

A SUPPORT STRUCTURE FOR AT LEAST ONE CONDUIT STRUCTURE OF A FLOW METER

[001] The invention relates to the technical field of flow sensors. More specifically, a support structure that is to be part of at least one conduit structure of a flow meter, for stiffening the conduit structure against exerted forces as the flow meter is under operation.

BACKGROUND OF THE INVENTION

[002] A mass flow meter is an instrument that calculates the flow rate of a fluid by measuring the mass of flowing fluid with respect to a unit of time. A Coriolis flow meter is a type of mass flow meter that measures parameters that include any one or a combination of mass, density, and temperature of a fluid through the Coriolis effect phenomenon.

[003] The operation of the Coriolis flow meter involves simple harmonic motion. More specifically, when fluid in the conduit structures (e.g., flow tubes) of the Coriolis flow meter flows at a certain speed, it does a synchronous simple harmonic motion or circular motion with the tube. This produces a reaction force of the cross product of the flow velocity of the medium and the angular velocity of the simple harmonic motion, which is the so-called "Coriolis force". Under the action of the Coriolis force, the synchronous vibration collected by sensors located at the symmetrically positioned ends of the tube to obtain a phase difference (or time difference). Since the phase difference value is proportional to the flow rate, the mass flow rate of the fluid is obtained.

[004] Conventionally, during operation of a Coriolis flow meter, the fluid flowing between an input and an output of the flow meter may exert forces upon the conduit structures of the flow meter. Hence, over time, these conduit structures may become mechanically skewed. This shall cause the zero point of the flow meter, which serves as a reference of mass flow measurement, to become compromised and unstable. As a result, a flow meter may provide inaccurate mass flow measurements of fluid after a long period of use, thereby affecting its operational lifespan.

[005] There are a few disclosed technologies over the prior art that may relate to a support structure for conduit structures of a flow meter. Among them include a Japan Patent Application JP5247048B2, which discloses a flow meter setup for eliminating the adjustment of the resonant frequency for two sensor tubes while ensuring stable vibration of the sensor tubes. This prior art provides a support column that supports an exciter and sensing means (e.g., pickups). The support column is placed between two sensor tube through which the measured fluid flows. The magnets of the exciter on the support column vibrates the two sensor tubes in a direction that brings them closer together or further apart, and the pickups detect the relative displacement of the two sensor tubes. Since only coils are attached to the sensor tubes, the distortion of the vibration of the sensor tubes is reduced compared to cases where magnets are mounted on the sensor tubes.

[006] However, the aforementioned prior art still exhibits the shortcomings as previously described as its support column provides vibrations instead of providing resistance against them. Accordingly, a support structure for at least one conduit structure (e.g., flow tube) of a flow meter, which overcomes the aforementioned shortcomings, is much desired.

SUMMARY OF INVENTION

[007] The present invention intends to provide support structure for at least one conduit structure of a flow meter, comprising a body, which has one or more regions. The regions include a first region that interfaces with the conduit structure of the flow meter, with the first region having a first end and a second end. The regions further include a second region that extends from the first end of the first region, and a third region that extends from the second end of the first region. The second region and the third region meet at a common location that is at a distance away from the first region.

[008] Preferably, regarding the support structure, its first region has a convex section, in which there is a stationary point or location therealong that is a maxima or a minima of the first region.

[009] Preferably, regarding the support structure, the common location is at a distance away from the stationary point or location of the first region in which both of them are substantially aligned to each other.

[0010] Preferably, regarding the support structure, the second region has a first spatial extent between the first end of the first region and the common location, and the third region has a second spatial extent between the second end of the first region and the common location. The first spatial extent is either substantially equivalent to, longer than, or shorter than, the second spatial extent.

[0011] Preferably, regarding the support structure, the second region and the third region are both planar.

[0012] Preferably, regarding the support structure, the second region and the third region are oriented to be at a first angle with respect to each other.

[0013] The present invention also intends to provide a conduit structure of a flow meter, comprising at least one support structure, the support structure comprises a body that has one or more regions. The regions of the body of the support structure includes a first region that interfaces with the conduit structure of the flow meter, with the first region having a first end and a second end. The regions of the body of the support structure further includes a second region that extends from the first end of the first region, a third region that extends from the second end of the first region. The second region and the third region of the support structure meet at a common location that is at a distance away from the first region of the support structure.

[0014] Preferably, regarding the conduit structure, it further comprises one or more portions that accommodates fluid flow, which include a first portion, a second portion, and a third portion, wherein the third portion is in connection with the first portion and the second portion, and the third portion includes at least one concave area.

[0015] Preferably, regarding the conduit structure, the first region of the support structure has a convex section, in which there is a stationary point or location therealong that is a maxima or a minima of the first region of the support structure.

[0016] Preferably, regarding the conduit structure, the first region of the support structure that includes its convex section interfaces with the third portion that include its concave area, and optionally, any one or both the first portion and the second portion.

[0017] Preferably, regarding the conduit structure, the common location along the support structure in which the second region and the third region of the support structure meet is at a distance away from the stationary point or location of the first region in which both of them are substantially aligned to each other.

[0018] Preferably, regarding the conduit structure, the second region and the third region of the support structure are oriented to be at a first angle with respect to each other.

[0019] Preferably, regarding the conduit structure, it further comprises an inlet that allows entry of fluid into the conduit structure, and an outlet that allows exit of fluid from the conduit structure.

[0020] The present invention further intends to provide a flow meter comprising at least one conduit structure, and at least one support structure, comprising a body that has one or more regions. The regions of the body of the support structure include a first region that interfaces with the conduit structure, with the first region having a first end and a second end. The regions of the body of the support structure further include a second region that extends from the first end of the first region, and a third region that extends from the second end of the first region. The second region and the third region of the support structure meet at a common location that is at a distance away from the first region of the support structure.

[0021] Preferably, regarding the flow meter, the conduit structure comprises one or more portions, which include a first portion, a second portion, and a third portion, wherein the third portion is in connection with the first portion and the second portion, and the third portion includes at least one concave area.

[0022] Preferably, regarding the flow meter, the first region of the support structure has a convex section, in which there is a stationary point or location therealong that is a maxima or a minima of the first region of the support structure.

[0023] Preferably, regarding the flow meter, the first region of the support structure that includes its convex section interfaces with the third portion of the conduit structure that include its concave areas, and optionally, any one or both the first portion and the second portion of the conduit structure.

[0024] Preferably, regarding the flow meter, the common location along the support structure in which the second region and the third region of the support structure meet is at a distance away from the stationary point or location of the first region of the support structure in which both of them are substantially aligned to each other.

[0025] Preferably, regarding the flow meter, the conduit structure further comprises an inlet that allows entry of fluid into the conduit structure, and an outlet that allows exit of fluid from the conduit structure.

[0026] Preferably, regarding the flow meter, it further comprises at least one exciter module for inducing the conduit portion to vibrate, and one or more detector modules for sensing vibrations of the conduit structure that allow for computation of mass flow characteristics of the fluid flowing through the conduit structure.

[0027] One skilled in the art will readily appreciate that the invention is well adapted to carry out the objects and obtain the ends and advantages mentioned, as well as those inherent therein. The embodiments described herein are not intended as limitations on the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] To facilitate an understanding of the invention, there is illustrated in the accompanying drawings the preferred embodiments from an inspection of which when

considered in connection with the following description, the invention, its construction and operation and many of its advantages would be readily understood and appreciated.

[0029] FIG. 1 illustrates a first side view of the support structure, according to one example embodiment.

[0030] FIG. 2 illustrates a second side view of the support structure, according to one example embodiment.

[0031] FIG. 3 illustrates a perspective view of one conduit structure that has the support structure, according to one example embodiment.

[0032] FIG. 4 illustrates a side view of one conduit structure that has the support structure, according to one example embodiment.

[0033] FIG. 5 illustrates a perspective view of a flow meter having one or more conduit structures that have the support structure, according to one example embodiment.

[0034] FIG. 6 illustrates a side view of the flow meter having one or more conduit structures that have the support structure, according to one example embodiment.

[0035] FIG. 7 illustrates a diagram showing forces acting upon one conduit structure that lacks the support structure of the present invention, in a simulation environment.

[0036] FIG. 8 illustrates a diagram showing forces acting upon one conduit structure that has the support structure of the present invention, in a simulation environment.

DETAILED DESCRIPTION OF THE INVENTION

[0037] The present invention relates to a support structure that is to be part of at least one conduit structure of a flow meter, for stiffening the conduit structures against exerted forces as the flow meter is under operation. The support structure may be part of the conduit

structure, and shall advantageously minimize the deformation of the conduit structure over time.

[0038] From hereon, it is to be noted that, in the context of the present application, the term “fluid” may refer to matter that is in a liquid state, a gaseous state, a liquid-gaseous state, or any other state which enables the said matter to exhibit flow properties.

[0039] **FIG. 1** and **FIG. 2** illustrate the support structure **100** of the present invention. More specifically, **FIG. 1** illustrates a first side view of the support structure **100**, while **FIG. 2** illustrates a second side view of the support structure **100**.

[0040] With reference to **FIG. 1** and **FIG. 2**, the support structure **100** may be a body that is defined across one or more orthogonal axes that include a first axis (e.g., the x-axis), a second axis (e.g., y-axis), and a third axis (e.g., z-axis). The body of the support structure **100** may be fully solid, partially solid (e.g., mesh-like), or the like. The body of the support structure **100** may comprise a plurality of regions, which may include a first region **110**, a second region **120**, and a third region **130**.

[0041] With reference to **FIG. 1** and **FIG. 2**, the first region **110** of the support structure **100** may be represented by one or more edges that form at least one perimeter that may define at least one area or surface that may have one or a combination of one or more curves, one or more planes, and one or more discontinuities. Preferably, the first region **110** as shown in **FIG. 1** and **FIG. 2** has at least one area or surface that exhibits at least one curve that may have a convex section, which may be similar to a “U” shape, a “V” shape, or the like. Along the convex section, there may be at least one the stationary point or location that may be a maxima or minima of the convex section. The first region **110** may be one that is substantially parabolic, in which there may be an axis or of symmetry or a plane of symmetry, which may be along the stationary point or location of the first region **110**, that is parallel to at least one orthogonal axis or plane (e.g., the z-axis, or the zx-plane).

[0042] With reference to **FIG. 1** and **FIG. 2**, the first region **110** of the support structure **100** may include a first end **111** and a second end **112**. The first end **111** and the second end **112** may each be located along the first region **110** at a location that is furthest away from the

stationary point or location. These ends **111**, **112** may be substantially at a distance away from each other.

[0043] With reference to **FIG. 1** and **FIG. 2**, the second region **120** of the support structure **100** may be represented by one or more edges that form at least one perimeter that may define at least one area or surface that may have one or a combination of one or more curves, one or more planes, and one or more discontinuities. Preferably, the second region **120** as shown in **FIG. 1** and **FIG. 2** has at least one area or surface that is substantively planar. The second region **120** may extend from the first end **111** of the first region **110** towards the perimeter of the first region **110**.

[0044] With reference to **FIG. 1** and **FIG. 2**, the third region **130** of the support structure **100** may be represented by one or more edges that form at least one perimeter that may define at least one area or surface that may have one or a combination of one or more curves, one or more planes, and one or more discontinuities. Preferably, the third region **130** as shown in **FIG. 1** and **FIG. 2** has at least one area or surface that is substantively planar. The third region **130** may extend from the second end **112** of the first region **110** towards the perimeter of the first region **110**.

[0045] With reference to **FIG. 1** and **FIG. 2**, as the second region **120** and the third region **130** each extend from a corresponding end **111**, **112** of the first region **110**, the second region **120** and the third region **130** may meet at a common location. The common location is one that may be at a distance away from the perimeter of the first region **110**. In particular, the common location in which the second region **120** and the third region **130** meet may be one that is along the axis of symmetry or plane of symmetry of the first region **110**. More specifically, the common location may be at a distance away from the stationary point or location located along the convex section of the first region **110**, while being in alignment therewith via the axis of symmetry or plane of symmetry of the first region **110**. With that, there is a distance *DI* between the common location and the stationary point or location located along the convex section of the first region **110**.

[0046] With reference to **FIG. 1** and **FIG. 2**, it is to be noted that the second region **120** has a first spatial extent between the first end **111** of the first region **120** and the common location,

and the third region **130** has a second spatial extent between the second end **112** of the first region **110** and the common location. The first spatial extent may be substantially equivalent to the second spatial extent in terms of their vector or scalar lengths.

[0047] With reference to **FIG. 1** and **FIG. 2**, it is to be noted that the axis of symmetry or plane or symmetry of the first region **110** may also be the axis of symmetry or plane or symmetry of the support structure **100**.

[0048] With reference to **FIG. 1** and **FIG. 2**, as the second region **120** and the third region **130** meet at a common location, they may be orientated with respect to each other at a first angle $\theta 1$. The first angle $\theta 1$ may be any one of an acute angle, a right angle, an obtuse angle, or a straight angle.

[0049] With reference to **FIG. 1** and **FIG. 2**, as the second region **120** and the third region **130** meet at a common location, each of these regions **120**, **130** may be orientated with respect to the axis of symmetry or plane or symmetry of the support structure **110** at a second angle $\theta 2$. The second angle $\theta 2$ may substantially be one that is half of the first angle $\theta 1$.

[0050] It is to be noted that, (i) the location in which the second region **120** extends from the first end **111** of the first region **110**, and (ii) the location in which the third region **130** extends from the second region **120**, may be continuous or discontinuous. With reference to **FIG. 1**, these locations are discontinuous in which there may be at least one edge defined between the regions.

[0051] It is to be noted that the location in which the second region **120** and the third region meet may be continuous or discontinuous. With reference to **FIG. 1** and **FIG. 2**, these locations are discontinuous in which there may be at least one edge defined therealong them.

[0052] With that, it is to be noted that the support structure **100** as presented in **FIG. 1** and **FIG. 2** may be interpreted to have a semicircular shape with a triangular cut-out.

[0053] With reference to **FIG. 1** and **FIG. 2**, the body of the support structure **110** may be further defined to have a fourth region **140** and a fifth region **150**, in which each of them

may be is at least one area or surface defined with at least one perimeter formed from edges that include portions of the first region **110**, portions of the second region **120**, and portions of the third region **130**. Preferably, the fourth region region **140** and the fifth region **150** are at a distance away from each other in which they are separated by the first region **110**, the second region **120**, and the third region **130**. This may define a thickness $T1$ of the body of the support structure **110**.

[0054] It is to be noted that the embodiment of the support structure **100** as presented in **FIG. 1** and **FIG. 2** are meant to be non-limiting. In one example alternative embodiment, the common location in which the second region **120** and the third region **130** meet may be one that is a distance away from the described axis of symmetry or plane of symmetry along the body of the support structure **100**. In such an alternative embodiment, the spatial extent between the first end **111** and the common location and the spatial extent between the second end **112** and the common location may be different, in which the former may be longer than the latter, or vice versa.

[0055] **FIG. 3** and **FIG. 4** illustrate one conduit structure **200** having the support structure **100**, which may be according to the example embodiment of **FIG. 1** and **2**. In particular, **FIG. 3** illustrates its perspective view, while **FIG. 4** illustrates its side view. By way of example, the conduit structure **200** may be a flow tube of a flow meter.

[0056] With reference to **FIG. 3** and **FIG. 4**, the conduit structure **200** may have an elongated and tubular body that allows fluid to flow therethrough. In particular, the conduit structure **200** may have an inlet **211** and an outlet **212**, which may be regarded as ends of the conduit structure **200**. Furthermore, the conduit structure **200** may have one or more portions that accommodate fluid flow, which include a first portion **221**, a second portion **222**, and a third portion **223**.

[0057] With reference to **FIG. 3** and **FIG. 4**, the inlet **211** and outlet **212** are each formed with an opening to enable a flow of fluid through the conduit structure **200**. Furthermore, the inlet **211** and the outlet **212** may each have an elbowed section so that fluid entering the inlet **211** or fluid exiting the outlet **212** may be directed towards a direction different from an incoming direction of the fluid. It is to be noted that the distinctions of the inlet **211** and

outlet **212** may not be limited to as shown in the figures, and they may be swapped if so desired.

[0058] With reference to **FIG. 3** and **FIG. 4**, the first portion **221** and the second portion **222** each may have at least one straight section. Furthermore, the first portion **221** and the second portion **222** may each have a first end and a second end. The first end of the first portion **211** may be in connection with the inlet **221**, and the first end of the second portion **222** may be in connection with the outlet **212**.

[0059] With reference to **FIG. 3** and **FIG. 4**, the third portion **223** may have curved regions or discontinuous regions. By way of example, the third portion **223** may have a shape similar to a “U” shape, a “V” shape, or the like. Preferably, the third portion **223** has at least one curved region in which it may have at least one convex area and one concave area. Furthermore, the third portion **223** may have a first end and a second end. The first end of the third portion **223** may be in connection with the second end of the first portion **211**, and the second end of the third portion **223** may be in connection with a second end of the second portion **222**.

[0060] With reference to **FIG. 3** and **FIG. 4** and with reference to the descriptions of the conduit structure **200** so far, the conduit structure **200** may also substantially have an axis of symmetry or plane of symmetry that is parallel to an orthogonal axis or plane, (e.g., the z-axis, or the zx-plane). The axis of symmetry or plane of symmetry of the conduit structure **200** may be identical to the support structure **100**.

[0061] With reference to **FIG. 3** and **FIG. 4**, the support structure **100** may be part of the conduit structure **200**. In particular, the support structure **100** and the entirety of the conduit structure **200** may be integrally formed as a single piece through additive manufacturing processes such as three-dimensional (3D) printing. In certain alternative embodiments, the support structure **100** is one that may be attachable to and/or detachable from the conduit structure **200**.

[0062] With reference to **FIG. 3** and **FIG. 4**, the first region **110** of the support structure **100** may be interfaced with any one or a combination of the surfaces of the first portion **221**, the

second portion **222**, and the third portion **223** of the conduit structure **200**. More specifically, the convex section along the first region **110** of the support structure **100** may be interfaced with the concave area of the third portion **233** of the conduit structure **200**, and the first region **110** may optionally be interfaced with any one or both the of the first portion **221** and the second portion **222** of the conduit structure **200**. It is to be noted that the first region **110** of the support structure **100** may be entirely covered or partially covered by the surfaces of the conduit structure **200**.

[0063] With reference to **FIG. 3** and **FIG. 4**, the second region **120** and the third region **130** of the support structure **100** may be away from surfaces of the conduit structure **200** except at the areas where the second region **120** and the third region **130** extend from the first region **110** of the support structure **100**.

[0064] With reference to **FIG. 3** and **FIG. 4**, the common location in which the second region **120** and the third region **130** of the support structure **100** meet may be one that is at a distance away from the convex area of the third portion **223** of the conduit structure **200**. As the conduit structure **200** may also substantially have an axis of symmetry or plane of symmetry that is identical to that of the support structure **100**, the common location may be at a distance away from convex area of the third portion **223** of the conduit structure **200** while being in alignment therewith via the aforementioned axis of symmetry or plane or symmetry.

[0065] It is to be noted that as the first region **110** of the support structure **100** is interfaced with the conduit structure **200**, the orientation of the support structure **100** along the conduit structure **200** may be one that perpendicular to the axis of symmetry or plane of symmetry of the conduit structure **200**. Alternatively, the support structure **100** may be orientated to be non-perpendicular with respect to the axis of symmetry of the conduit structure **200**.

[0066] **FIG. 5** and **FIG. 6** illustrates a flow meter **300** comprising one or more conduit structures **200**. More specifically, the flow meter **300** has two conduit structures **200**. Each conduit structure **200** is to have the support structure **100**. By way of example, the flow meter **300** may have a setup similar to that of a Coriolis flow meter, or the like. It is to be noted that the flow meter **300**, the conduit structures **200**, and the support structure may be

integrally formed as a single piece through additive manufacturing methods such as 3D printing.

[0067] With reference to **FIG. 5** and **FIG. 6**, the flow meter **300** further comprises an input **311** and an output **312**. The input **311** may be in connection with inlets **211** of the conduit structures **200**, to allow an inflow of fluid into all conduit structures **200** of the flow meter **300**. Whereas, the output **312** may be in connection with outlets of the conduit structures **200**, to allow fluid from the conduit structures **200** to exit therefrom. It is to be noted that the distinctions of the input **311** and output **312** may not be limited to as shown in the figures, and they may be swapped if so desired.

[0068] With reference to **FIG. 5** and **FIG. 6**, the flow meter **300** further comprises one or more holders, which include a first holder **321**, a second holder **322**, and a third holder **323**. These holders **321 – 323** may be formed from one or more sets of holding elements that may be part of the conduit structures **200** of the flow meter **300**. These holders **321 – 323** are to support the mounting of electronic components that relate to measurement of fluid flow of fluid flowing through the conduit structures **200**.

[0069] With reference to **FIG. 5** and **FIG. 6**, the holding elements of the first holder **321** may be located along the first portion **221** of each conduit structure **200**, the holding elements of the second holder **322** may be located along the second portion **222** of each conduit structure **200**, and the holding elements of the third holder **323** may be located along the third portion **223** of each conduit structure **200**. The first holder **321** and the second holder **322** may be substantially opposite to each other along their respective portions of the conduit structure **200**. Whereas, the third holder **323** may be along a stationary point or location along the convex area of the third portion **223** of the conduit structure **200**. The first holder **321** may support mounting of a first detector module, the second holder **322** may support mounting of a second detector module, and the third holder **323** may support mounting of an exciter module.

[0070] With reference to **FIG. 5** and **FIG. 6**, the first holder **321**, the second holder **322**, and the third holder **322**, which are located along the portions of the conduit structure **200**, may be substantially opposite to the first region **110** of the support structure **100**. The first holder

321 may be located along the first portion **221** of the conduit structure **200** and substantially near to the first end **111** of the first region **110** of the support structure **100**. The second holder **322** may be located along a second portion **222** of the conduit structure **200** and substantially near to the second end **112** of the first region **110** of the support structure **100**. The third holder **232** may be located along the convex area of the third portion **223** of the conduit structure **200** and may be substantially be in alignment with the common location in which the second region **120** and the third region **130** of the support structure **100** meet.

[0071] With reference to **FIG. 5** and **FIG. 6**, the operation of the flow meter **300** shall now be briefly described. First, fluid may enter the flow meter **300** via the input **311**. Subsequently, the fluid may flow through the conduit structures **200**. Finally, the fluid may exit the flow meter **300** via the output **312**. As fluid flows through the conduit structures **200**, the exciter module mounted on the third holder **323** may excite conduit structures **200** for it to vibrate at one or more vibration modes. The first detector module mounted on the first holder **321** and the second detector module on the second holder **322** may then sense the vibrations of the conduit structures **200** at their respective locations, for providing these signals of these vibrations to a receiving device. The receiving device may then compute mass flow characteristics (e.g., mass flow rate) of the fluid flowing through the conduit structures **200**, based on these signals.

[0072] With reference to **FIG. 6**, the forces experienced by the conduit structures **200** of the flow meter **300** are further illustrated. In particular, during operation of the flow meter **300**, fluid may flow through the conduit structures **200** in a single direction from the input **311** to the output **312**. Hence, there may be a unidirectional force that is exerted upon the conduit structures **200** that may be attributed to the flow of the fluid. Due to this force, the conduit structures **200** may gradually deform and become skewed over time according to the direction of the force. As such, the zero point of the flow meter **300** shall become unstable over time. As shown in **FIG. 6**, the fluid flowing within the conduit structures **200** may have a first velocity component v_z along the z-axis and a second velocity component v_y that is along the y-axis, which may exert an overall force in a single direction according to the direction of the overall velocity component V .

[0073] With reference to **FIG. 6**, by having support structure **100** be part of the conduit structures **200**, the support structure **100** may stiffen their corresponding conduit structure **200**. In particular, the portions of the conduit structure **200** that are interfaced with the first region **110** of the support structure **100** are stiffened and thus shall resist the force exerted by the fluid flowing through the conduit structures **200**. More specifically, as fluid flows through the vibrating conduit structure **200**, the support structure **100** shall also provide a force that causes portions of the conduit structures **200** (i.e. the first portion **221** and the second portion **222**) to contract towards a centre of the Coriolis forces that are acting upon the third portion **223** of the conduit structure **200**, for causing a torsional force along the conduit structure **200**. With this, the deformation of the conduit structures **200** over time is decreased and/or eliminated, as such, the zero point stability of the flow meter **300** is maintained.

[0074] **FIG. 7** and **FIG. 8** are figures that illustrates forces acting upon two different conduit structures **200**, which is done in a simulation environment for their comparison. In particular, **FIG. 7** illustrates a diagram showing forces acting upon one conduit structure **200** that lacks the support structure **100** of the present invention in the simulation environment. Whereas, **FIG. 8** illustrates a diagram showing forces acting upon one conduit structure **200** that has the support structure **100** of the present invention in the simulation environment. In particular, within the simulation environment, the conduit structures **200** of **FIG. 7** and **FIG. 8** are set to have similar structural properties, and both are to receive simulated fluid of similar properties.

[0075] With reference to **FIG. 7**, as fluid flows across the conduit structure **200** that lacks the support structure **100** in the simulation environment, it experiences deformation forces that may reach a maximum of around 3.69×10^{-4} N. Whereas, with reference to **FIG. 8**, as fluid flows across the conduit structure **200** having the support structure **100** in the simulation environment, it experiences deformation forces that may reach a maximum of around 2.13×10^{-4} N. This indicates that a conduit structure **200** having the support structure **100** may experience a reduction of deformation forces by as much as 42% as when it is under operation. Hence, by having the support structure **100**, the lifecycle of the conduit structure **200** of the flow meter **300** may be increased for it to be beyond the conventional operational lifespan of 5 – 10 years.

[0076] Furthermore, it by having a conduit structure **200** having the support structure **100** of the present application, the conduit structure **200** may be regarded as having extra material, which adds stiffness to its overall structure. By having a stiffer overall structure, during operation of the conduit structure **200**, certain natural frequencies of the vibration modes of the flow meter **300** may be shifted for them to be lowered. Hence, the conduit structure **200**, as well as its support structure **100**, may be constructed to have a smaller overall size while having the exciter module operating under the same operating frequency.

[0077] With this, a support structure **100** for at least one conduit structure **200** of a flow meter **300**, has been presented and described. The present disclosure includes as contained in the appended claims, as well as that of the foregoing description. Although this invention has been described in its preferred form with a degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangements of parts may be resorted to without departing from the scope of the invention.

CLAIMS

1. A support structure for at least one conduit structure of a flow meter, comprising a body, which has one or more regions that include
 - a first regions that interfaces with the conduit structure of the flow meter, with the first region having a first end and a second end;
 - a second region that extends from the first end of the first region; and
 - a third region that extends from the second end of the first region;wherein the second region and the third region meet at a common location that is at a distance away from the first region.
2. The support structure according to claim 1, wherein the first region has a convex section, in which there is a stationary point or location therealong that is a maxima or a minima of the first region.
3. The support structure according to claim 2, wherein the common location is at a distance away from the stationary point or location of the first region in which both of them are substantially aligned to each other.
4. The support structure according to any one of the preceding claims, wherein
 - the second region has a first spatial extent between the first end of the first region and the common location; and
 - the third region has a second spatial extent between the second end of the first region and the common location;wherein the first spatial extent is either substantially equivalent to, longer than, or shorter than, the second spatial extent.
5. The support structure according to any one of the preceding claims, wherein the second region and the third region are both planar.
6. The support structure according to any one of the preceding claims, wherein the second region and the third region are oriented to be at a first angle with respect to each other.

7. A conduit structure of a flow meter, comprising
at least one support structure, the support structure comprises a body that has one or more regions that include
 - a first region that interfaces with the conduit structure of the flow meter, with the first region having a first end and a second end;
 - a second region that extends from the first end of the first region; and
 - a third region that extends from the second end of the first region;wherein the second region and the third region of the support structure meet at a common location that is at a distance away from the first region of the support structure.
8. The conduit structure according to claim 7, further comprising one or more portions that accommodates fluid flow, which include a first portion, a second portion, and a third portion, wherein the third portion is in connection with the first portion and the second portion, and the third portion includes at least one concave area.
9. The conduit structure according to claim 8, wherein the first region of the support structure has a convex section, in which there is a stationary point or location therealong that is a maxima or a minima of the first region of the support structure.
10. The conduit structure according to claim 9, wherein the first region of the support structure that includes its convex section interfaces with
 - the third portion that include its concave area; and optionally,
 - any one or both the first portion and the second portion.
11. The conduit structure according to claim 9 or 10, wherein the common location along the support structure in which the second region and the third region of the support structure meet is at a distance away from the stationary point or location of the first region in which both of them are substantially aligned to each other.
12. The conduit structure according to any one of claims 7 – 11, wherein the second region and the third region of the support structure are oriented to be at a first angle with respect to each other.

13. The conduit structure according to any one of claims 7 – 12, further comprising an inlet that allows entry of fluid into the conduit structure; and an outlet that allows exit of fluid from the conduit structure.
14. A flow meter comprising
at least one conduit structure; and
at least one support structure, comprising a body that has one or more regions that include
 - a first region that interfaces with the conduit structure, with the first region having a first end and a second end;
 - a second region that extends from the first end of the first region; and
 - a third region that extends from the second end of the first region;wherein the second region and the third region of the support structure meet at a common location that is at a distance away from the first region of the support structure.
15. The flow meter according to claim 14, wherein the conduit structure comprises one or more portions accommodates fluid flow, which include a first portion, a second portion, and a third portion, wherein the third portion is in connection with the first portion and the second portion, and the third portion includes at least one concave area.
16. The flow meter according to claim 15, wherein the first region of the support structure has a convex section, in which there is a stationary point or location therealong that is a maxima or a minima of the first region of the support structure.
17. The flow meter according to claim 16, wherein the first region of the support structure that includes its convex section interfaces with
 - the third portion of the conduit structure that include its concave areas; and optionally,
 - any one or both the first portion and the second portion of the conduit structure.
18. The flow meter according to claim 16 or 17, wherein the common location along the support structure in which the second region and the third region of the support structure

meet is at a distance away from the stationary point or location of the first region of the support structure in which both of them are substantially aligned to each other.

19. The flow meter according to any one of claims 14 – 18, wherein the conduit structure further comprises

an inlet that allows entry of fluid into the conduit structure; and
an outlet that allows exit of fluid from the conduit structure.

20. The flow meter according to any one of claims 14 – 19, further comprising
at least one exciter module for inducing the conduit portion to vibrate; and
one or more detector modules for sensing vibrations of the conduit structure that allow for computation of mass flow characteristics of the fluid flowing through the conduit structure.