said sensing axis.

In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the
10 mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples, at least one said mounting structure comprises an
15 elongate mounting post, anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction non-parallel to said sensing axis to permit at least a portion of said differential movement between the support member
20 and the housing.

In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end
25 and said second longitudinal end in at least one direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to the housing and
30 anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end

and said second longitudinal end in at least one direction non-parallel to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples, at least one said mounting structure comprises an
5 elongate mounting post, anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction orthogonal to said sensing axis to permit at least a portion of said differential movement between the support member
10 and the housing.

In at least some examples, said mounting post is cantilevered from said housing at said first longitudinal end and removably affixed to said support member at said second longitudinal end. Optionally, said mounting post is integrally formed with or fixedly mounted to said housing. Additionally or alternatively, said mounting post is
15 accommodated within a well formed in said housing, and wherein said second longitudinal end projects outwardly from a mouth of said well.

In at least some examples, said mounting post is removably affixed to said housing at said first longitudinal end and cantilevered from said support member at said second longitudinal end. Optionally, said mounting post is integrally formed with or fixedly
20 mounted to said support member. Additionally or alternatively, said mounting post is accommodated within a well formed in said housing, and wherein said first longitudinal end is removably affixed to a base of said well.

In at least some examples optionally including at least one of the above examples, said mounting post is formed as a solid beam element having a cross-section that is
25 uniform or varies along the longitudinal axis of the beam element. By way of non-limiting example, said cross-section is circular, or oval, or square or rectangular or other polygonal. Additionally or alternatively, and by way of non-limiting example, a ratio of a length of said mounting post or of said beam element to a width of said mounting post or of said beam element in the range about 0.3 to about 10, more preferably in the range
30 about 1 to about 5, and more preferably about 3.

. Additionally or alternatively, and by way of non-limiting example, said mounting post or said beam element is spaced from said well by a spacing that is within about 10% and 20% of a width of said mounting post or said beam element.

In at least some examples optionally including at least one of the above examples,
5 said mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in a plurality of directions orthogonal to said sensing axis.

In at least some examples optionally including at least one of the above examples, said mounting post is configured for preferentially allowing displacement between said
10 first longitudinal end and said second longitudinal end in a first direction orthogonal to said sensing axis while providing relative resistance to such displacement along a second direction orthogonal to said sensing axis as compared with said first direction.

In at least some examples optionally including at least one of the above examples, said housing comprising two housing members configured for accommodating
15 therebetween said flexure member. By way of non-limiting example, the accelerometer comprises at least three said mounting structures associated with each said housing member. For example, each said mounting structure associated with one said housing member is in longitudinally opposed relationship with a corresponding said mounting structure associated with the other said housing member. Additionally or alternatively,
20 said pendulum member pivotably connected to said support member via a hinge arrangement, and wherein said mounting structures are located with respect to said flexure member at positions of 90°, 180° and 270° about a center axis thereof, the 0° position being associated with said hinge arrangement.

In at least some examples optionally including at least one of the above examples,
25 said mounting structures are configured for isolating said pendulum member from strain effects arising from said differential movement.

In at least some examples optionally including at least one of the above examples, said flexure member and said housing comprise different thermal properties one from the other at least along directions orthogonal to said sensing axis.

In at least some examples optionally including at least one of the above examples, said flexure member and said housing are made from materials having different coefficients of thermal expansion one from the other at least along directions orthogonal to said sensing axis.

- 5 In at least some examples optionally including at least one of the above examples, said flexure member is made from a non-metallic material and said housing is made from a metallic material.

In at least some examples optionally including at least one of the above examples, said flexure member is made from any suitable material, including, for example, at least
10 one of the following: any suitable metallic material or metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable ceramics; any suitable non-metallic material.

In at least some examples optionally including at least one of the above examples, said housing is made from any suitable material, including, for example, at least one of
15 the following: any suitable metallic material or metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable ceramics; any suitable non-metallic material.

In at least some examples optionally including at least one of the above examples, said mounting structure is at least one of deformable bendable and shearable for allowing
20 said differential movement between the support member and the housing.

In at least some examples optionally including at least one of the above examples, said mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in a direction orthogonal to said sensing axis by any one of bending, deforming or shearing of the mounting post with respect to a
25 longitudinal axis of the mounting post.

In at least some examples optionally including at least one of the above examples, said mounting structure is slidable for allowing said differential movement between the support member and the housing.

In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to a first one of said housing and said support member, and having a second longitudinal end thereof configured for sliding displacement with respect to a second one of said housing and said
5 support member, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and said second one of said housing and said support member in a direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples, at least one said mounting structure comprises an
10 elongate mounting post, anchored at a first longitudinal end thereof to a first one of said housing and said support member, and having a second longitudinal end thereof configured for sliding displacement with respect to a second one of said housing and said support member, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and said second one of said housing
15 and said support member in a direction non-parallel to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to a first one of said housing and said support member, and having a second longitudinal end thereof
20 configured for sliding displacement with respect to a second one of said housing and said support member, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and said second one of said housing and said support member in a direction orthogonal to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

25 In at least some examples optionally including at least one of the above examples, the accelerometer further comprises a force sensing system configured for sensing movement of the pendulum member from a datum position in response to an acceleration or force applied to accelerometer along said sensing axis and for generating an output that is a measure of said acceleration or force.

30 In at least some examples optionally including at least one of the above examples, the accelerometer further comprises a force sensing system configured for sensing

movement of the pendulum member from a datum position in response to an acceleration or force applied to accelerometer parallel to said sensing axis, for generating a restoring or balancing force to the pendulum member to return the pendulum member to the datum position, and for generating an output that is indicative of the restoring force, which in
5 turn provides a measure of said acceleration or said force.

In at least some examples optionally including at least one of the above examples, said force sensing system comprises stators, capacitors and balancing coils, and an electronics package for operation thereof.

In at least some examples optionally including at least one of the above examples,
10 at least one said mounting structure is configured for clamping in load bearing contact the support member to the housing in a direction generally parallel to said sensing axis while concurrently allowing for said differential movement between the support member and the housing in at least one direction orthogonal to said sensing axis.

According to a second aspect of the presently disclosed subject matter there is also
15 provided a housing member for use with a flexure member of an accelerometer, the housing member comprising at least one mounting structure or a plurality of mounting structures configured for clamping in load bearing contact the flexure member to the housing member while concurrently allowing for differential movement between the support member and the housing member, for example in a direction orthogonal to the
20 sensing axis.

In at least some examples said mounting structure is at least one of deformable bendable and shearable for allowing said differential movement between the support member and the housing.

In at least some examples optionally including at least one of the above examples
25 for the second aspect of the presently disclosed subject matter at least, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to the housing member and configured for being anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second
30 longitudinal end in at least one direction different from said sensing axis to permit at least

a portion of said differential movement between the support member and the housing member.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, at least one said
5 mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to the housing member and configured for being anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction non-parallel to said sensing axis to permit at least
10 a portion of said differential movement between the support member and the housing member.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal
15 end thereof to the housing member and configured for being anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction orthogonal to said sensing axis to permit at least a portion of said differential movement between the support member and the housing
20 member.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said mounting post is cantilevered from said housing member at said first longitudinal end and removably affixed to said support member at said second longitudinal end. Optionally, said mounting
25 post is integrally formed with or fixedly mounted to said housing member. Additionally or alternatively, said mounting post is accommodated within a well formed in said housing member, and wherein said second longitudinal end projects outwardly from a mouth of said well.

In at least some examples optionally including at least one of the above examples
30 for the second aspect of the presently disclosed subject matter at least, said mounting post is formed as a solid beam element having a cross-section that is uniform or varies along

the longitudinal axis of the beam element. By way of non-limiting example, said cross-section is circular, or oval, or square or rectangular or other polygonal. Additionally or alternatively, and by way of non-limiting example, a ratio of a length of said mounting post or of said beam element to a width of said mounting post or of said beam element in
5 the range about 0.3 to about 10, more preferably in the range about 1 to about 5, and more preferably about 3. Additionally or alternatively, and by way of non-limiting example, said mounting post or said beam element is spaced from said well by a spacing that is within about 10% and 20% of a width of said mounting post or said beam element.

In at least some examples optionally including at least one of the above examples
10 for the second aspect of the presently disclosed subject matter at least s, said mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in a plurality of directions orthogonal to said sensing axis.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said mounting post
15 is configured for preferentially allowing displacement between said first longitudinal end and said second longitudinal end in a first direction orthogonal to said sensing axis while providing relative resistance to such displacement along a second direction orthogonal to said sensing axis as compared with said first direction.

In at least some examples optionally including at least one of the above examples
20 for the second aspect of the presently disclosed subject matter at least, said housing member is configured for mounting to another housing member for accommodating therebetween the flexure member.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, there are at least
25 three said mounting structures associated with said housing member. Additionally or alternatively, said mounting structures are located with respect to the housing member at positions of 90°, 180° and 270° about a center axis thereof, the 0° position being associated with a hinge arrangement of the flexure member.

In at least some examples optionally including at least one of the above examples
30 for the second aspect of the presently disclosed subject matter at least, said housing

member comprises different thermal properties from the flexure member at least along directions orthogonal to said sensing axis.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said housing
5 member is made from materials having a coefficient of thermal expansion different from that of the flexure member, at least along directions orthogonal to said sensing axis.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said housing member is made from any suitable material, including, for example, at least one of the
10 following: any suitable metallic material or metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable ceramics; any suitable non-metallic material.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said mounting post
15 is configured for allowing displacement between said first longitudinal end and said second longitudinal end in a direction orthogonal to said sensing axis by any one of bending, deforming or shearing of the mounting post with respect to a longitudinal axis of the mounting post.

In at least some examples optionally including at least one of the above examples
20 for the second aspect of the presently disclosed subject matter at least, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to said housing, and having a second longitudinal end thereof configured for sliding displacement with respect to the flexure member, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and
25 the flexure member in a direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal
30 end thereof to said housing, and having a second longitudinal end thereof configured for

sliding displacement with respect to the flexure member, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and the flexure member in a direction non-parallel to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

5 In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to said housing, and having a second longitudinal end thereof configured for sliding displacement with respect to the flexure member, wherein the mounting post is
10 configured for allowing sliding displacement between said second longitudinal end and the flexure member in a direction orthogonal to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

 In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, the housing
15 member further comprises at least a part of an force sensing system configured for sensing movement of the pendulum member from a datum position in response to an acceleration or force applied to accelerometer along said sensing axis and for generating an output that is a measure of said acceleration or force.

 In at least some examples optionally including at least one of the above examples
20 for the second aspect of the presently disclosed subject matter at least, the housing member further comprises at least a part of an force sensing system configured for sensing movement of the pendulum member from a datum position in response to an acceleration or force applied to accelerometer parallel to said sensing axis, for generating a restoring or balancing force to the pendulum member to return the pendulum member to the datum
25 position, and for generating an output that is indicative of the restoring force, which in turn provides a measure of said acceleration or said force.

 In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said force sensing system comprises stators, capacitors and balancing coils, and an electronics package for
30 operation thereof.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said mounting structures are configured for clamping in load bearing contact a support member of the flexure member to the housing in a direction generally parallel to said sensing axis while
5 concurrently allowing for said differential movement between the support member and the housing in at least one direction different from said sensing axis.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said mounting structures are configured for clamping in load bearing contact a support member of the
10 flexure member to the housing in a direction generally parallel to said sensing axis while concurrently allowing for said differential movement between the support member and the housing in at least one direction non-parallel to said sensing axis.

In at least some examples optionally including at least one of the above examples for the second aspect of the presently disclosed subject matter at least, said mounting
15 structures are configured for clamping in load bearing contact a support member of the flexure member to the housing in a direction generally parallel to said sensing axis while concurrently allowing for said differential movement between the support member and the housing in at least one direction orthogonal to said sensing axis.

According to a third aspect of the presently disclosed subject matter there is also
20 provided a flexure member for use with a housing of an accelerometer, comprising a pendulum member hingedly connected to a support member via a hinge arrangement, and further comprising at least one mounting structure or a plurality of mounting structures configured for clamping in load bearing contact the support member to the housing while concurrently allowing for differential movement between the support member and the
25 housing, for example in a direction orthogonal to said sensing axis.

In at least some examples said mounting structure is at least one of deformable bendable and shearable for allowing said differential movement between the support member and the housing.

In at least some examples optionally including at least one of the above examples
30 for the third aspect of the presently disclosed subject matter at least, at least one said

mounting structure comprises an elongate mounting post, configured to be anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, at least one said mounting structure comprises an elongate mounting post, configured to be anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction non-parallel to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, at least one said mounting structure comprises an elongate mounting post, configured to be anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction orthogonal to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting post is configured for being removably affixed to said housing at said first longitudinal end and cantilevered from said support member at said second longitudinal end. Optionally, said mounting post is integrally formed with or fixedly mounted to said support member. Additionally or alternatively, said mounting post is for being accommodated within a well formed in said housing, and wherein said first longitudinal end is removably affixed to a base of said well.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting post is formed as a solid beam element having a cross-section that is uniform or varies along the longitudinal axis of the beam element. By way of non-limiting example, said cross-
5 section is circular, or oval, or square or rectangular or other polygonal. Additionally or alternatively, and by way of non-limiting example, a ratio of a length of said mounting post or of said beam element to a width of said mounting post or of said beam element in the range about 0.3 to about 10, more preferably in the range about 1 to about 5, and more preferably about 3. Additionally or alternatively, and by way of non-limiting example,
10 said mounting post or said beam element is spaced from said well by a spacing that is within about 10% and 20% of a width of said mounting post or said beam element.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting post is configured for allowing displacement between said first longitudinal end and said
15 second longitudinal end in a plurality of directions orthogonal to said sensing axis.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting post is configured for preferentially allowing displacement between said first longitudinal end and said second longitudinal end in a first direction orthogonal to said sensing axis while
20 providing relative resistance to such displacement along a second direction orthogonal to said sensing axis as compared with said first direction.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, the housing comprising two housing members and the flexure member is configured for being
25 accommodating therebetween. By way of non-limiting example, the flexure member comprises at least three pairs of said mounting structures. For example, in each said pair, one said mounting structure associated is in longitudinally opposed relationship with the other said mounting structure. Additionally or alternatively, said pendulum member pivotably connected to said support member via a hinge arrangement, and said mounting
30 structures are located with respect to said flexure member at positions of 90°, 180° and

270° about a center axis thereof, the 0° position being associated with said hinge arrangement.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting
5 structures are configured for isolating said pendulum member from strain effects arising from said differential movement.

In at least some examples optionally including at least one of the above example for the third aspect of the presently disclosed subject matter at least, said flexure member comprises different thermal properties from those of the housing at least along directions
10 orthogonal to said sensing axis.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said flexure member is made from materials having a coefficient of thermal expansion different from that of the housing at least along directions orthogonal to said sensing axis.

15 In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said flexure member is made from any suitable material, including, for example, at least one of the following: any suitable metallic material or metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable ceramics; any suitable
20 non-metallic material.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in a direction orthogonal to said sensing axis by any one of
25 bending, deforming or shearing of the mounting post with respect to a longitudinal axis of the mounting post.

In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to said support member, and having a second longitudinal end thereof configured for sliding
30 displacement with respect to the housing, wherein the mounting post is configured for

allowing sliding displacement between said second longitudinal end and said second one of the housing and said support member in a direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

5 In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to said support member, and having a second longitudinal end thereof configured for sliding displacement with respect to the housing, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and said second one
10 of the housing and said support member in a direction non-parallel to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

 In at least some examples, at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to said support
15 member, and having a second longitudinal end thereof configured for sliding displacement with respect to the housing, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and said second one of the housing and said support member in a direction orthogonal to said sensing axis to permit at least a portion of said differential movement between the support member and
20 the housing.

 In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting structures are configured for clamping in load bearing contact the support member to the housing in a direction generally parallel to said sensing axis while concurrently allowing
25 for said differential movement between the support member and the housing in at least one direction different from said sensing axis.

 In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting structures are configured for clamping in load bearing contact the support member to the
30 housing in a direction generally parallel to said sensing axis while concurrently allowing

for said differential movement between the support member and the housing in at least one direction non-parallel to said sensing axis.

In at least some examples optionally including at least one of the above examples for the third aspect of the presently disclosed subject matter at least, said mounting
5 structures are configured for clamping in load bearing contact the support member to the housing in a direction generally parallel to said sensing axis while concurrently allowing for said differential movement between the support member and the housing in at least one direction orthogonal to said sensing axis.

10 BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the disclosure and to see how it may be carried out in practice, examples will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 is a transverse cross-sectional view of an accelerometer according to one
15 example of the presently disclosed subject matter, comprising a mounting structure according to a first example of the presently disclosed subject matter.

Fig. 2 is a plan view of the flexure member of the accelerometer example of Fig.
1.

Figs. 3(a) and 3(b) are partial transverse cross-sectional views of the example of
20 the mounting structure of Fig. 1; in Fig. 3(a) there is no differential displacement between the support ring and the housing; in Fig. 3(b) there is differential displacement between the support ring and the housing; **Figs. 3(c) and 3(d)** are partial transverse cross-sectional views of alternative variations of the example of Figs. 3(a) and 3(b).

Figs. 4(a) to 4(d) are partial transverse cross-sectional views of alternative
25 variations of the examples of Figs. 3(a) to 3(d).

Fig. 5 is a plan view of an alternative variation of the example of Fig. 2.

Figs. 6(a) to 6(c) are partial transverse cross-sectional views of alternative variations of the examples the mounting structure of Figs. 1 to 5.

Figs. 7(a) to 7(b) are partial transverse cross-sectional views of an alternative variation of the examples the mounting structure of Figs. 1 to 6(c).

Fig. 8 is a partial transverse cross-sectional view of a mounting structure according to a second example of the presently disclosed subject matter.

5 **Figs. 9(a) to 9(b)** are partial transverse cross-sectional views of an alternative variation of the example of Fig. 8.

DETAILED DESCRIPTION

Referring to Fig. 1, an accelerometer according to a first example of the presently disclosed subject matter, generally designated **100**, comprises housing **30**, and flexure
10 member **50**. The accelerator **100** defines sensing axis **A** and is configured for sensing accelerations along this axis.

Referring also to Fig. 2, flexure member **50**, also referred to interchangeably herein as a reed, has a generally disc like shape and comprises a support member in the form of generally annular support ring **52** (also referred to interchangeably herein as a support frame)
15 and pendulum **55** (also referred to interchangeably herein as a paddle or as a proof mass) which has a generally disc like shape. An imaginary plane **P** can be defined with respect to the flexure member **50**, in particular with respect to the support ring **52**, generally orthogonal to the sensing axis **A** (see Fig. 1). Plane **P** can be coplanar with either one of the opposite-facing annular faces **56**, **57** of the support ring **52**, or can be located anywhere inbetween
20 faces **56**, **57**, for example. A datum or null position **D** for the pendulum **55** can be defined as the position of the pendulum **55** with respect to the support ring **52** when there is an absence of any acceleration or force **F** acting on the accelerator along sensing axis **A** and no restoring force is generated by the accelerometer **100**. In this example, in the datum position **D** the pendulum **55** is generally coplanar with the support ring **52**.

25 In alternative variations of this example the support member or support ring **52** can have a different form, for example rectangular or other polygonal shape, which can be closed or open, and/or the pendulum **55** can have a different form, for example rectangular or other polygonal shape, which can be closed or open.

The pendulum **55** is connected to the support ring **52** via a hinge arrangement in the form of hinge structures **62**, which are displaced from the geometric centre and center of gravity of the pendulum **55**. The hinge structures **62** are, in this example, formed as flexures or film hinges, and define a single hinge axis **B** generally parallel to the plane **P**. Thus, in
5 this example the hinge axes of the hinge structures are co-axial, but in alternative variations of this example the hinge axes can be non-coaxial, for example parallel but spaced from one another, or can intersect one another (optionally also both parallel to plane **P**). The hinge structures **62** enable the pendulum **55** to pivot with respect to the support ring **52** about hinge
10 axis **B**, which is generally orthogonal to sensing axis **A** (although in alternative variations of this example the in hinge axis can be non-orthogonal to sensing axis **A**). The pendulum **55** is generally circular about an axis **59** (parallel to sensing axis **A**), and is spaced from the support ring **52** by gap **51** along most of pendulum perimeter **58** excluding the locations of the hinge structures **62**. In alternative variations of this example the pendulum can be non-circular, for example polygonal, oval and so on.

15 The flexure member **50** can be made from any suitable material, including, for example, at least one of the following: any suitable metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable ceramics.

Housing **30** includes housing members **31** and **33** which interconnect via
20 interconnecting flanges **34**, **36**, or are otherwise joined to one another. In this example the housing **30**, and the housing members **31** and **33** are generally cylindrical about an axis generally coaxial with sensing axis **A**, though in alternative variation of this example the housing **30**, and the housing members **31** and **33** can have any other suitable shape.

When joined together, the housing members **31** and **33** define a gap **G** for
25 accommodating therein the flexure member **50** in clamping contact therewith via mounting structures **80**, as will be disclosed in greater detail herein.

For example, the housing members **31**, **33** are made any suitable material, including, for example, at least one of the following: any suitable metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable
30 ceramics.

The accelerometer **100** further comprises a suitable force sensing system **200** for operation of the accelerometer **100**, and in particular is configured for sensing movement of the pendulum **55** from the datum position in response to an acceleration or force **F** applied to accelerometer **100** along sensing axis **A**, and for generating an output that is a measure of the acceleration or force **F**. In particular, the electromagnetic system **200** is configured for sensing movement of the pendulum **55** from the datum position **D** in response to an acceleration or force **F** applied to accelerometer **100** parallel to sensing axis **A**, for generating a restoring or balancing force to the pendulum **55** to return this to the datum position **D**, and for generating an output that is indicative of the restoring force, which in turn provides a measure of the acceleration or force **F**.

The force sensing system **200** is mounted within the housing **30** and, in this example, is in the form of an electromagnetic sensing system, comprising an electronics package **220**, stators **280** and balancing coils **270**. The electronics package **220** operatively connected to stators **280** and coils **270**, and further comprises electrical connections (not shown) on the outside of the housing **30**, for routing electrical power to the force sensing system **200** from an external power source, and/or for outputting the aforesaid output of the electro magnetic system **200**.

Each stator **280** is accommodated in a recess **281** formed in a respective one of housing members **31** and **33**, and is generally cylindrical, having a respective inner bore **282**, generally concentric with axis **59**, and a permanent magnet **284** concentrically accommodated in the bore **282** to define an annular gap **288** between the outer facing cylindrical surface **285** of the magnet **284** and the inner facing cylindrical surface **283** of the bore **282**.

The coils **270** are mounted to the pendulum **55**, one on each of face **66** and face **67** thereof, generally concentric with axis **59** and inwardly spaced from the pendulum perimeter **58**. In the assembled accelerometer **100**, each coil **270** is accommodated in the respective bore **282**, in particular the respective gap **288**, with the respective magnet **284** positioned within the respective coil **270**.

A capacitor plate **210** is provided on each face **66**, **67** of pendulum **55**, and each capacitor plate **210** forms a capacitor with facing surface **289** of the respective magnet **284**. The two capacitors are part of a pick-off or feedback circuit (typically comprised in the

electronics package **220**) for sensing movement of the pendulum **55** from the datum position **D**.

In operation, an acceleration or force **F** applied to the accelerometer **100** along sensing axis **A** results in a pendulous pivotal movement of the pendulum **55** with respect to axis **B**, in particular about axis **B**, and thus pendulum **55** moves with respect to the support ring **52**, the housing members **31**, **33**, and the stators **280**. This causes a change in the spacing between each capacitor plate **210** and the facing surface **289** of the respective magnet **284**, which results in a differential capacitance change that is sensed by the feedback circuit comprised in the electronics package **220**. The feedback circuit almost concurrently applies a suitable current/voltage to the balance coils **270** that, via interaction with the magnets **284**, generates a balancing force to the pendulum **55** such as to return the pendulum **55** to the datum position **D**. The current/voltage that is required for maintaining the pendulum **55** at the datum position **D** provides a measure of the acceleration or force **F** that is acting to the accelerometer **100**, and a suitable output corresponding to this current/voltage, for example a digital or analog signal, is generated by the electronics package **220**.

In alternative variations of this example the force sensing system **200** can thus comprise any such system currently known in the art or developed in the future for the stated purpose, for example as disclosed in any one of US 3,702,073, US 4,250,757, US 4,498,342, US 4,932,258, US 5,111,694, US 5,182,949, US 5,287,744, and US 5,763,779, the contents of which are incorporated herein in their entirety, or can include other types of force sensing systems, for example based on sensing and/or generating electrostatic forces or bimetallic forces generated as a result of the applied force or acceleration along the sensing axis **A**.

As already indicated, when the accelerometer is assembled, the flexure member **50** is accommodated in gap **G** and is in clamping contact with the housing members **31** and **33** via mounting structures **80**. The accelerometer **100** thus comprises a plurality of mounting structures **80**, which are configured for clamping the support ring **52** to the housing **30** in a direction parallel to sensing axis **A** while concurrently allowing for differential movement between the support ring **52** and the housing **30** in a direction orthogonal to sensing axis **A**.

The mounting structures **80** are configured for clamping the support ring **52** to the housing members **31** and **33** in a direction parallel to sensing axis **A**, while concurrently

allowing limited relative movement between the support ring **52** and the housing members **31** and **33** in one or more directions different from sensing axis **A**, i.e., non-parallel to sensing axis **A**. In particular, the mounting structures **80** are configured for clamping the support ring **52** to the housing members **31** and **33** in a direction parallel to sensing axis **A**, while
5 concurrently allowing limited relative movement between the support ring **52** and the housing members **31** and **33** in one or more directions orthogonal to sensing axis **A**, i.e., parallel to plane **P**.

In at least some examples including the example of Fig. 1, the mounting structures **80** act as a mechanical buffer between the support ring **52** and the housing members **31** and
10 **33**.

In this example, three pairs of mounting structures **80** are provided, three mounting structures **80** in housing member **31** in opposed relationship with three mounting structures **80** in housing member **33**. The mounting structures **80** are located at positions 90°, 180° and 270° on plane **P** with respect to the flexure member **50** and axis **59**, the 0° position being in-
15 between the hinge structures **62**, as illustrated in Fig. 2.

Referring also to Figs. 3(a) and 3(b), each mounting structure **80** according to a first example thereof, comprises an elongate mounting post **82**, a base end **89** thereof being anchored to the respective housing member **31** or **33**. The base end **89** is cantilevered from the base **83** of a well **84** formed on the respective housing member **31** or **33**. The mounting
20 post **82** is concentrically received in the well **84** and is separated from the walls **85** thereof by a lateral gap **T**. The mounting post **82** has a length **L** greater than the depth **d** of well **84** so that the free end **81** of the post **82** projects from the mouth of the well **84**.

Mounting post **82** is in the form of a solid beam element, generally prismatic, having a uniform cross-section along its longitudinal length from base end **89** to free end **81**, which
25 are aligned along longitudinal axis **C**, generally parallel to the sensing axis **A**. In the assembled accelerometer **100**, free end **81** of each mounting structure **80** is anchored to the support ring **52**. The free end **81** comprises a generally flat face **87** and is received in a complementarily-shaped shallow recess **61** formed in the faces **56**, **57** of support ring **52**. The shallow recesses **61** facilitate alignment of the support ring **52** with respect to the
30 housing members **31** and **33** during assembly of the accelerometer **100**. In alternative variations of this example the support rings lacks one or more of the recesses **61**, and the

respective face(s) **87** about the respective face **56** or face **57** directly, and are anchored thereto by frictional or shear forces thereat.

Referring to Fig. 3(b) in particular, each mounting post **82** is configured for allowing the free end **81** thereof to be displaced with respect to the base end **89** or to the base **83** (and thus with respect to the rest of the respective housing member **31** or **33**) by a displacement Δ responsive to a lateral force **Q** being applied to the free end **81**, in a direction generally parallel to plane **P**. In particular, such a displacement is reversible, so that in the absence of force **Q**, the free end **81** returns to its initial position with respect to the base end **89**. In this example, such a displacement is provided by any one of reversible bending, or otherwise
10 deforming (including shearing) the mounting post **82**.

In operation, when the support ring **52** on the one hand, and the housing **30** in particular housing members **31** and **33** on the other hand, have different thermal properties, for example are made from materials having different coefficients of thermal expansion (at least along directions parallel to plane **P**, i.e., at least along directions orthogonal to the
15 sensing axis **A**), and the accelerometer is subjected to a change in temperature, for example heating or cooling, such that the accelerometer experiences a change in temperature, the support ring **52** expands or contracts along a direction parallel to plane **P** by an amount that is different from the respective expansion or contraction of the housing members **31** and **33**. The differential thermal expansions or contractions result in the free end **81** of each mounting
20 post **82** (which is clampingly mounted (i.e., anchored) to the support ring **52**) moving laterally with respect to the respective base end **89** (which is affixed (i.e., anchored) to the respective housing member **31** or **33**) as seen in Fig. 3b), for example. In one example, the housing members **31** and **33** are made from a suitable material, for example a suitable metal, for example stainless steel, and at least the support ring **52** of flexure member **50** is made
25 from a different material, for example a different metal, or from silicon or fused quartz.

Without being bound to theory, it is believed that the thermal strains generated by the differential thermal expansions or contractions are essentially absorbed by the flexing or deformation of the mounting structures **80**, thereby decoupling thermal strains from the support ring **52** and thus from the flexures **62**. In this manner the support ring **52** (in
30 particular the part thereof comprising the hinge structures **62**) does not become distorted and/or does not introduce thermal bias into the accelerometer **100**, or at least minimizes

distortion and/or bias as compared to clamping the support ring **52** to the housing members **31** and **33** directly or via pads to prevent differential movement between the support ring **52** to the housing members **31** and **33**, in the absence of said mounting structures **80**.

Similarly, any mounting strains that may be introduced as a result of slight
5 manufacturing or mounting errors between the support ring **52** on the one hand, and the housing members **31** and **33** on the other hand can also be absorbed by the relative displacement between the free end **81** and the base end **89** of the mounting structures **80**.

The lateral gap **T** provides a maximum limit to the movement of the free end **81** with respect to the base end **89** or base **83**, and thus with respect to the well **84**, and the dimension
10 of **T** is thus chosen to allow for the maximum desired or expected range of differential movement between the support ring **52** and the housing members **31** and **33**.

As already mentioned, the three pairs of mounting structures **80** are located one pair each at positions 90°, 180° and 270° on support ring **52** with respect to axis **59**, and thus any differential thermal expansions or contractions between the support ring **52** on the one hand,
15 and the housing members **31** and **33** on the other hand, are effectively isolated from or at least spaced away from, the flexures **62**.

In alternative variations of this example, the mounting structures **80** in each pair are not necessarily co-axially aligned, but instead each mounting structure on one housing member **31** can be located in different positions with respect to the mounting structures on
20 the other housing member **33**; additionally or alternatively, the mounting structures **80** can be provided at other locations instead of one or more of positions 90°, 180° and 270° with respect to axis **59**, for example at 60°, 180° and 300°. Additionally or alternatively, in such or other alternative variations of this example the accelerometer can comprise less than three pairs of mounting structures, for example 1 pair or 2 pairs of mounting structures **80**
25 (exclusively or in combination with other types of mounting structures, for example conventional pads). Alternatively, in other alternative variations of this example the accelerometer can comprise more than three pairs of mounting structures, for example 4 or 5 or six or more pairs of mounting structures **80** (exclusively or in combination with other types of mounting structures, for example conventional pads). Additionally or alternatively,
30 in such or other alternative variations of this example the accelerometer can comprise instead

of paired sets of mounting structures, single mounting structures **80** on one side only of the support ring **52** or on one only of said housing member **31** or **33**.

In this example, the mounting posts **82** are each integrally formed with the respective housing members **31** and **33**, and for example can be suitably machined or cast with respect
5 to the housing members **31** and **33**. In alternative variations of this example, at least one mounting post **82'** can be manufactured as a plug member, separately from the respective housing member **31** or **33**, which comprises the respective well **84'** formed therein, for example by machining or casting, and the mounting post is then affixed in the well, for example as illustrated in Fig. 3(c). While in the example of Figs. 1 and 2 each mounting post
10 **80** is formed as a prismatic solid, in alternative variations of this example at least one mounting post can be partially or fully hollow, or can comprise one or more slots **86** parallel to axis **C**, which can increase flexibility of the mounting post, for example as illustrated in Fig. 3(d).

It is to be noted that at least in some alternative variations of the first example the
15 respective mounting structure does not require the respective well per se, and rather the respective mounting post projects from the inner facing surface of the respective housing member by the appropriate length **L** to ensure providing the desired or required relative displacement between the free end and the base end of the mounting post responsive to the differential movement between the support ring **52** and the housing **30**, in particular the
20 housing elements **31**, **33**.

By way of non limiting example, the ratio of length **L** to the width **W** of the mounting post **82** can be in the range about 0.3 to about 10, more preferably in the range about 1 to about 5, and more preferably about 3.

By way of non limiting example, the spacing **T** is within about 10% to about 20%
25 of a width **W**.

By way of non limiting example, width **W** is between about 1mm and about 4mm, spacing **T** is about 0.1mm to about 0.5mm or up to 1mm, length **L** is in the range about 0.3mm to about 10mm, more preferably in the range about 1mm to about 5mm, and more preferably about 3mm, and depth **d** is in the range about 0.2mm to about 9.5mm, more

preferably in the range about 1mm to about 5mm. In one such example, **W** is 2.5mm, spacing **T** is 0.5mm, and length **L** is 3.25mm, and depth **d** is 3mm.

In the first example, the mounting posts **82** are substantially identical to one another and have uniform circular cross-sections. Accordingly, each mounting post **82** can be bent
5 or otherwise deformed in any direction parallel to plane **P**, and is not constrained to bend or otherwise deform in any particular such direction.

In an alternative variation of this example, and referring to Figs. 4(a) and 4(b), at least one mounting structure, herein designated **80A** has all the features and elements of the mounting structure **80** of the example of Fig. 3(a) and Fig 3(b), *mutatis mutandis*, with the
10 main difference that the respective mounting post **82A** has a rectangular cross-section, and thus preferentially bends or otherwise distorts along one direction parallel to plane **P**, i.e. orthogonal to the long sides of the rectangle. At the same time, the respective mounting post **82A** provides more resistance to bending or distortion along a direction parallel to plane **P** that is orthogonal to the short sides of the rectangle. For example, and referring to Fig. 5,
15 two such mounting structures **80A** can be mounted to each respective housing member **31** or **33**, one each at the 90° and 180° locations, and further comprising a conventional mounting pad **80X** at location 270° (instead of a mounting structure **80** or **80A**) that does not provide for differential movement between the support ring **52** and the housing members **31** and **33**. The mounting posts **80A** provided at the 90° are oriented with the long sides of the rectangular cross-section orthogonal to a line **H** joining the 90° and 270° locations, and thus preferentially allow for relative differential movement between the support ring **52** and the housing members **31** and **33** along a direction parallel to line **H**. The mounting posts **80A** provided at the 180° location are oriented with the long sides of the rectangular cross-section orthogonal to a line **V** joining the 0° and 180° locations, and thus preferentially allow for
25 relative differential movement between the support ring **52** and the housing members **31** and **33** along a direction parallel to line **V**. Since lines **H** and **V** are orthogonal to one another (and parallel to plane **P**), and there is no differential movement between the support ring **52** and the housing members **31** and **33** at the 270° location, all differential movement between the support ring **52** and the housing members **31** and **33** can be resolved along orthogonal
30 directions **V** and **H** via the two pairs of mounting posts **80A**.

Fig. 4(c) illustrates another variation of the example of Figs. 4(a), 4(b), in which the respective mounting post, designated **80A'**, has an elliptical cross-section, and the mounting post **80A'** preferentially bends or otherwise deforms along a direction orthogonal to the major axis of the ellipse.

5 Fig. 4(d) illustrates yet another variation of the example of Figs. 4(a), 4(b), in which the respective mounting post, designated **80A''**, has a square cross-section, and the mounting post **80A''** has two preferential directions for bending or otherwise deforming, i.e., along directions orthogonal to the four sides of the square.

It is readily apparent that the cross-section of the mounting post can be chosen to
10 provide bending or distortion of the mounting post in one or more preferred directions with respect to plane **P**.

Referring to Figs 6(a) and 6(b), in alternative variations of the examples illustrated in Figs. 1 to 5, the respective mounting post, designated **80B'** and **80B''**, can have a non-uniform cross-section along its longitudinal length. For example, referring to Fig. 6(a), the
15 mounting post **80B'** has a cross-section that diminishes from the respective base **89B'** to the respective free end **81B'**, and thus is more resistant to bending or deforming than a corresponding mounting post of uniform cross-section having a cross-section comparable to the average cross-section of mounting post **80B'**. For example, referring to Fig. 6(b), the mounting post **80B''** has a cross-section that increases from the respective base **89B''** to the
20 respective free end **81B''**, and thus is less resistant to bending or deforming than a corresponding mounting post of uniform cross-section having a cross-section comparable to the average cross-section of mounting post **80B''**; at the same time having a relatively larger respective free end **81B''** can be useful in reducing the local stresses at the respective recess **61B''** formed in the support ring **52**. A variation of the example of Fig. 6(b) is illustrated in
25 Fig. 6(c). For example, the mounting posts illustrated in Figs. 6(a) to 6(c) can be manufactured as plugs and mounted to the housing members **31**, **33** in a similar manner to that disclosed herein for the plugs of Fig 3(c), *mutatis mutandis*.

Thus, the profile and/or the solidity of the cross-section of the respective mounting post, and/or the longitudinal variation of the cross-section thereof, can be designed to control
30 or limit the manner and range of differential movement between the support ring **52** and the housing members **31** and **33**.

In a variation of the first example, and referring to Figs. 7(a) and 7(b), the free end **81G** of the corresponding mounting post **82G** of the respective mounting structure **80G** is not received and locked in place via a recess in the support ring **52** or is otherwise fixedly abutted, i.e., anchored, to the support ring **52**. Rather, the free end **81G** is configured for relative sliding displacement with respect to the support ring **52**, while at the same time providing clamping contact between the housing **30** and the ring member **52**. It is to be noted that in this example, the mounting structure **80G** does not require a well to be provided in the respective housing member **31** or **33**, nor to be cantilevered at the base of such a well; rather, the mounting post **82G** can project directly from a respective surface of the housing member **31** or **33**. In this example, the free end **81G** has a convexly part-cylindrical contact surface **87G** that is configured to slide radially with respect to a complementarily-shaped radial groove **69** formed in the support ring **52**. Thus, in response to a differential displacement between the support ring **52** and the corresponding housing member **31**, the free end **81G** of mounting post **82G** (which is clampingly and slidingly mounted to the support ring **52**) moves with respect to the groove **69** along the radial direction of the groove. Thus, an arrangement can be provided similar to that illustrated in Fig. 5, in which two such mounting structures **80G** can be mounted to each respective housing member **31** or **33**, one each at the 90° and 180° locations, and further comprising a conventional mounting pad **80X** at location 270° that does not provide for differential movement between the support ring **52** and the housing members **31** and **33**. The mounting posts **80G** provided at the 90° allow for relative differential sliding movement between the support ring **52** and the housing members **31** and **33** along a direction parallel to line **H**. The mounting posts **80G** provided at the 180° allow for relative differential movement between the support ring **52** and the housing members **31** and **33** along a direction parallel to line **V**. All differential movement between the support ring **52** and the housing members **31** and **33** can be resolved along orthogonal directions **V** and **H** via the two pairs of mounting posts **80G**. Alternatively, the free end **81G** has a convexly part-spherical contact surface that is configured to slide with respect to a relatively wide slot formed in the support ring **52**. Thus, in response to a differential displacement between the support ring **52** and the corresponding housing member **31**, the free end **81G** of mounting post **82G** (which is clampingly and slidingly mounted to the support ring **52**) slides with respect to the slot along any direction parallel to plane **P**, and thus three such pairs of mounting posts **80G** can be provided in configuration relative to the

housing **30** and the flexure member **50** as disclosed herein for the example of Figs. 1 and 2, *mutatis mutandis*.

Referring to Fig. 8, a mounting structure **180** according to a second example thereof, comprises the elements and features of the first example of the mounting structure and/or
5 alternative variations thereof as disclosed herein, *mutatis mutandis*, with some differences as will become clearer herein. In the second example, the mounting structure **180** comprises a mounting post **182**, similar to the mounting post of the first example or alternative variations thereof, *mutatis mutandis*, but with a base end **189** thereof being cantileverly mounted to the support ring **52**, rather than to the respective housing member **31** or **33**. When
10 the accelerometer is assembled, the mounting post **182** is concentrically received in well **184**, formed on the respective housing member **31** or **33**, and is separated from the walls **185** thereof by a lateral gap **T'**, similar to the corresponding well of the first example, *mutatis mutandis*. The free end **181** of mounting structure **180** comprises a generally flat face **187** and is received and fixedly retained in a complementarily-shaped shallow recess **161** formed
15 in the base **183** of well **184**, similar to recess **61** of the first example, *mutatis mutandis*, and thus the mounting post **182** has a length **L'** correlated to the spacing between the face **57** of the support ring **52** and the base **183**. In this example, the mounting post **182** is a prismatic solid, having a uniform circular cross-section along its longitudinal length from base end **189** to free end **181**, which are aligned along longitudinal axis **C'**, generally parallel to the
20 sensing axis **A**. In alternative variations of the second example, the mounting post can have a non-uniform cross-section, and/or a non circular cross-section, for example analogous to the examples illustrated in Figs. 4(a) to 6(c), *mutatis mutandis*.

The mounting post **182** is configured for allowing the free end **181** to be displaced with respect to the base end **189** responsive to a lateral force **Q** being applied to the free end,
25 in a direction generally parallel to plane **P**, in a manner similar to that of the first example, *mutatis mutandis*. In particular, such a displacement is reversible, so that in the absence of force **Q**, the free end **181** returns to its initial position with respect to the base end **189**. In this example, such a displacement is provided by any one of reversible bending, or otherwise deforming (including shearing) the mounting post **182**.

The lateral gap **T'** provides a limit to the movement of the base end **189** with respect to the free end **181** and thus the well **184**, and is thus chosen to allow for the maximum range of differential movement between the support ring **52** and the housing members **31** and **33**.

The mounting post **182** can be made from the same material as that of the ring member **50**, or of the housing members **31**, **33** or a different material.

In the example of Fig. 8, there is a second mounting post **182'**, similar to mounting post **182**, *mutatis mutandis*, mounted to face **56** of the support ring **52**, back-to-back with respect to the mounting post **182** that is mounted to face **57**. The second mounting post **182'** is also received in a corresponding well **184'** formed on the other housing member, similar to well **184**, *mutatis mutandis*, and operates in similar manner to mounting post **182**, *mutatis mutandis*. For example, the two mounting posts **182**, **182'** can be interlinked via a connection **186** as illustrated in Fig. 8.

In a variation of the example of Fig. 8, and referring to Figs. 9(a) and 9(b), at least one mounting structure **180G** is provided having the free end **181G** of the respective mounting post **180G** that is not received and locked in place via a recess; rather, the free end **181G** is configured for sliding with respect to a groove **69** or slot provided in the respective housing member **31** or **33**, while at the same time providing clamping contact between the housing **30** and the ring member **52**, in a similar manner to the example illustrated in Fig. 7(a) and 7(b) or alternative variations of the example illustrated therein, *mutatis mutandis*.

It is to be noted that an accelerometer according to at least one example of the present presently disclosed subject matter can comprise any desired number of mounting structures (singly, or in faced pairs, or in staggered pairs, for example), with any desired combination or permutation of different configurations of mounting structures being provided for clamping the respective support ring to the respective housing members, for example any combination of the examples of the mounting structures illustrated in Figs. 1 to 9(b) herein or alternative variations thereof.

Finally, it should be noted that the word “comprising” as used throughout the appended claims is to be interpreted to mean “including but not limited to”.

While there has been shown and disclosed example examples in accordance with the presently disclosed subject matter, it will be appreciated that many changes can be made therein without departing from the spirit of the presently disclosed subject matter.

CLAIMS:

1. Accelerometer for sensing acceleration along a sensing axis, comprising:
 - a flexure member, comprising a pendulum member pivotably connected to a support member via a hinge arrangement;
 - 5 a housing;
 - at least one mounting structure configured for clamping the support member to the housing in load bearing contact while concurrently allowing for differential movement between the support member and the housing.
2. Accelerometer according to claim 1, comprising a plurality of said mounting
10 structures.
3. Accelerometer according to claim 1 or claim 2, wherein at least one said mounting structure configured for clamping the support member to the housing in load bearing contact while concurrently allowing for differential movement between the support member and the housing in a direction orthogonal to said sensing axis.
- 15 4. Accelerometer according to any one of claims 1 to 3, wherein at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one
20 direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.
5. Accelerometer according to any one of claims 1 to 3, wherein at least one said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to the housing and anchored at the second longitudinal end thereof to the
25 support member, wherein the mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in at least one direction orthogonal to said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

6. Accelerometer according to claim 4 or claim 5, wherein said mounting post is cantilevered from said housing at said first longitudinal end and removably affixed to said support member at said second longitudinal end.
7. Accelerometer according to claim 6, wherein said mounting post is integrally
5 formed with or fixedly mounted to said housing.
8. Accelerometer according to any one of claims 4 to 7, wherein said mounting post is accommodated within a well formed in said housing, and wherein said second longitudinal end projects outwardly from a mouth of said well.
9. Accelerometer according to claim 6, wherein said mounting post is removably
10 affixed to said housing at said first longitudinal end and cantilevered from said support member at said second longitudinal end.
10. Accelerometer according to claim 9, wherein said mounting post is integrally formed with or fixedly mounted to said support member.
11. Accelerometer according to any one of claims 4 to 10, wherein said mounting post
15 is accommodated within a well formed in said housing, and wherein said first longitudinal end is removably affixed to a base of said well.
12. Accelerometer according to any one of claims 4 to 11, wherein said mounting post is formed as a solid beam element having a cross-section that is uniform or varies along the longitudinal axis of the beam element.
- 20 13. Accelerometer according to claim 11, wherein said cross-section is circular or oval or polygonal.
14. Accelerometer according to claim 11, wherein said cross-section is square or rectangular.
15. Accelerometer according to any one of claims 4 to 14 wherein a ratio of a length
25 of said mounting post to a width of said mounting post is in the range about 0.3 to about 10, more preferably in the range about 1 to about 5, and more preferably about 3.

- 16.** Accelerometer according to any one of claims 49 to 15 wherein said mounting post is spaced from said well by a spacing that is within about 10% and 20% of a width of said mounting post.
- 17.** Accelerometer according to any one of claims 4 to 16, wherein said mounting post
5 is configured for allowing displacement between said first longitudinal end and said second longitudinal end in a plurality of directions orthogonal to said sensing axis.
- 18.** Accelerometer according to any one of claims 4 to 17, wherein said mounting post is configured for preferentially allowing displacement between said first longitudinal end and said second longitudinal end in a first direction orthogonal to said sensing axis while
10 providing relative resistance to such displacement along a second direction orthogonal to said sensing axis as compared with said first direction.
- 19.** Accelerometer according to any one of claims 1 to 18, wherein said housing comprising two housing members configured for accommodating therebetween said flexure member.
- 20.** Accelerometer according to claim 19, comprising at least three said mounting
15 structures associated with each said housing member.
- 21.** Accelerometer according to claim 20, wherein each said mounting structure associated with one said housing member is in longitudinally opposed relationship with a corresponding said mounting structure associated with the other said housing member.
- 22.** Accelerometer according to any one of claims 19 to 21, wherein said pendulum
20 member pivotably connected to said support member via a hinge arrangement, and wherein said mounting structures are located with respect to said flexure member at positions of 90°, 180° and 270° about a center axis thereof, the 0° position being associated with said hinge arrangement.
- 23.** Accelerometer according to any one of claims 1 to 22, wherein said mounting
25 structures are configured for isolating said pendulum member from strain effects arising from said differential movement.

24. Accelerometer according to any one of claims 1 to 23, wherein said flexure member and said housing comprise different thermal properties one from the other at least along directions orthogonal to said sensing axis.

25. Accelerometer according to any one of claims 1 to 24, wherein said flexure member and said housing are made from materials having different coefficients of thermal expansion one from the other at least along directions orthogonal to said sensing axis.

26. Accelerometer according to any one of claims 1 to 25, wherein said flexure member is made from a non-metallic material and said housing is made from a metallic material.

27. Accelerometer according to any one of claims 1 to 26, wherein said flexure member is made from any suitable material, including, for example, at least one of the following: any suitable metallic material or metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable ceramics; any suitable non-metallic material.

28. Accelerometer according to any one of claims 1 to 27, wherein said housing is made from any suitable material, including, for example, at least one of the following: any suitable metallic material or metal, for example stainless steel, aluminium, titanium or alloys thereof; composites; silicon; fused quartz or other suitable ceramics; any suitable non-metallic material.

29. Accelerometer according to any one of claims 1 to 28, wherein said mounting structure is at least one of deformable, bendable and shearable for allowing said differential movement between the support member and the housing.

30. Accelerometer according to any one of claims 4 to 29, wherein said mounting post is configured for allowing displacement between said first longitudinal end and said second longitudinal end in a direction orthogonal to said sensing axis by any one of bending, deforming or shearing of the mounting post with respect to a longitudinal axis of the mounting post.

31. Accelerometer according to any one of claims 1 to 3, wherein said mounting structure is slidable for allowing said differential movement between the support member and the housing.

32. Accelerometer according to any one of claims 1 to 3 or 31, wherein at least one
5 said mounting structure comprises an elongate mounting post, anchored at a first longitudinal end thereof to a first one of said housing and said support member, and having a second longitudinal end thereof configured for sliding displacement with respect to a second one of said housing and said support member, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and
10 said second one of said housing and said support member in a direction different from said sensing axis to permit at least a portion of said differential movement between the support member and the housing.

33. Accelerometer according to any one of claims 1 to 3 or 31, wherein at least one said mounting structure comprises an elongate mounting post, anchored at a first
15 longitudinal end thereof to a first one of said housing and said support member, and having a second longitudinal end thereof configured for sliding displacement with respect to a second one of said housing and said support member, wherein the mounting post is configured for allowing sliding displacement between said second longitudinal end and said second one of said housing and said support member in a direction orthogonal to said
20 sensing axis to permit at least a portion of said differential movement between the support member and the housing.

34. Accelerometer according to any one of claims 1 to 33, further comprising a force sensing system configured for sensing movement of the pendulum member from a datum position in response to an acceleration or force applied to accelerometer along said
25 sensing axis and for generating an output that is a measure of said acceleration or force.

35. Accelerometer according to any one of claims 1 to 34, further comprising a force sensing system configured for sensing movement of the pendulum member from a datum position in response to an acceleration or force applied to accelerometer parallel to said sensing axis, for generating a restoring or balancing force to the pendulum member to
30 return the pendulum member to the datum position, and for generating an output that is

indicative of the restoring force, which in turn provides a measure of said acceleration or said force.

36. Accelerometer according to claim 34 or claim 35, wherein said force sensing system comprises stators, capacitors and balancing coils, and an electronics package for
5 operation thereof.

37. Accelerometer according to any one of claims 1 to 36, wherein at least one said mounting structure is configured for clamping in load bearing contact the support member to the housing in a direction generally parallel to said sensing axis while concurrently allowing for said differential movement between the support member and the housing in
10 at least one direction orthogonal to said sensing axis.

38. A housing member for use with a flexure member of an accelerometer, the housing member comprising at least one mounting structure configured for clamping in load bearing contact the flexure member to the housing member while concurrently allowing for differential movement between the support member and the housing.

15 **39.** A housing member according to claim 38, comprising a plurality of said mounting structures.

40. A housing member according to any one of claims 38 to 39, wherein said mounting structure is at least one of deformable, bendable and shearable for allowing said differential movement between the support member and the housing.

20 **41.** A housing member according to any one of claims 38 to 40, wherein at least one said mounting structure configured for clamping the support member to the housing in load bearing contact while concurrently allowing for differential movement between the support member and the housing in a direction different from said sensing axis.

42. A housing member according to any one of claims 38 to 40, wherein at least one
25 said mounting structure configured for clamping the support member to the housing in load bearing contact while concurrently allowing for differential movement between the support member and the housing in a direction orthogonal to said sensing axis.

43. A flexure member for use with a housing of an accelerometer, comprising a pendulum member hingedly connected to a support member via a hinge arrangement, and

further comprising at least one mounting structure configured for clamping in load bearing contact the support member to the housing while concurrently allowing for differential movement between the support member and the housing.

5 **44.** A flexure member according to claim 43, comprising a plurality of said mounting structures.

45. A flexure member according to any one of claims 43 to 44, wherein said mounting structure is at least one of deformable, bendable and shearable for allowing said differential movement between the support member and the housing.

10 **46.** A flexure member according to any one of claims 43 to 45, wherein at least one said mounting structure configured for clamping the support member to the housing in load bearing contact while concurrently allowing for differential movement between the support member and the housing in a direction different from said sensing axis.

15 **47.** A flexure member according to any one of claims 43 to 45, wherein at least one said mounting structure configured for clamping the support member to the housing in load bearing contact while concurrently allowing for differential movement between the support member and the housing in a direction orthogonal to said sensing axis.