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(54) **VORTEX-INDUCED VIBRATION SUPPRESSION DEVICE AND MATING COLLAR SYSTEM**

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(60) Provisional application No. 61/440,580, filed on Feb. 8, 2011.

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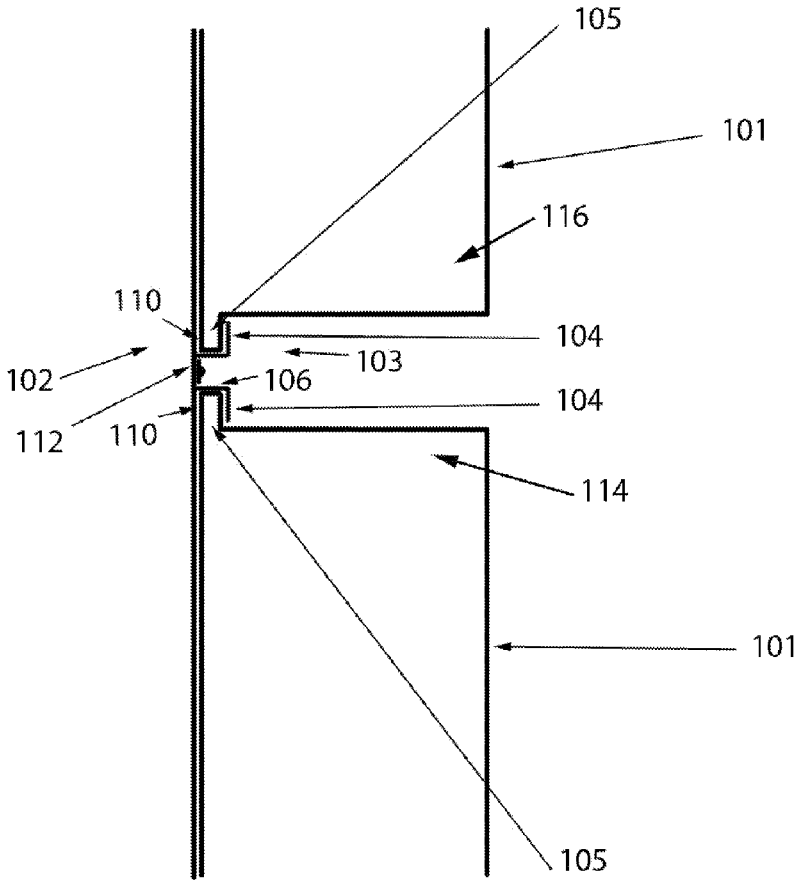
(57) **ABSTRACT**

A system including a vortex-induced vibration (VIV) suppression device dimensioned to suppress a vortex-induced vibration of a support structure, the VIV suppression device having a base portion that encircles at least a portion of the support structure and a support member formed along the base portion. The system further including a collar having a body portion defining an annular channel and a flange portion extending outwardly from the annular channel, the flange portion dimensioned to form a receiving channel around the support structure for receiving the support member. The support member is received within the receiving channel to secure the VIV suppression device to the support structure and the VIV suppression device is capable of rotating around the support structure along the receiving channel.



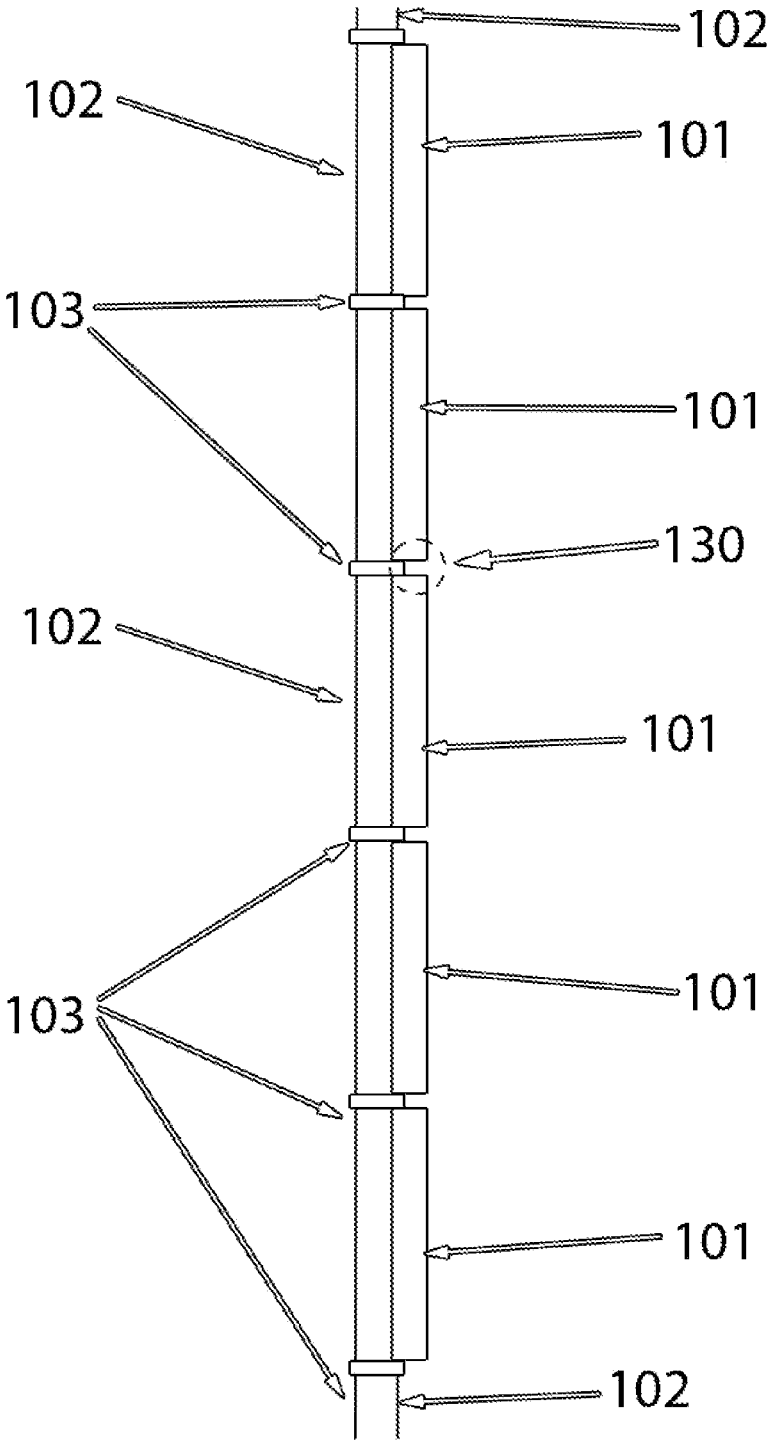


FIG. 1

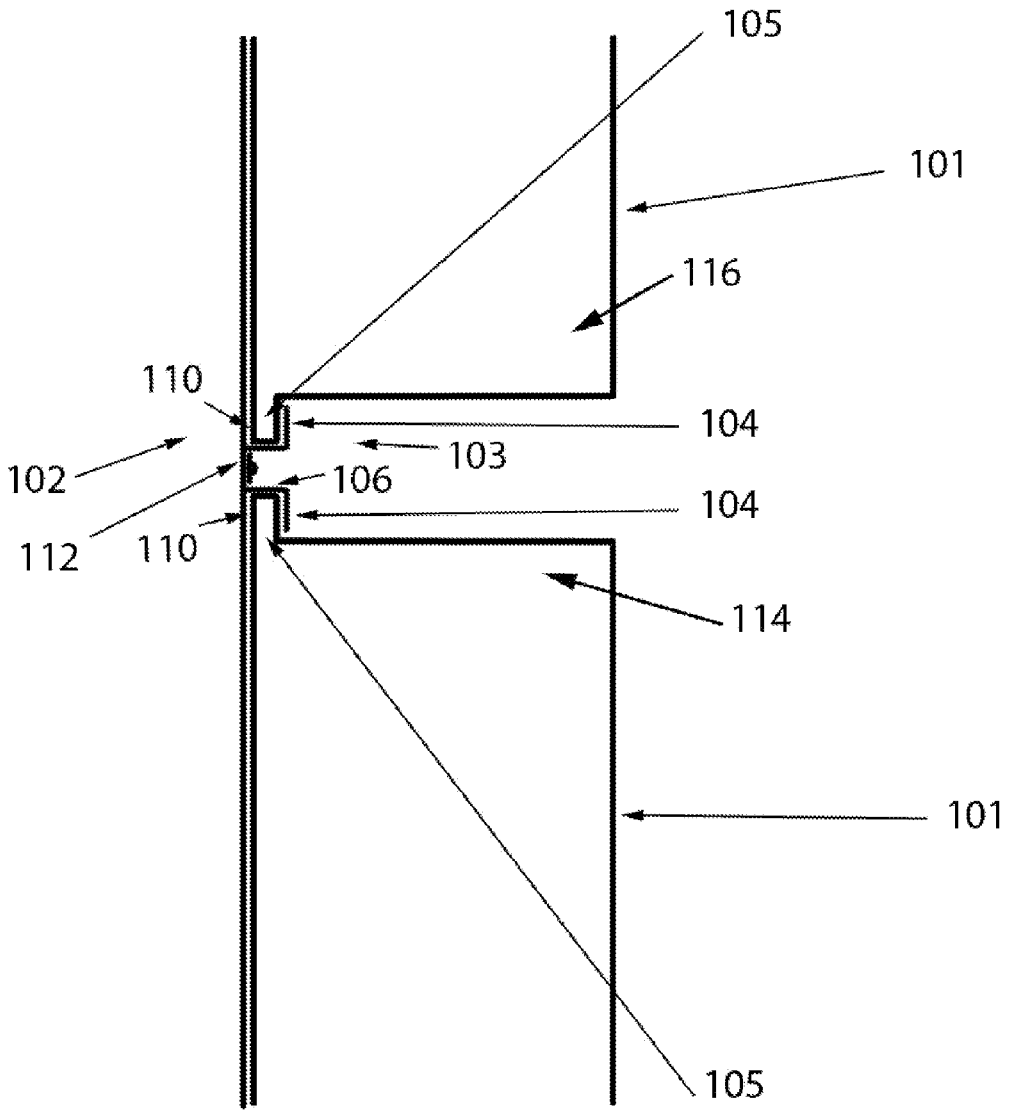


FIG. 2

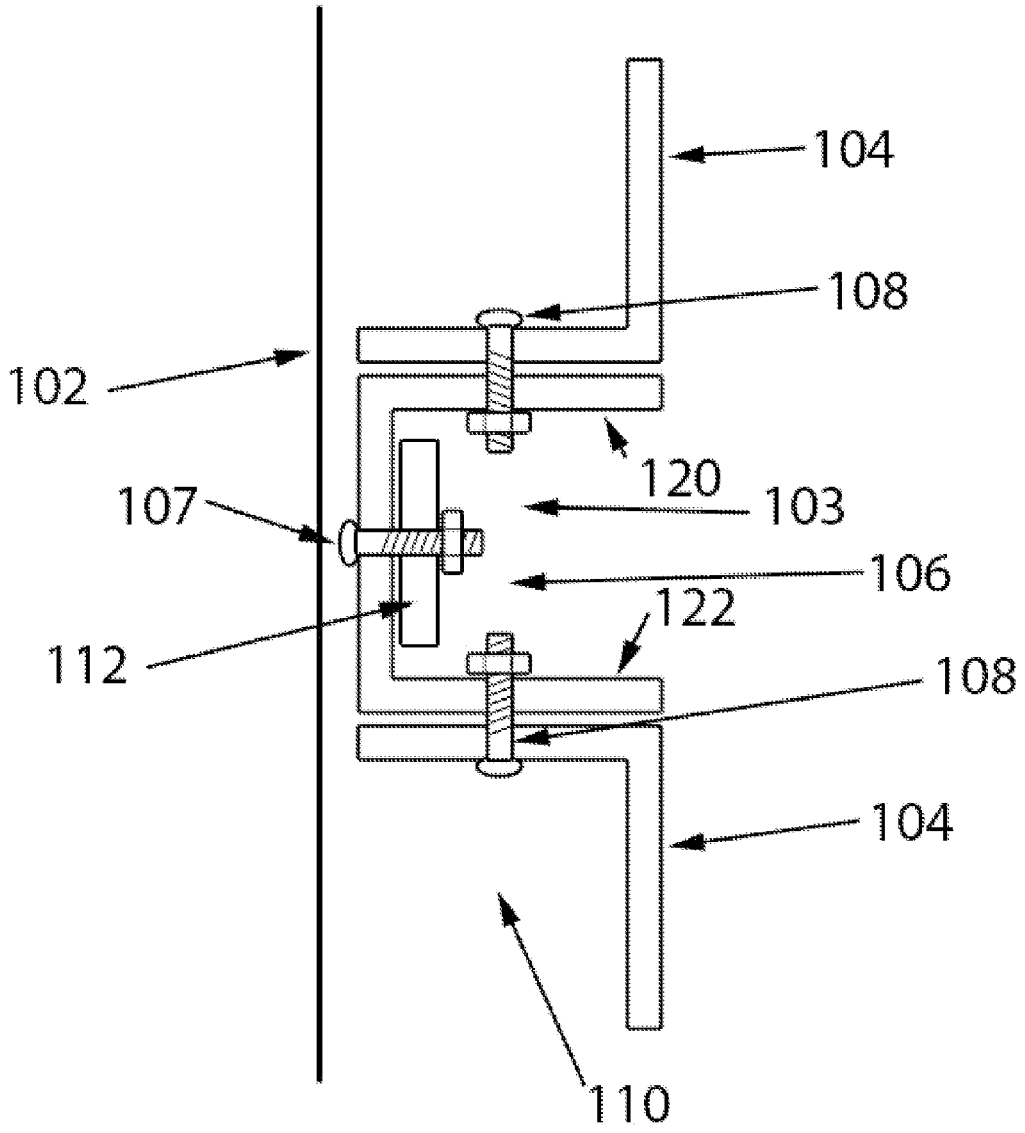


FIG. 3

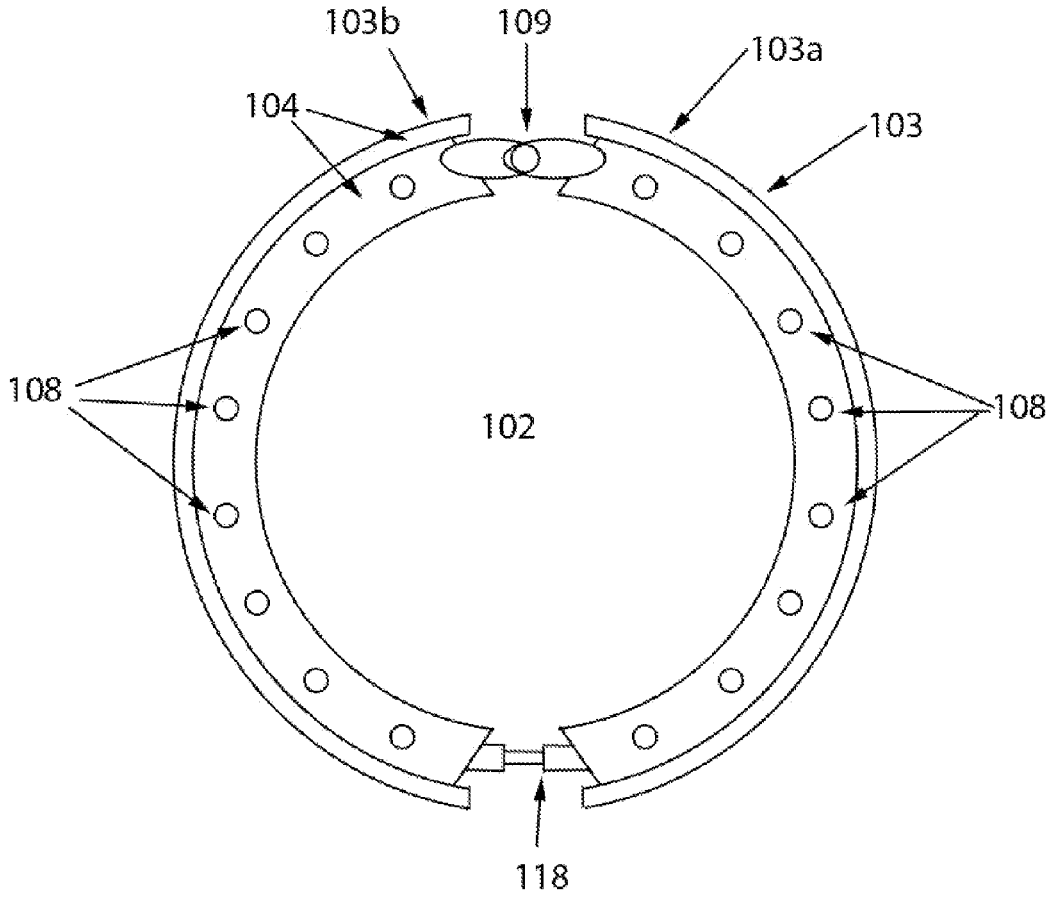


FIG. 4

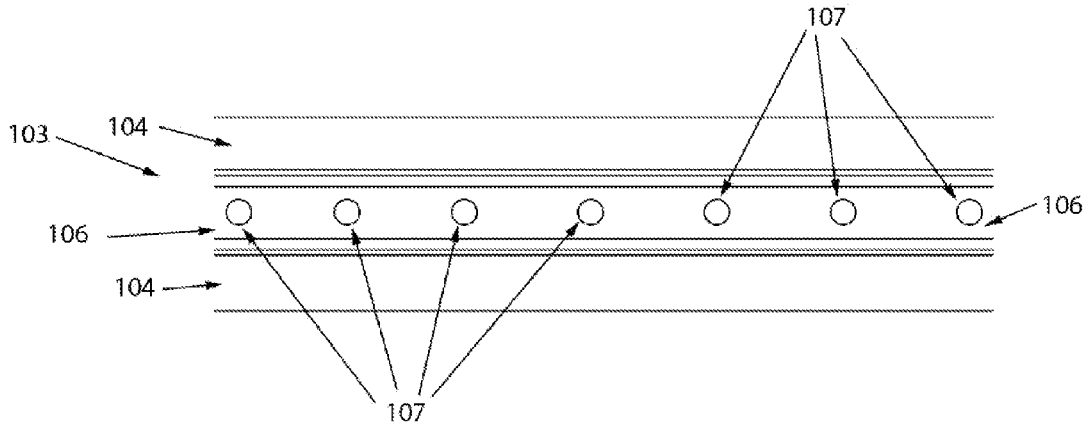


FIG. 5

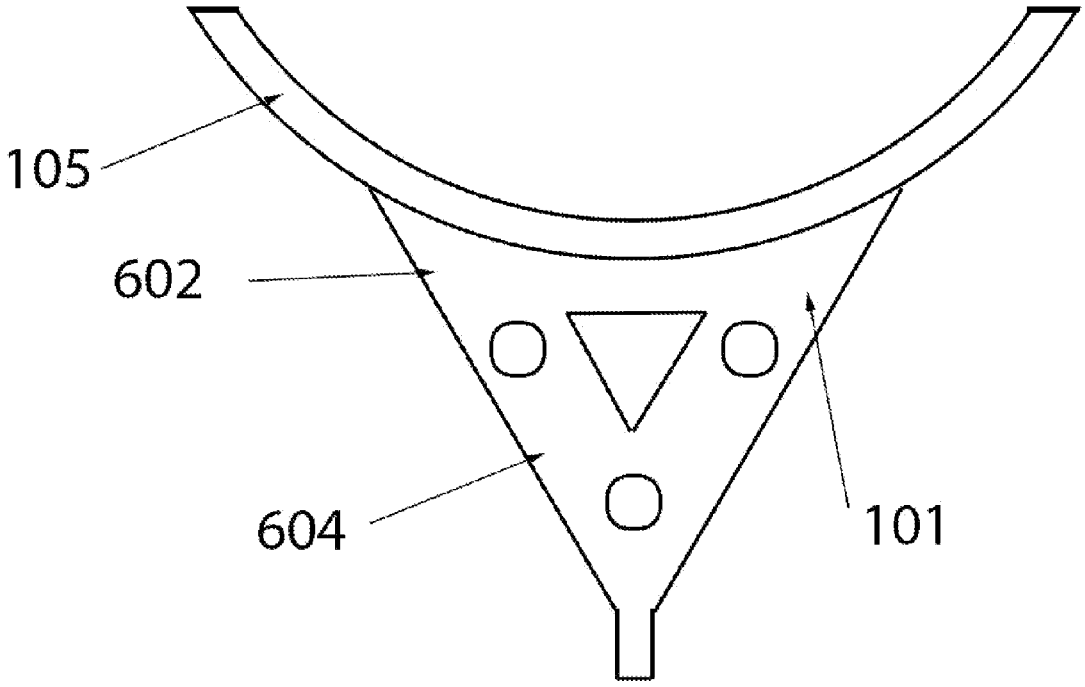


FIG. 6

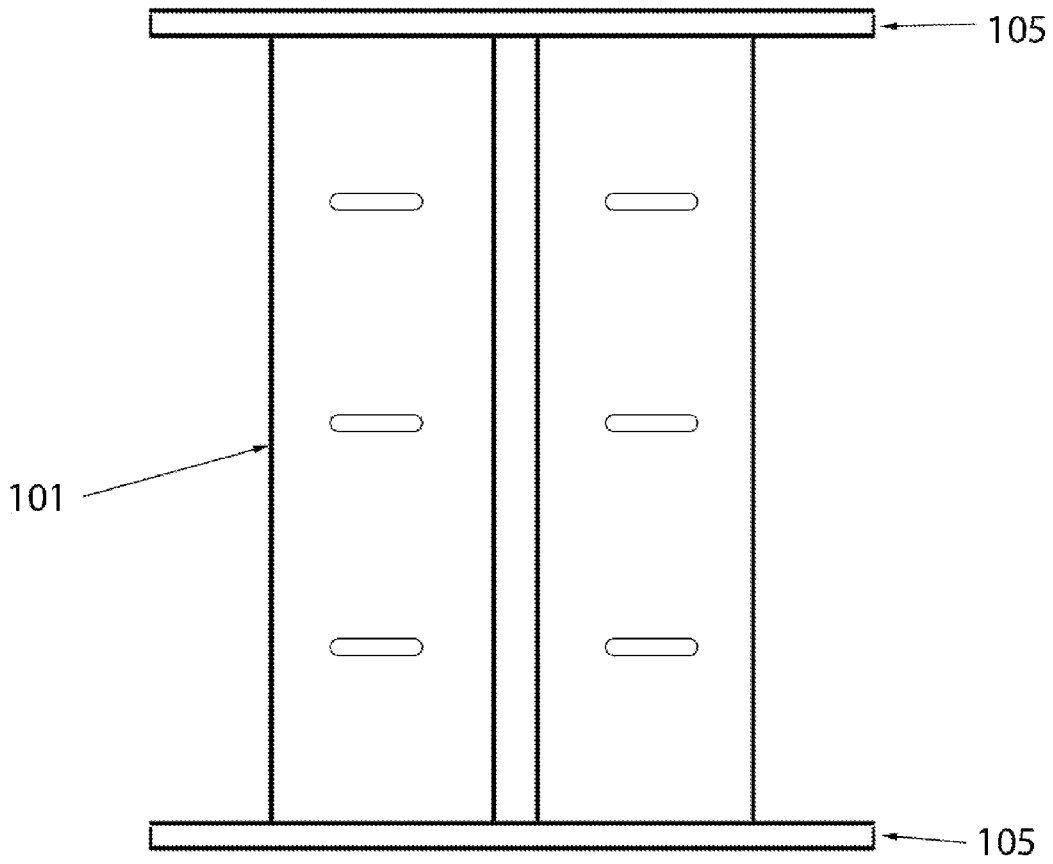


FIG. 7

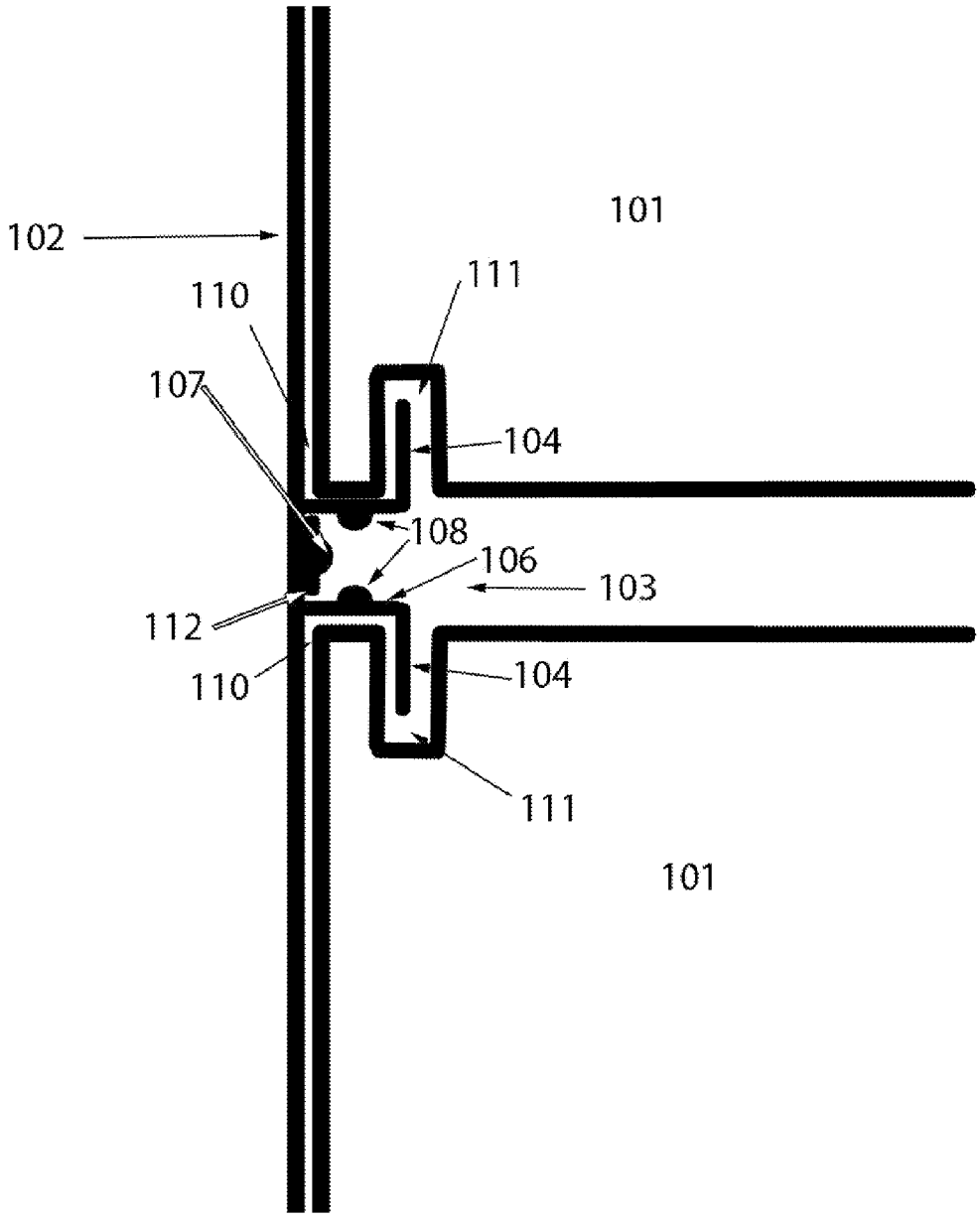


FIG. 8

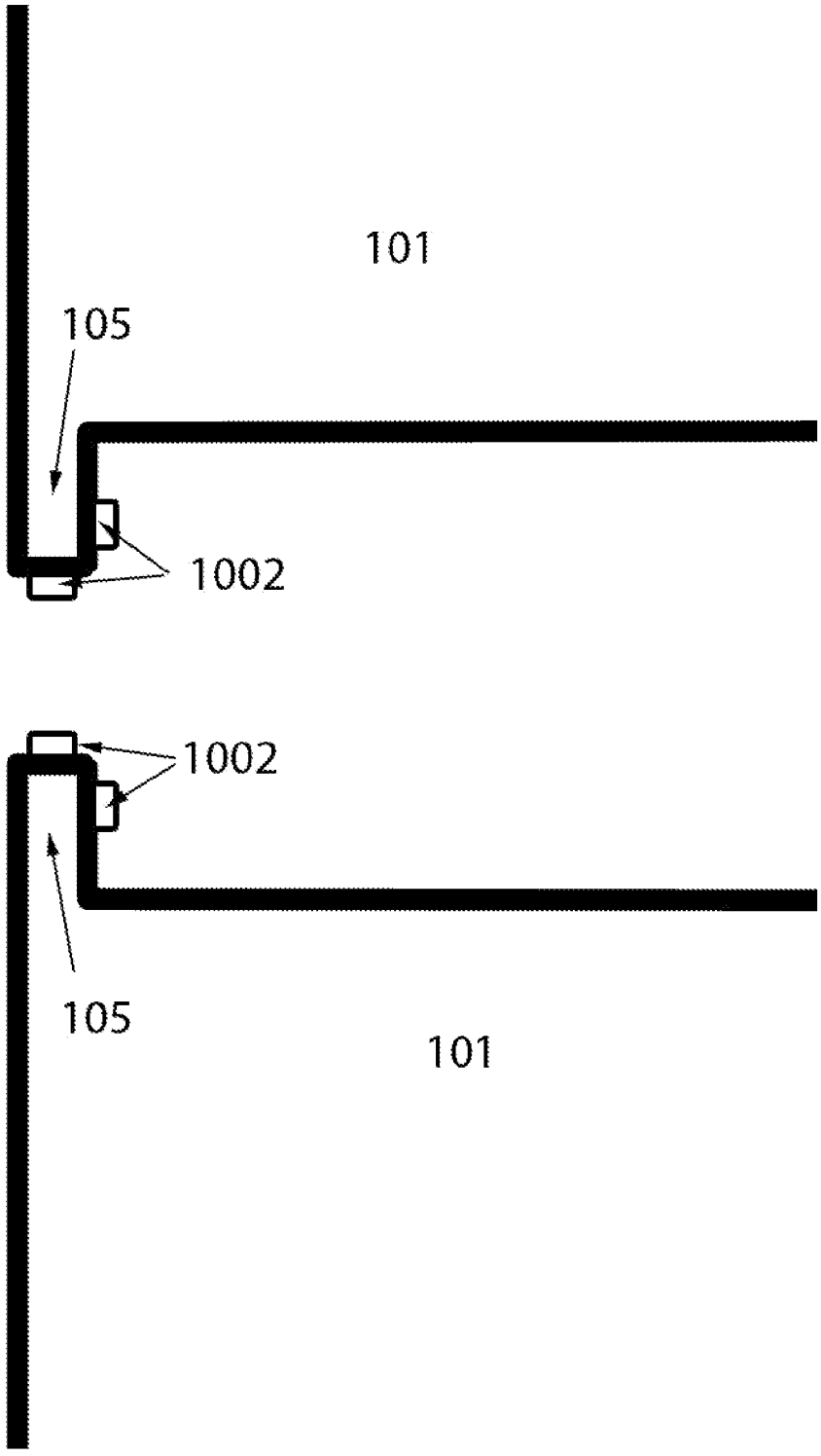


FIG. 9

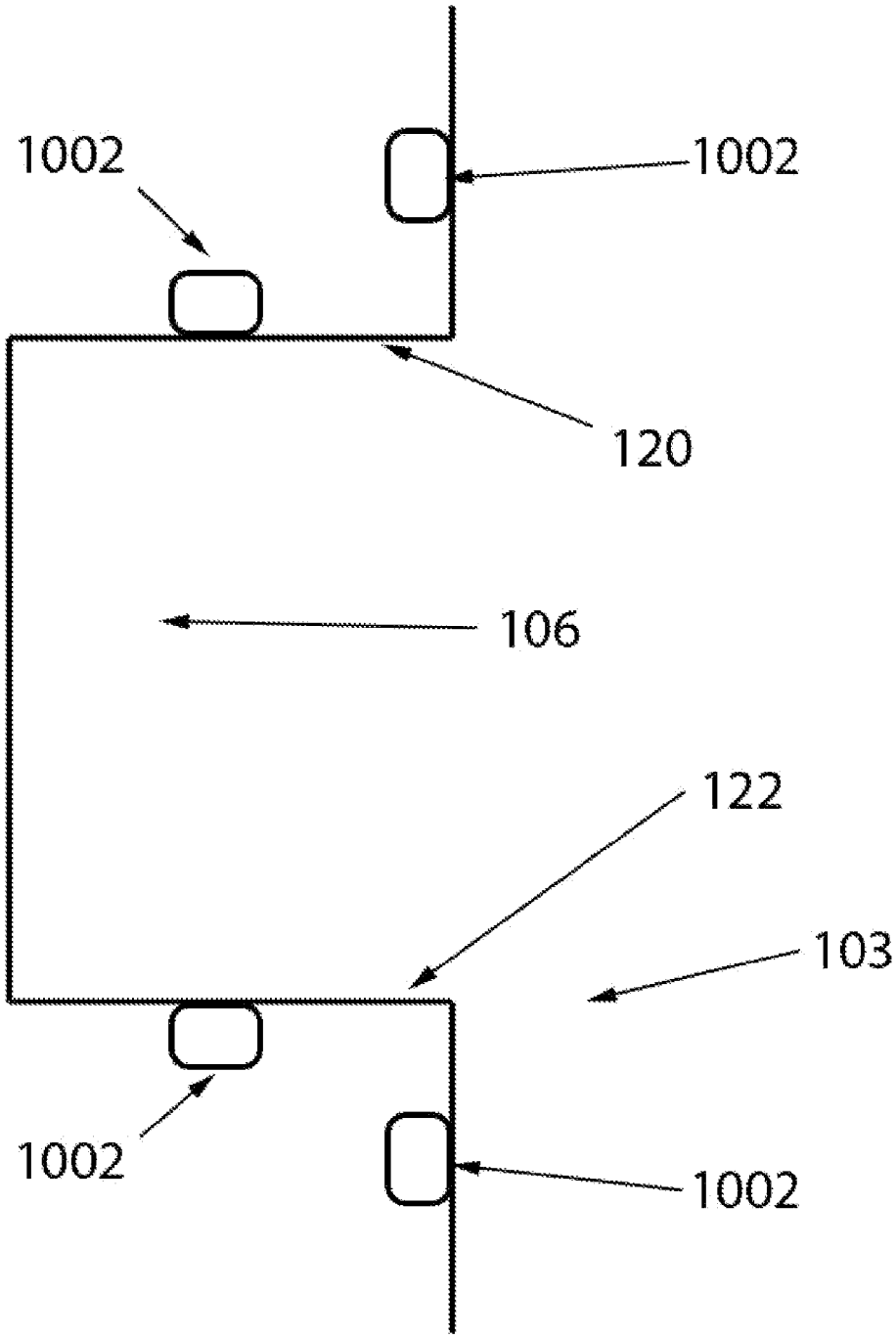


FIG. 10

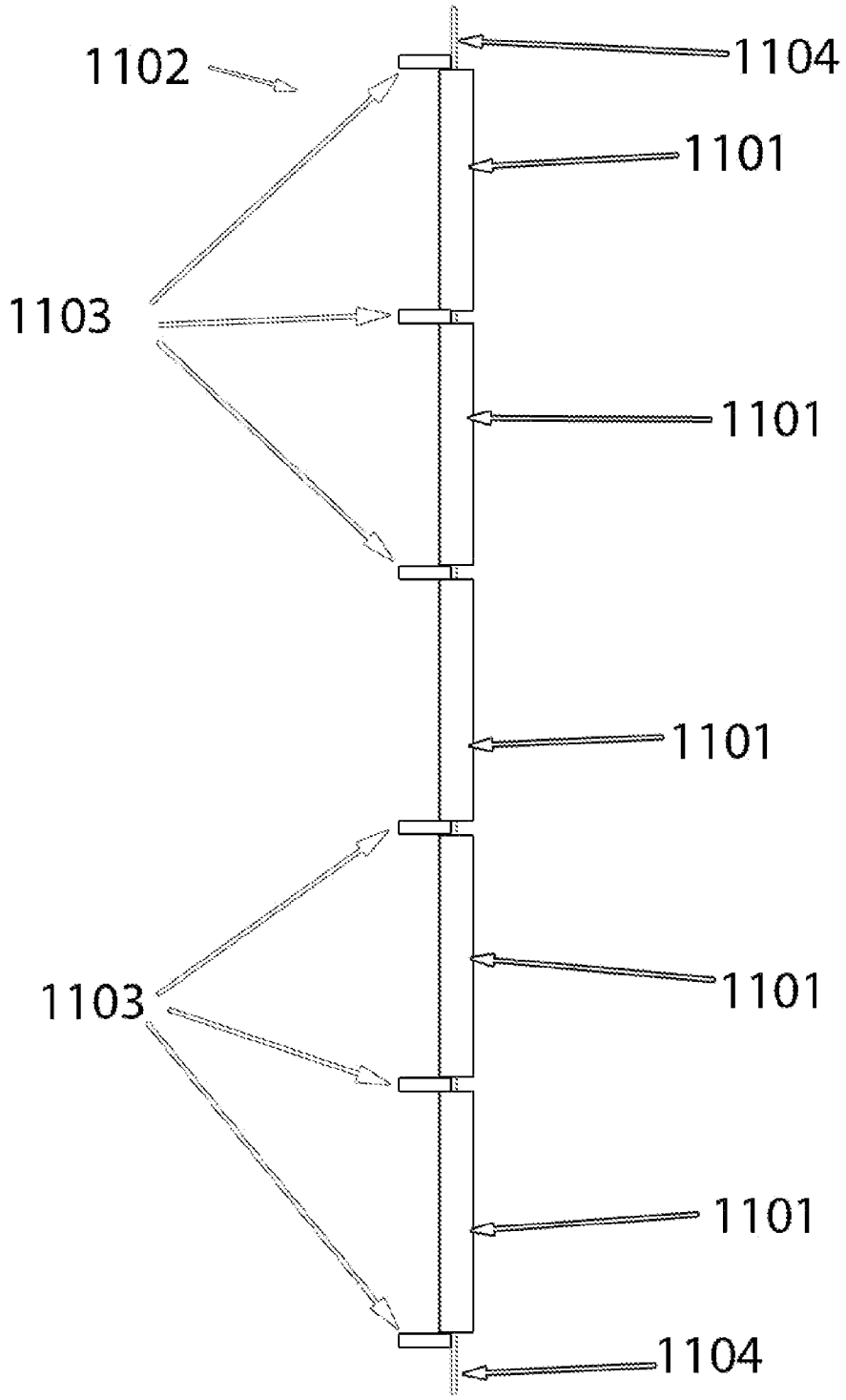


FIG. 11

VORTEX-INDUCED VIBRATION SUPPRESSION DEVICE AND MATING COLLAR SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The application is a divisional of co-pending U.S. patent application Ser. No. 13/368,241, filed Feb. 7, 2012, which application is a non-provisional application of U.S. Provisional Patent Application No. 61/440,580, filed Feb. 8, 2011 and incorporated herein by reference.

FIELD

[0002] A VIV suppression device and mating collar system for supporting the VIV suppression device along a support structure.

BACKGROUND OF THE INVENTION

[0003] A difficult obstacle associated with the exploration and production of oil and gas is management of significant ocean currents. These currents can produce vortex-induced vibration (VIV) and/or large deflections of tubulars associated with drilling and production. VIV can cause substantial fatigue damage to the tubular or cause suspension of drilling due to increased deflections. VIV suppression devices of a variety of sizes and shapes can be attached to the tubular to suppress these ocean current effects on the tubular. One such device is a helical strake, which consists of vanes that are wrapped in a helical pattern around the tubular. While helical strakes, if properly designed, can reduce the VIV fatigue damage rate of a tubular in an ocean current, they typically produce an increase in the drag on the tubular and hence an increase in deflection. Thus, helical strakes can be effective for solving the vibration problem at the expense of worsening the drag and deflection problem.

[0004] Another solution is to use fairings as the VIV suppression device. Typical fairings have a substantially triangular shape and work by streamlining the current flow past the tubular. A properly designed fairing can reduce both the VIV and the drag. Fairings are usually made to be free to weathervane around the tubular with changes in the ocean current. Fairings are usually designed with a specific chord-to-thickness ratio (chord divided by thickness), with the chord measured from the tip of the fairing nose to the tip of the fairing tail, and the thickness measured across the fairing normal to the flow direction, thus the chord is typically at least a little larger than the thickness.

[0005] One of the most important components of the overall system cost of fairings is the installation costs. For many applications, the cost of installation can exceed the cost of the fairing system hardware. In particular, drilling risers require fast installation times for fairings due to the very large cost associated with the drilling rig, where the rig is priced by the day. Fairing installation, however, can be time consuming, which in turn drives up costs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The embodiments disclosed herein are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings in which like references indicate similar elements. It should be noted that references to "an" or "one" embodiment in this disclosure are not necessarily to the same embodiment, and they mean at least one.

[0007] FIG. **1** illustrates a side view of one embodiment of VIV suppression devices and collars positioned around a support structure.

[0008] FIG. **2** illustrates a cross-sectional side view of one embodiment of VIV suppression devices and collars positioned around a support structure.

[0009] FIG. **3** illustrates a cross-sectional side view of one embodiment of a collar having flanges.

[0010] FIG. **4** illustrates a top view of one embodiment of a collar having flanges.

[0011] FIG. **5** illustrates a front view of one embodiment of a collar having flanges.

[0012] FIG. **6** illustrates a top view of one embodiment of a VIV suppression device having a support member.

[0013] FIG. **7** illustrates a front view of one embodiment of a VIV suppression device having a support member.

[0014] FIG. **8** illustrates a cross-sectional side view of another embodiment of a VIV suppression device and a collar.

[0015] FIG. **9** illustrates a cross-sectional side view of a bottom end and a top end of one embodiment of adjacent VIV suppression devices having bearings.

[0016] FIG. **10** illustrates a cross-sectional side view of one embodiment of a collar having a bearing.

[0017] FIG. **11** illustrates a side view of an embodiment of an installation system for VIV suppression devices and collars.

DETAILED DESCRIPTION OF THE INVENTION

[0018] In this section we shall explain several preferred embodiments with reference to the appended drawings. Whenever the shapes, relative positions and other aspects of the parts described in the embodiments are not clearly defined, the scope of the embodiments is not limited only to the parts shown, which are meant merely for the purpose of illustration. Also, while numerous details are set forth, it is understood that some embodiments may be practiced without these details. In other instances, well-known structures and techniques have not been shown in detail so as not to obscure the understanding of this description.

[0019] FIG. **1** illustrates a side view of one embodiment of VIV suppression devices and collars positioned around a support structure. VIV suppression devices **101** are positioned around support structure **102** and restrained axially by collars **103**. Support structure **102** may be any structure that experiences VIV. Representatively, support structure **102** may be an underwater tubular structure. VIV suppression devices **101** may be any type of device suitable for suppressing VIV of support structure **102**, for example, fairings. In some embodiments, the fairings are tail fairings that do not include a strap to attach the tail fairing to an underlying support structure. Alternatively, the fairings may be full fairings, meaning the fairing tail extends from a cylindrical body that wraps around tubular **102**. Alternatively, each of VIV suppression devices **101** may be any type of suppression device that is positioned around tubular **102** and held in place axially using collars **103**, for example, a tubular fairing, a helical strake or a VIV suppression device that encircles the underlying tubular and has other shapes and sizes (e.g. round, square, rectangular, etc). Each of VIV suppression devices **101** may be the same type of device or different types of devices. For example, they may be any combination of fairings and helical strakes.

[0020] Collars **103** are positioned between each of VIV suppression devices **101** to axially restrain VIV suppression devices **101** along support structure **102**. In this aspect, collars **103** are of a size and dimension that allows them to be tightly secured around support structure **102** at a desired position. In one embodiment, collars **103** may be substantially cylindrical structures that have a clam shell type configuration that allows them to be opened and tightly closed around support structure **102** to hold them in place. In some embodiments, VIV suppression devices **101** may mate with collars **103** in a manner that axially restrains VIV suppression devices **101** along support structure **102** and holds VIV suppression devices **101** around support structure **102** while still allowing VIV suppression devices to rotate around support structure **102**. Collars **103** and/or VIV suppression devices **101** may be dimensioned such that VIV suppression devices **101** weathervane around the entire circumference of support structure **102**, only a portion of support structure **102**, or, alternatively, do not weathervane at all. Since collars **103** mate with VIV suppression devices **101**, a typical installation sequence along support structure **102** may include the installation of a collar **103**, then the installation of a VIV suppression device **101**, then the installation of a collar, etc. alternating between VIV suppression devices and collars.

[0021] VIV suppression devices **101** and collars **103** may be made of metal (such as stainless steel, copper, aluminum, Inconel, brass, or other metal), plastic (such as ABS, PVC, polyethylene, or other plastic), wood, rubber (such as urethane), fiberglass, other composite, material, synthetic material, or any suitable material. VIV suppression devices **101** and collars **103** may be made of the same material or may be made of different materials. More than one material may be used in the construction of VIV suppression devices **101** and/or collars **103**. VIV suppression devices **101** and collars **103** may be made by any suitable means including molding, forming, or the like.

[0022] In one embodiment, collars **103** mate with VIV suppression devices **101** through mating members on abutting sides of collars **103** and VIV suppression devices **101**. Mating collars **103** with their respective VIV suppression devices **101** provides several installation advantages. In particular, as previously discussed, VIV suppression devices **101** may be tail fairings. Tail fairings are typically secured around the associated supported structure using one or more straps that attach to opposing sides of the tail fairing and wrap around the support structure. Installation of each tail fairing is time consuming because each strap must be secured to the fairing and around the support structure. For example, it can take on average 5-6 minutes to install a tail fairing around a support structure using a strap. By mating collars **103** with VIV suppression devices **101** (e.g. tail fairings), a strap or other securing mechanism that wraps around the support structure is no longer needed to secure the VIV suppression device around the support structure. In particular, the components disclosed herein allow for the installation of, for example, a tail fairing in approximately 1-2 minutes. Thus, significantly reducing installation time and, in turn, installation costs.

[0023] FIG. **2** illustrates an exploded cross sectional side view of a portion of a mating collar and VIV suppression device arrangement. The portion illustrated in FIG. **2** corresponds to portion **130** identified in FIG. **1** with dashed lines. From this view, it can be seen that collar **103** includes a body portion that defines annular channel **106** and flange portions **104** that extend outwardly from annular channel **106**. Annular channel **106** may be dimensioned to receive strap or band **112** or other securing mechanism for securing collar **103** around support structure **102**. In particular, strap **112** encircles collar **103** once it is positioned around support structure **102** and can be tightened so that collar **103** fits snuggly around support structure **102**.

[0024] Flange portions **104** may be of any desired size and shape, and may be attached to collar **103** by any suitable means, including mechanical fastening, chemical bonding, welding, or clamping. It is important to note that collar **103** and one or more flange portions **104** may be of a single piece construction so that there is no need for an additional fastening means to fasten one or more flange portions **104** to collar **103**.

[0025] Flange portions **104** may be substantially planar structures that extend outwardly from a side wall of annular channel **106**. Flange portions **104** may extend from only one side of annular channel **106** or both sides of annular channel **106** such that flange portions **104** extend from both a top and bottom of collar **103**. The terms top and bottom refer to opposing ends of the vertically aligned collar **103**. For example, the top is the end of collar **103** facing the sky and the bottom is the end of collar **103** facing the sea floor, when collar **103** is positioned around support structure **102**. Flange portions **104** may extend from the sidewall of annular channel **106** at an angle of approximately 90 degrees. In this aspect, flange portions **104** form an L-shaped structure with the sidewall of annular channel **106**. Alternatively, flange portions **104** may have other shapes (e.g. a curved shape) and extend at other angles (e.g. less than 90 degrees) to accommodate other geometries of mating support members **105** extending from VIV suppression device **101**. For example, flange portions **104** may have a shape such that they form a C-shaped, U-shaped, or V-shaped structure with the sidewall of annular channel **106**. Support members **105** may be T-shaped or C-shaped, instead of rectangular as shown in FIG. **2**. The above described configuration provides for fast installation. Note that it is possible to preinstall one or more components. It is also possible to install one or more support members **105** and/or one or more collar flange portions **104** during vessel installation of the system.

[0026] Flange portions **104** may form an annular receiving channel **110** around support structure **102** for receiving support member **105**. Support member **105** may extend from one or both ends of VIV suppression devices **101**. FIG. **2** illustrates support member **105** extending from a top end **114** of VIV suppression device **101** and another support member **105** extending from bottom end **116** of the abutting VIV suppression device. Receiving channel **110** may be of any size and shape suitable for receiving and mating with support member **105**. Representatively, in embodiments where support member **105** is a substantially rectangular protrusion extending from an end of VIV suppression device **101** in an axial direction, receiving channel **110** may have a substantially rectangular or square cross-sectional dimension with an open end so that support member **105** can be inserted into receiving channel **110**. Other sizes and shapes (e.g. C-shaped, U-shaped or V-shaped) may also be suitable so long as receiving channel **110** is capable of receiving and mating with support member **105**.

[0027] Where VIV suppression device **101** includes support member **105** extending from both ends (see FIG. **7**), both ends can be secured within receiving channel **110** of the respective adjacent collar **103**. Since both the top and bottom

ends of VIV suppression device **101** are inserted into receiving channel **110**, VIV suppression device **101** is restrained from axial motion along support structure **102** while still allowing VIV suppression device **101** to weathervane around support structure **102** as support member **105** slides within receiving channel **110**. In addition, receiving channel **110** formed by flange portions **104** prevents VIV suppression device **101** from being able to pull away normally from support structure **102**. In this aspect, an additional securing mechanism (e.g. a strap, band or the like) is not needed to secure VIV suppression device **101** to support structure **102**.

[0028] Flange portions **104** and support members **105** may be made of the same or different materials as each other and collar **103** and VIV suppression device **101**, respectively. Representatively, flange portions **104** and support members **105** may be made of metal (such as stainless steel, copper, aluminum, Inconel, brass, or other metal), plastic (such as ABS, PVC, polyethylene, or other plastic), wood, rubber (such as urethane), fiberglass, other composite, material, synthetic material, or any suitable material. Still further, more than one material may be used in the construction of flange portions **104** and support members **105**. Flange portions **104** and support members **105** may be made by any suitable means including molding, injection forming, or the like. Flange portions **104** and support members **105** may be integrally formed as a single unit with collar **103** and VIV suppression device **101**, respectively, or separately formed and attached to the preformed structure, for example, by mounting or bolting the pieces together.

[0029] Representatively, as illustrated in the exploded cross-sectional side view of FIG. **3**, in one embodiment, flange portions **104** are separate structures that are attached to a preformed substantially U-shaped collar **103**. It is noted that similar to FIG. **2**, the portion illustrated in FIG. **3** corresponds to portion **130** identified in FIG. **1** with dashed lines. Collar **103** is shown adjacent to support structure **102**, and contacts support structure **102** once strap **112** is tightened around the circumference of support structure **102**. Strap **112** is attached to collar **103** by fastener **107**. Fastener **107** may be, for example, a bolt or other similar fastening mechanism. Strap **106** may, however, be attached to collar **103** by any suitable means, including mechanical fastening, banding, welding, chemical bonding, or by making strap **112** and collar **103** in a single piece. Alternatively, collar **103** may be tightened around support structure **102** by other means and strap **112** omitted. For example, collar **103** may be a clam shell structure having a spring and bolt mechanism that can be used to tighten the free ends together and accommodate variations in the diameter of support structure **102**.

[0030] Flange portions **104** may have a substantially L-shaped profile and may be attached to sidewalls **120**, **122** of collar **103** by any suitable fastening means **108**, including mechanical fastening, banding, welding, chemical bonding. Alternatively, collar **103** and one or more collar flange portions **104** may be formed as a single integrally formed piece. Although L-shaped flange portions **104** are illustrated, as previously discussed, flange portions **104** may be of any desired geometry to accept a VIV suppression device and act to constrain the device while still allowing for rotation around the underlying support structure.

[0031] Fasteners **107** and **108** may be countersunk, but as noted above, other attaching mechanisms may be used. Fasteners **107** and **108** may be made of made of metal (such as stainless steel, copper, aluminum, Inconel, brass, or other metal), plastic (such as ABS, PVC, polyethylene, or other plastic), wood, rubber (such as urethane), fiberglass, other composite, material, synthetic material, or any suitable material. More than one material may be used to make each component, and they may, or may not, be made of the same material.

[0032] FIG. **4** illustrates a top view of one embodiment of a collar. Collar **103** is shown placed around support structure **102**. Since flange portion **104** extends outwardly from a top and bottom portion of collar **103**, only a top flange portion **104** can be seen from this view. In particular, it can be seen that in one embodiment, flange portion **104** is attached to the annular channel of collar **103** using fasteners **108**. Collar **103** may be a clam shell type structure such that a first section **103***a* and second section **103***b* of collar **103** are movably attached together with optional hinge **109** at one side and collar fastener **118** at an opposite side. Hinge **109** and fastener **118** may be attached to abutting sections of flange portion **104** or the body portion of collar sections **103***a* and **103***b*.

[0033] Although fasteners **108** are illustrated, fasteners **108** may be replaced by other attachment methods, including other methods of mechanical fastening, banding, welding, chemical bonding, or by integrally forming collar **103** with flange portions **104** as a single piece. Hinge **109** is optional, but may be required if collar **103** is too stiff to be easily placed around the support structure **102**. Hinge **109** may be constructed by any suitable method, including: termination of flange portion **104** in the hinge area so that the material stiffness is lower; thinning of the collar **103** and/or flange portion **104** material; use of a different material in the hinge area; or any other suitable hinges that are commercially available. More than one hinge may be used, and the collar **103** and flange portion **104** may be hinged differently, or in different locations. Collar fastener **118** may be replaced by other suitable means of fastening, including mechanical fastening methods, banding, welding, or chemical bonding. Collar fastener **118** may include spring mechanisms that assist in the accommodation of changes in the outside diameter of support structure **102**.

[0034] Hinge **109** and collar fastener **118** may be made of metal (such as stainless steel, copper, aluminum, Inconel, brass, or other metal), plastic (such as ABS, PVC, polyethylene, or other plastic), wood, rubber (such as urethane), fiberglass, other composite, material, synthetic material, or any suitable material. More than one material may be used to make each component, and they may, or may not, be made of the same material.

[0035] FIG. **5** illustrates a front view of one embodiment of a collar. From this view, it can be seen that flange portions **104** extend outwardly from both sides of annular channel **106** formed by the body portion of collar **103**. Strap **106** is positioned within annular channel **106** and attached to collar **103** using fasteners **107**. Strap **106** may act as a strength member for the overall collar **103**, or may act as an anode, or any other desired function. Strap **106** may be attached to collar **103** by any suitable means, including mechanical fastening, banding, welding, chemical bonding, or by making strap **106** and collar **103** in a single piece. Similarly, flange portions **104** may be attached to collar **103** by any suitable means, including mechanical fastening, banding, welding, chemical bonding, or by making collar **103** and one or more flange portions **104** as a single piece.

[0036] Strap **106** may be made of metal (such as stainless steel, copper, aluminum, Inconel, brass, or other metal), plas-

tic (such as ABS, PVC, polyethylene, or other plastic), wood, rubber (such as urethane), fiberglass, other composite, material, synthetic material, or any suitable material. More than one material may be used to make strap **106**.

[0037] FIG. **6** illustrates a top view of one embodiment of a VIV suppression device having support members. In this embodiment, VIV suppression device **101** is illustrated as a fairing having a tail portion **604** that extends from a base portion **602** that is positioned along the underlying support structure. Alternatively, a full fairing (i.e. a fairing having a tail portion extending from a body portion that encircles an underlying structure), or any other type of VIV suppression device that weathervanes about the underlying structure, such as a multi sided device (e.g square, rectangular, etc.), splitter plate(s), or other fairings (e.g. long chord fairing, perforated fairing, etc.).

[0038] As previously discussed, support member **105** extends in an axial direction from the top and bottom of VIV suppression device **101** so that it can be received within receiving channel **110** formed along the top and bottom ends of the abutting collar **103**. From this view, it can be seen that support member **105** may also extend beyond the sides of base portion **602** if VIV suppression device **101** and curve around the underlying support structure **102**. Representatively, support member **105** may be a single structure having a length greater than a width of body portion **602** such that when it is attached along the annulus of base portion **602**, it extends beyond the opposing sides of body portion **602**. In other embodiments, support member **105** may be two separate structures that are attached or formed at opposing sides of body portion **602**.

[0039] Support member **105** can be rounded or curved similar to the outer surface of support structure **102** so as to facilitate rotation around the underlying support structure **102**. Support member **105** may cover only a small portion, or it may cover a large portion, of the support structure circumference. Representatively, support member **105** may have a length that is length than the entire circumference of support structure **102** such that it encircles only a portion of support structure **102**. Support member **105** may be made of one continuous integrally formed piece or separate sections.

[0040] FIG. **7** illustrates a front view of one embodiment of a VIV suppression device. From this view, it can be seen that support members **105** may have the same length such that they each cover the same portion of the underlying support structure circumference, or they may have different lengths such that they cover different portions of the support structure. Support members **105** may be identical in shape, material and construction, or they may be different in shape, material, and construction.

[0041] FIG. **8** illustrates an exploded side cross-sectional view of another embodiment of a VIV suppression device and collar. It is noted that similar to FIG. **2**, the portion illustrated in FIG. **8** corresponds to portion **130** identified in FIG. **1** with dashed lines. In this embodiment, collar **103** is adjacent to support structure **102**. Strap **112** encircles collar **103** and is attached to collar **103** by fastener **107**. Flange portions **104** extend outwardly from annular channel **106** formed by the body portion of collar **103**. In one embodiment, flange portions **104** extend from, and are attached to, sidewalls of annular channel **106** by fasteners **108**.

[0042] Similar to the previously described VIV suppression devices, VIV suppression devices **101** include support members **110** that are received within receiving channel **110** formed between flange portions **104** and support member **102**. In this embodiment, however, support members **110** also form a portion of grooves **111** formed within the ends of VIV suppression devices **101**. Flange portions **104** fit within grooves **111** and keep VIV suppression device **101** from being able to slide axially along support structure **102** or pull away normally from support structure **102**. However, since flange portions **104** are positioned within respective grooves **111**, VIV suppression devices **101** are able to slide around support structure **102** and weathervane with changes in current direction.

[0043] Since, in this embodiment, flange portions **104** serve as a male piece that mates with female piece, grooves **111**, of VIV suppression devices **101**, flange portions **104** may consist of other geometries such as an "I" cross section or a "T" cross section, or any other cross section that allows it to mate and interlock within grooves **111**. Similarly, grooves **111** may be of any suitable shape or cross section that allows them to serve as the female piece in the interface with flange portions **104**. For example, flange portions **104** may form a triangular structure with the outermost end being the wide portion of the triangle and grooves **111** may have a triangular cross-sectional shape complimentary to flange portions **104** such that flange portions **104** can interlock within grooves **111** and prevent VIV suppression devices **101** from pulling away from support structure **102**. Flange portions **104** may be separate from collar **103**, or one or more flange portions **104** and collar **103** may be of a single piece construction. Each of the flange portions **104** attached to collar **103** may be identical or they may be different in size, shape, geometry, attachment, material, or construction.

[0044] Grooves **111** may be constructed in any suitable manner, including molding grooves **111** into VIV suppression devices **101**, or cutting VIV suppression devices **101** to form grooves **111** at each end. In some embodiments, grooves **111** may be substantially annular grooves having a curvature similar to that of support structure **102** so that they follow the curve of the base portion of VIV suppression devices **101**. In this aspect, when flange portions **104** of the abutting collars **103** are inserted within grooves **111**, VIV suppression devices **101** are able to rotate around collars **103** and the associated support structure **102**.

[0045] FIG. **9** illustrates a cross-sectional side view of a bottom end and a top end of adjacent VIV suppression devices. VIV suppression devices **101** may be substantially similar to the previously discussed devices except in this embodiment, bearings **1002** are attached to support members **105**. In one embodiment, bearings **1002** may be pads that provide a bearing surface between the support members **105** and the associated collar and flanges.

[0046] Any number of bearings **1002** may be used. Representatively, in one embodiment, all of the interfacing surfaces between the collar flanges and the collar (or collar flanges) will have one or more bearings. Bearings **1002** may be located on support members **105**, or in embodiments such as that of FIG. **8**, within grooves **111** of VIV suppression devices. Additionally, or alternatively, bearings **1002** may be formed on portions of the associated collars contacting VIV suppression devices **101**. For examples, as illustrated in FIG. **10**, bearings **1002** may be provided on an outer surface of the collar flange or annular channel **106** that contacts support members **105** of VIV suppression devices **101**.

[0047] Bearings **1002** may be of any size, shape, dimension and material suitable for minimizing the friction and/or mini-

mizing any binding of VIV suppression devices **101** so that they are free to weathervane about an underlying structure with less friction or binding. Representatively, bearings **1002** may be made of metal (such as Teflon, stainless steel, copper, aluminum, Inconel, brass, or other metal), plastic (such as ABS, PVC, polyethylene, or other plastic), wood, rubber (such as urethane), fiberglass, other composite, material, synthetic material, or any suitable material. Coatings on the materials (such as Teflon coating) may also be used. More than one material may be used to make each of bearings **1002**, and each of the bearings **1002** may, or may not, be made of the same material (i.e. one bearing may have one material composition, and another bearing may have the same, or a different material composition). Bearings **1002** may be attached to VIV suppression devices **101** or collar **103** by any suitable attachment means, for example, an adhesive, mechanical attachment means (e.g. bolt) or chemical attachment means, or they may be integrally formed with VIV suppression devices **101** or collar **103**.

[0048] FIG. **11** illustrates a side view of an embodiment of an installation system for VIV suppression devices and collars. VIV suppression devices **101** and collars **103** may be substantially similar to any of the previously discussed devices and collars. In one embodiment to facilitate underwater installation of the VIV suppression system **1102**, VIV suppression devices **101** and collars **103** are mated with one another as previously discussed (e.g. by positioning collar flanges against the support members or grooves of the VIV suppression devices) and aligned along cable **1102**. Cable **1104** may then be lowered into the water along the underwater support structure. Collars **103** may initially be in an open position such that once system **1102** is properly aligned along the underwater support structure, a diver, remotely operated vehicle (ROV) or other means may be used to clamp collars **103** around the support structure. Alternatively, collars **103** may be in a closed position such that they are opened and closed underwater. Since VIV suppression devices **101** are mated with collars **103**, they are also attached to the support structure. Suppression system **1102** may be installed vertically or horizontally. In addition, various arrangements and substitutions may be made for cable **1104**, and any number of VIV suppression devices **101** and collars **103** may be used. For example, collars **103** and VIV suppression devices **101** may be positioned along cable **1104** in the desired alignment (i.e. alternating collar **103** and devices **101**) without mating them together. Once the cable **1104** is lowered into the water and aligned with the desired support structure, installation may include installing one of collars **103** around the support structure, mating the adjacent VIV suppression device **101** with the installed collar **103** and then installing and mating a second collar **103** at the other end of VIV suppression device **101**.

[0049] While the foregoing written description of the invention enables one of ordinary skill to make and use what is considered presently to be the best mode thereof, those of ordinary skill will understand and appreciate the existence of variations, combinations, and equivalents of the specific embodiment, method, and examples herein. The invention should therefore not be limited by the above described embodiment, method, and examples, but by all embodiments and methods within the scope and spirit of the invention.

[0050] It should also be appreciated that reference throughout this specification to "one embodiment", "an embodiment", or "one or more embodiments", for example, means that a particular feature may be included in the practice of the invention. Similarly, it should be appreciated that in the description various features are sometimes grouped together in a single embodiment, Figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects may lie in less than all features of a single disclosed embodiment. Thus, the claims following the Detailed Description are hereby expressly incorporated into this Detailed Description, with each claim standing on its own as a separate embodiment of the invention.

[0051] In the foregoing specification, the invention has been described with reference to specific embodiments thereof. It will, however, be evident that various modifications and changes can be made thereto without departing from the broader spirit and scope of the invention as set forth in the appended claims. Representatively, VIV suppression devices that utilize a flange or protrusion inserted into a portion of a collar such that the device is held against the underlying support structure such as a tubular and is free to weathervane around the tubular are described. It is contemplated, however, than any type of mechanism for mating a VIV suppression device to a collar that prevents the VIV suppression device from pulling away from the support structure and allows the VIV suppression device to slide around the collar may be used. For example, the VIV suppression device may be fixedly attached to a ring that rotates within the collar or rotatably attached to a ring that is fixed within the collar and/or the support structure. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

What is claimed is:

1. An apparatus for axially aligning and securing a vortex-induced vibration (VIV) suppression device about a support structure, the apparatus comprising:

a collar having a body portion defining an annular channel and a flange portion extending outwardly from the annular channel, the flange portion dimensioned to form a receiving channel around the support structure that is capable of receiving a portion of the VIV suppression device and securing the VIV suppression device about the support structure.

2. The apparatus of claim **1** wherein the receiving channel comprises an L-shaped, a U-shaped or a C-shaped profile.

3. The apparatus of claim **1** wherein the flange portion is a first flange portion and the receiving channel is a first receiving channel, the collar further comprising a second flange portion extending outwardly from an opposing side of the annular channel to form a second receiving channel between the collar and the support structure.

4. The apparatus of claim **1** wherein the collar and the flange portion are a single integrally formed structure.

5. The apparatus of claim **1** wherein the flange portion is attached to the annular channel by an attachment mechanism.

6. The apparatus of claim **1** further comprising:

a strap member dimensioned to fit within the annular channel and encircle the collar to hold the collar to the support structure.

7. The apparatus of claim **1** further comprising:

a bearing member attached to the collar to minimize friction between the collar and the VIV suppression device.

8. The apparatus of claim **1** wherein the VIV suppression device is a strapless tail fairing.

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