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Inventor(s)	Nonn; Daniel F. et al.

Marine drives having noise and vibration isolating joint

Abstract

A marine drive is for propelling a marine vessel in a body of water. The marine drive has a supporting frame configured to support the marine drive with respect to the marine vessel; an extension leg depending on the supporting frame; a motor housing depending on the extension leg, the motor housing for containing an electric motor; and a vibration isolating joint which couples the extension leg to the motor housing. The vibration isolating joint has an isolating connector assembly having an elastomeric member which is clamped between the extension leg and motor housing and configured to limit transfer of vibrations from the motor housing to the extension leg, and a compression limiter which prevents over clamping of the elastomeric member during assembly of the extension leg and the motor housing.

Inventors: **Nonn; Daniel F. (Campbellsport, WI), Wald; Benjamin C. (Stillwater, OK), Frost; Brent C. (Fond du Lac, WI), Waisanen; Andrew S. (Fond du Lac, WI)**

Applicant: **Brunswick Corporation** (Mettawa, IL)

Family ID: **1000006478616**

Assignee: **Brunswick Corporation (Mettawa, IL)**

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Primary Examiner: Avila; Stephen P

Attorney, Agent or Firm: Andrus Intellectual Property Law, LLP

Background/Summary

FIELD
(1) The present disclosure relates to marine drives for propelling a marine vessel in water, and more particularly to marine drives having one or more noise and vibration isolating joints.
BACKGROUND
(2) The following U.S. Patents and Applications are incorporated by reference in entirety.
(3) U.S. Pat. No. 9,701,383 discloses a marine propulsion support system having a transom bracket, a swivel bracket, and a mounting bracket. A drive unit is connected to the mounting bracket by a plurality of vibration isolating mounts, which are configured to absorb loads on the drive unit that do not exceed a mount design threshold. A bump stop located between the swivel bracket and the drive unit limits deflection of the drive unit caused by loads that exceed the threshold. An outboard motor includes a transom bracket, a swivel bracket, a cradle, and a drive unit supported between first and second opposite arms of the cradle. First and second vibration isolating mounts connect the first and second cradle arms to the drive unit, respectively. An upper motion-limiting bump stop is located remotely from the vibration isolating mounts and between the swivel bracket and the

drive unit.

(4) U.S. Pat. No. 9,963,213 discloses a system for mounting an outboard motor propulsion unit to a marine vessel transom. The propulsion unit's midsection has an upper end supporting an engine system and a lower end carrying a gear housing. The mounting system includes a support cradle having a head section coupled to a transom bracket, an upper structural support section extending aftward from the head section and along opposite port and starboard sides of the midsection, and a lower structural support section suspended from the upper structural support section and situated on the port and starboard sides of the midsection. A pair of upper mounts couples the upper structural support section to the midsection proximate the engine system. A pair of lower mounts couples the lower structural support section to the midsection proximate the gear housing. At least one of the upper and lower structural support sections comprises an extrusion or a casting.

(5) U.S. patent application Ser. No. 17/469,479 discloses a propulsion device for rotating a propulsor to propel a marine vessel. The propulsion device includes a drive housing having a cavity that extends along a first central axis. A motor is positioned within the cavity. The motor rotates a shaft extending along a second central axis that is non-coaxial with the first central axis. The shaft is configured to rotate the propulsor to propel the marine vessel.

(6) U.S. patent application Ser. No. 17/487,116 discloses an outboard motor having a transom clamp bracket configured to be supported on a transom of a marine vessel and a swivel bracket configured to be supported by the transom clamp bracket. A propulsion unit is supported by the swivel bracket, the propulsion unit comprising a head unit, a midsection below the head unit, and a lower unit below the midsection. The head unit, midsection, and lower unit are generally vertically aligned with one another when the outboard motor is in a neutral tilt/trim position. The propulsion unit is detachable from the transom clamp bracket.

(7) U.S. patent application Ser. No. 17/509,739 discloses an apparatus for removably supporting a marine drive on a marine vessel. The apparatus has a transom bracket assembly for mounting to the marine vessel, a steering bracket for coupling the marine drive to the transom bracket assembly so the marine drive is steerable relative to the transom bracket assembly and the marine vessel, and an integrated copilot and locking mechanism configured to retain the steering bracket in a plurality of steering orientations. The mechanism is further configured to lock and alternately unlock the steering bracket relative to the transom bracket assembly so that in a locked position the marine drive is retained on the transom bracket assembly and so that in an unlocked position the marine drive is removable from the transom bracket assembly.

(8) U.S. patent application Ser. No. 17/550,463 discloses a marine drive having a supporting frame for coupling the marine drive to a marine vessel, a gearcase supporting a propulsor for propelling the marine vessel in water, an extension leg disposed between the supporting frame and the gearcase, and an adapter plate between the supporting frame and the extension leg. A tube is in the extension leg. The tube has a lower end which is coupled to the gearcase and upper end which is coupled to the adapter plate by a compression nut threaded onto the tube, wherein threading the compression nut down on the tube compressively engages the compression nut with the adapter plate, which in turn clamps the extension leg between the supporting frame and the gearcase.

(9) U.S. patent application Ser. No. 17/554,540 discloses an outboard motor having a cowling, a gearcase, a midsection located axially between the cowling and the gearcase, a steering arm extending forwardly from the midsection, and an anti-ventilation plate between the midsection and the gearcase. A wing extends laterally from the steering arm. The wing, a lateral side of the cowling, and a lateral side of the gearcase together define a side tripod which supports the outboard motor in a side laydown position. The anti-ventilation plate has a rear edge with laterally outer rear support members, which together with the rear of the cowling form a rear tripod which supports the outboard motor in a rear laydown position.

(10) U.S. patent application Ser. No. 17/585,214 discloses a marine drive for propelling a marine vessel. The marine drive has a propulsor configured to generate a thrust force in a body of water; a

battery that powers the propulsor; and a supporting frame which supports the marine drive relative to marine vessel. The supporting frame has a monolithic body defining a frame interior, and further has a support leg extending downwardly from the monolithic body and a steering arm extending forwardly from monolithic body. A cowling is fixed to the supporting frame via at least one hidden fastener that extends from the frame interior, through the supporting frame, and into engagement with the cowl body, wherein hidden fastener being accessible during installation.
(11) U.S. patent application Ser. No. 17/671,041 discloses a marine drive for propelling a marine vessel in a body of water. The marine drive comprises a gearcase defining a motor cavity; a motor disposed in the motor cavity; a propulsor shaft extending from the gearcase, wherein the motor is configured to cause rotation of the propulsor shaft; a propulsor which is rotated by the propulsor shaft to create a thrust force in the body of water; and a vent conduit having a first end connected to the motor cavity and a second end which vents the motor cavity to atmosphere.
SUMMARY
(12) This Summary is provided to introduce a selection of concepts which are further described below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.
(13) In examples disclosed herein, a marine drive is for propelling a marine vessel in a body of water. The marine drive has a supporting frame configured to support the marine drive with respect to the marine vessel, an extension leg depending on the supporting frame, a motor housing depending on the extension leg, the motor housing for containing an electric motor, and a vibration isolating joint which couples the extension leg to the supporting frame. The vibration isolating joint has an isolating connector assembly including an elastomeric member which is clamped between the extension leg and the supporting frame and configured to limit transfer of vibrations from the extension leg to the supporting frame, and a compression limiter which prevents over clamping of the elastomeric member during assembly of the extension leg and the motor housing.
(14) In examples disclosed herein, a marine drive is for propelling a marine vessel in a body of water. The marine drive has a supporting frame configured to support the marine drive with respect to the marine vessel; an extension leg depending on the supporting frame; a motor housing depending on the extension leg, the motor housing for containing an electric motor; and a vibration isolating joint which couples the extension leg to the motor housing. The vibration isolating joint has an isolating connector assembly having an elastomeric member which is clamped between the extension leg and motor housing and configured to limit transfer of vibrations from the motor housing to the extension leg, and a compression limiter which prevents over clamping of the elastomeric member during assembly of the extension leg and the motor housing.
(15) In examples disclosed herein, a marine drive is for propelling a marine vessel in a body of water. The marine drive has a motor housing, the motor housing having a first housing portion and a second housing portion which together define a motor cavity; an electric motor nested in the first housing portion, the electric motor being configured to cause rotation of an output shaft extending from the first housing portion; and a propulsor coupled to the output shaft so that rotation of the output shaft causes rotation of the propulsor. A vibration isolating joint couples first housing portion to the second housing portion. The vibration isolating joint comprises an isolating connector assembly having an elastomeric member which is clamped between the first housing portion and the second housing portion and is configured to limit transfer of vibrations from the first housing portion to the second housing portion, and a compression limiter which prevents over clamping of the elastomeric member during assembly of the motor housing.
(16) In examples disclosed herein, a marine drive is for propelling a marine vessel in a body of water. The marine drive has a motor housing, the motor housing having a first housing portion and a second housing portion which together define a motor cavity; an electric motor nested in the first housing portion, the electric motor being configured to cause rotation of an output shaft axially

extending from the first housing portion; a propulsor coupled to the output shaft so that rotation of the output shaft causes rotation of the propulsor; and an elastomeric isolator located radially between the electric motor and the first housing portion. The elastomeric isolator is configured to isolate vibrations emanating from the electric motor and limit transfer of said vibrations to the first housing portion.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The present disclosure includes the following Figures.
(2) FIG. **1** is a side perspective view of a first embodiment of a marine drive for propelling a marine vessel in water according to the present disclosure.
(3) FIG. **2** is a closer view of the marine drive, showing portions of a supporting frame configured to support the marine drive with respect to the marine vessel, an extension leg depending on the supporting frame, and a vibration isolating joint which couples the extension leg to the supporting frame.
(4) FIG. **3** is an exploded view of what is shown in FIG. **2**.
(5) FIG. **4** is a view of Section **4-4**, taken in FIG. **2**.
(6) FIG. **5** is another sectional view of the vibration isolating joint.
(7) FIG. **6** is a view of Section **6-6**, taken in FIG. **2**.
(8) FIG. **7** is a closer view of a portion of Section **6-6**.
(9) FIG. **8** is a perspective view of a lower unit of a second embodiment of a marine drive, showing portions of an extension leg, a motor housing depending on the extension leg, and a vibration isolating joint which couples the extension leg to the motor housing.
(10) FIG. **9** is an exploded view of what is shown in FIG. **8**.
(11) FIG. **10** is a view of Section **10-10**, taken in FIG. **8**.
(12) FIG. **11** is an exploded view of the motor housing of FIG. **8**, showing a rear housing portion, portions of a front housing portion, and a vibration isolating joint which couples the front housing portion to the rear housing portion.
(13) FIG. **12** is a view of Section **12-12**, taken in FIG. **8**.
(14) FIG. **13** is a perspective view of a motor housing of a third embodiment of a marine drive.
(15) FIG. **14** is an exploded view of what is shown in FIG. **13**.
(16) FIG. **15** is a view of Section **15-15**, taken in FIG. **13**.
DETAILED DESCRIPTION
(17) The invention described herein below has been found to be particularly useful in configurations of marine drives having an electric motor located in a lower gearcase and being configured to power a propulsor, such as one or more propeller(s), impeller(s), and/or the like. The illustrated embodiment is just one example of such a marine drive, however the present invention is not limited for use with the illustrated configuration, and in other examples the present invention can be implemented in differently configured marine drives having an internal combustion engine, a hybrid-electric powerhead, and/or the like. The configurations of the marine drive shown and described herein below, including the supporting frame, electric motor, and gearcase, are merely exemplary. The present invention is also useful in conjunction with many other marine drive configurations.
(18) During research and development in the field of marine drives, the present inventors determined that electric motors can be rich in harmonic content, and the noise generated is very tonal and prominent. This may result in poor sound quality, which users may consider annoying or irritating and can present as an unrefined product. The vibrations created by electric motors in existing marine propulsion devices can travel up through the various structures and joints of the

propulsion device with minimal resistance. Through their research and experimentation, the inventors determined that it would be advantageous to provide vibration isolating (i.e. dampening) features that isolate the motor from other portions of the marine drive. The present disclosure is a result of the present inventors' efforts in this regard.
(19) FIG. **1** depicts a marine drive **10** for propelling a marine vessel in a body of water. In the illustrated embodiment, the marine drive **10** extends from top to bottom in an axial direction AX, from front to back in a longitudinal direction LO which is perpendicular to the axial direction AX, and from side to opposite side in a lateral direction LA which is perpendicular to the axial direction AX and perpendicular to the longitudinal direction LO. FIG. **1** only depicts certain portions of the marine drive **10**. Although not shown, the marine drive **10** is attachable to the marine vessel via, for example, a conventional transom bracket and/or the like. Other suitable arrangements are provided in the above-incorporated patents, and others are widely commercially available for purchase from Brunswick Corporation and its companies Attwood and Mercury Marine, among others.
(20) The marine drive **10** is an outboard motor having a supporting frame **12** for rigidly supporting the various components of the marine drive **10** with respect to the marine vessel. The supporting frame **12** has a generally rectangular, box-shaped body **14** with port and starboard sides **16**, a front side **18**, a rear side **20**, a bottom **22**, and an open upper end **24** providing access to a frame interior for containing a rechargeable battery (not shown) providing battery power to the marine drive **10**. The supporting frame **12** also has a steering arm **26** extending forwardly from the front side **18** of the body **14**. The steering arm **26** is configured for connection to a tiller arm **28** for manually steering the marine drive **10** relative to the marine vessel about a steering axis **30**, which is defined by the above-noted transom bracket. See, for example, the presently-incorporated U.S. patent application Ser. No. 17/509,739.
(21) A cowling, shown schematically at **36**, is fixed to and surrounds most or all of the body **14** of the supporting frame **12**, as further disclosed in the above-incorporated U.S. patent application Ser. No. 17/585,214. The cowling **36** defines a cowling interior **38** in which the body **14** of the supporting frame **12** and various components of the marine drive **10** are disposed. It should be understood that the various components described above are exemplary and could vary from what is shown. For example, the present invention is not limited for use with the particular type of supporting frame shown in the figures. The supporting frame can be any type of supporting frame known in the art for framing and supporting portions of the marine drive, including being configured to support various components of the marine drive, and/or to couple the marine drive to the marine vessel. Embodiments of various other suitable supporting frames for marine drives are provided in the above-incorporated patents.
(22) The supporting frame **12** has a support leg **32** extending downwardly from the bottom **22** of the body **14** and having a lower end **33** that is coupled to the lower unit **34** of the marine drive **10** by a novel vibration isolating joint **140**. The lower unit **34** generally includes a motor housing **42**, an extension leg **44**, and an anti-ventilation plate **47** disposed between the motor housing **42** and the extension leg **44**. The extension leg **44** depends on the supporting frame **12**, and the motor housing **42** depends on the extension leg **44**. The motor housing **42** has a front housing portion **46** and a rear housing portion **48** that are mated together and define a motor cavity **50** for containing an electric motor **52** (see, e.g., FIG. **4**) and related componentry, which otherwise defines a generally open space that is devoid of fluid. The front housing portion **46** has a nosecone **49** with a smooth outer surface which transitions to an upwardly extending stem **54** and a downwardly extending skeg **56**.
(23) Referring to FIG. **4**, the stem **54** has a perimeter sidewall **58** which may be monolithic so as to avoid visible fasteners or unsightly seams. In other embodiments, it can be made of multiple pieces. The nosecone **49** is generally located axially between the stem **54** and the skeg **56** and protrudes forwardly therefrom. The front housing portion **46** also has a rear-facing annular body portion **60** which receives the rear housing portion **48** in the nested configuration shown. Static O-

ring seals **55** are located radially between the front housing portion **46** and rear housing portion **48** and are configured to seal these components together preferably so as to entirely prevent water intrusion into the motor cavity **50**. The rear housing portion **48** has a radially outer annular flange **62**. Fasteners **64** extend through smooth bores in the radially outer annular flange **62** and into threaded engagement with corresponding threaded bores in the face of the rear-facing annular body portion **60** of the front housing portion **46**, so as to firmly fasten the rear housing portion **48** to the front housing portion **46** in the nested arrangement shown. The rear housing portion **48** is generally cylindrical, having a perimeter sidewall **68** which smoothly tapers radially inwardly towards its rear end.

(24) The electric motor **52** is generally cylindrical and is contained within the rear housing portion **48**, in particular being mounted between a rear end cap **70** and a front end wall **72** of the rear housing portion **48**. The electric motor **52** causes rotation of a propulsor shaft **74** which longitudinally extends from the rear of the rear housing portion **48** via the rear end cap **70**. The electric motor **52** is a conventional item, for example an axial flux motor, a radial flux motor, or a transverse flux motor, such as those produced by Electric Torque Machines of Flagstaff, Arizona (a Graco Company). Front and rear bearings **76**, **78** support and facilitate rotation of the propulsor shaft **74** relative to the electric motor **52**. Annular dynamic seals **80** surround the propulsor shaft **74** and dynamically seal the rear housing portion **48** via the rear end cap **70** to the rotating propulsor shaft **74** and preferably prevents ingress of water to the motor cavity **50**. A conventional propulsor, shown schematically at box **82** in FIG. **4**, is mounted on the outer end of the propulsor shaft **74** such that rotation of the propulsor shaft **74** by the electric motor **52** causes rotation of the propulsor **82**, which in turn generates a thrust force for propelling the marine vessel in water. The type and configuration of the propulsor **82** can vary, and for example can include one or more propellers, impellers, and/or the like.

(25) With continued reference to FIG. **4**, the anti-ventilation plate **47** has a head **84** at its forward end which is sandwiched between the lower end of the extension leg **44** and the stem **54** of the front housing portion **46**. The head **84** has a perimeter sidewall **85** with a rounded forward end and a tapered rear end. The perimeter sidewall **85** is preferably monolithic so as to avoid external fasteners or other unsightly seams. In other examples it can be made of multiple pieces. The radially outer profile of the head **84** generally matches the radially outer profile of the lower end of the extension leg **44** and the radially outer profile of the upper end of the stem **54**, in particular such that these components together provide a smooth outer surface which is streamlined and encounters minimal hydrodynamic drag as the marine vessel travels through the water. Pins **86** register and maintain the head **84** of the anti-ventilation plate **47** in alignment with the stem **54** and the lower end of the extension leg **44**. The pins **86** extend through bores formed through the head **84** of the anti-ventilation plate **47** and into corresponding bores formed in the lower end of the extension leg **44** and in the upper end of the stem **54**. The anti-ventilation plate **47** has a generally flat tail **88** which extends rearwardly from both sides of the head **84**.

(26) The extension leg **44** includes an elongated body **40** having the perimeter sidewall **90** which defines a hollow interior **92**. The elongated body **40** is preferably monolithic to as to avoid externally visible fasteners or unsightly seam lines. In other embodiments it can be formed from multiple pieces. A rigid conduit portion or tube **94** is located in the hollow interior **92**. The tube **94** is generally impervious to fluids and has a hollow interior **91**, a lower end **96** which is fixedly coupled to the motor housing **42** and an upper end **98** which is coupled to the supporting frame **12** via a compression nut **100**, as further described herein below. In the non-limiting illustrated embodiments, the tube **94** is a monolithic aluminum tube. The hollow interior **91** provides a passageway for among other things, a wiring harness comprising electrical wires **102** extending from an upper portion of the marine drive **10** to the motor cavity **50**, and for connection to the electric motor **52**, i.e., for providing electricity to the electric motor **52** and/or for controlling the electric motor **52**.

(27) The lower end **96** of the tube **94** is fixedly or rigidly coupled to the motor housing **42** by a threaded connection **104** comprising outer threads on the outer diameter of the tube **94** and inner threads on the inner diameter of a cylindrical stack **106** extending upwardly from a bottom wall **107** of the stem **54**. Static O-ring seals **108** provide a seal between the outer diameter of the tube **94** and the inner diameter of the cylindrical stack **106** and prevents ingress of water into the motor cavity **50**. Thus the motor cavity **50** is effectively sealed from intrusion of water via the seal interfaces provided by seals **55**, **80** and **108**. The seals **55**, **80**, and **108** are exposed to the open interior of the motor cavity **50** and thus are subject to the environmental conditions therein, including changes in pressure. A radially outer shoulder **110** on the lower end **96** of the tube **94** bottoms out on a radially inner shoulder **112** in the cylindrical stack **106** when the threaded connection **104** is fully engaged. The outer diameter of the tube **94** at the upper end **98** has flat surfaces **115** (see, e.g., FIG. **3**) for engagement by a manual tool during installation, in particular for rotating the upper end **98** of the tube **94** relative to the motor housing **42** so as to complete the threaded connection **104**.
(28) Referring to FIGS. **3-5**, the extension leg **44** includes an adapter plate **114** which is fastened to the upper end of the elongated body **40**. The adapter plate **114** has a perimeter sidewall **116** and an interior abutment surface **118** which laterally and longitudinally extends between the tube **94** and the inner diameter of the perimeter sidewall **116** of the adapter plate **114**. The interior abutment surface **118** extends entirely around the tube **94**. As best seen in FIG. **2**, the upper end **98** of the tube **94** axially extends out of the hollow interior **92** of the extension leg **44**, through a hole in the interior abutment surface **118**, and protrudes into an interior passage **103** of the supporting frame **12**. The adapter plate **114** includes leg mounting flange **136** which extends from and around the perimeter of the perimeter sidewall **116** at a top side of the adapter plate **114**. Pins **117** register and maintain the adapter plate **114** in alignment with extension leg **44**. The pins **117** extend into bores formed in the perimeter sidewall **116** of the adapter plate **114** and into corresponding bores formed in the perimeter sidewall **90** of the upper end of the extension leg **44**. Additionally or alternatively, a fastener **120** may extend through at least one set of said corresponding bores to fasten the adapter plate **114** to the elongated body **40**.
(29) The compression nut **100** is engaged with the upper end **98** of the tube **94** via a threaded connection **124**, and particularly so as to clamp the extension leg **44** in place between the supporting frame **12** and the motor housing **42**, thereby providing increased overall load carrying capability compared to the prior art and advantageously avoiding the use of fasteners which are visible from the exterior of the lower unit **34**. As best seen in FIG. **3**, the inner diameter of the compression nut **100** has threads for engaging corresponding threads on the upper end **98** of the tube **94**. Flats **122** are disposed around the outer perimeter of the compression nut **100** for engagement by a manual tool for rotating the compression nut **100** about the tube **94**.
(30) To assemble the lower unit, a washer **128** and the compression nut **100** are slid onto the upper end **98** of the tube **94** until the threads abut. The compression nut **100** is then rotated by a wrench in a direction which causes the compression nut **100** to travel downwardly along the tube **94**, via engagement between the threads. Continued rotation of the compression nut **100** moves it into compressing engagement with the top of the interior abutment surface **118**. Compression of the compression nut **100** applies a corresponding clamping force on the adapter plate **114**, which pulls the tube **94** and motor housing **42** axially upwardly. This firmly compresses and clamps the head **84** of the anti-ventilation plate **47** and the extension leg **44** between the motor housing **42** and bottom of the adapter plate **114** without the need for external fasteners and in an improved load-bearing arrangement. Advantageously the entire arrangement can be easily assembled in an efficient manner and with minimal externally visible fasteners.
(31) Referring to FIGS. **2** and **3**, the lower end **33** of the supporting frame **12** has a frame mounting flange **134** which extends from and around the perimeter of the support leg **32** at a bottom end of the support leg **32**. The extension leg **44** includes a leg mounting flange **136** positioned at the upper end thereof. As previously discussed, the leg mounting flange **136** is included on the adapter plate

114 in the illustrated embodiments. Other embodiments, however, may include an extension leg with an integrally formed leg mounting flange. A radially outer profile of the leg mounting flange **136** generally matches the radially outer profile of the frame mounting flange **134**. A plurality of bores **146** are formed through the frame mounting flange **134**, and each bore **146** in the frame mounting flange **134** is arranged in vertical axial alignment with a corresponding bore **148** formed through the leg mounting flange **136**. In the non-limiting illustrated embodiments, the bores **146** in the frame mounting flange **134** are configured as double counterbored holes **146**. That is, the bores **146** in the frame mounting flange **134** are counterbored from both sides so that an annular ring **150** having an upper surface **152** and a lower surface **154** is formed around the interior diameter of the bores **146** (see, e.g., FIG. **7**). In other embodiments, at least one of the bores **148** formed through the leg mounting flange **136** may be configured as a counterbored hole, and/or at least one bore **146** in the frame mounting flange **134** may not be a counterbored hole.

(32) As is described in further detail herein below, the novel vibration isolating joint **140** couples the frame mounting flange **134** and the leg mounting flange **136**, thereby coupling the extension leg **44** to the supporting frame **12**. The vibration isolating joint **140** includes a plurality of isolating connector assemblies **142** spaced apart around the frame mounting flange **134** and the leg mounting flange **136**. Each isolating connector assembly **142** engages one of the counterbored holes **146** in the frame mounting flange **134** and the corresponding one of the bores **148** in the leg mounting flange **136**. In the non-limiting embodiment of FIG. **2**, the vibration isolating joint **140** includes six isolating connector assemblies **142**. Other embodiments may include a different number of isolating connector assemblies **142**, and/or at least one isolating connector assembly **142** may be arranged in a different position than those of the illustrated embodiments.

(33) Referring to FIGS. **3**, **6**, and **7**, each isolating connector assembly **142** includes an elastomeric member **160**, a compression limiter **162**, and a fastener **164**. The fastener **164** extends through the elastomeric member **160** and the compression limiter **162** and couples the frame mounting flange **134** and the leg mounting flange **136** together. The compression limiters **162** are rigid members having a rigid cylinder **166** with a bore **168** through which the fastener **164** extends. In the non-limiting illustrated embodiments, the compression limiters **162** include a first limiter portion **170** and a second limiter portion **172**. The first limiter portion **170** includes a first annular flange **174** and a first cylinder half **176** and is located between the leg mounting flange **136** of the extension leg **44** and the frame mounting flange **134** of the supporting frame **12**. The second limiter portion **172** includes a second annular flange **178** and a second cylinder half **180** and is located on an opposite side of the leg mounting flange **136** of the extension leg **44**. The first limiter portion **170** and the second limiter portion **172** oppose each other such that the first and second cylinder halves **176**, **180** abut each other to form the rigid cylinder **166**. Together, the first limiter portion **170** and second limiter portion **172** define an axial space **182** between the first and second annular flanges **174**, **178** in which elastomeric member **160** is located, as illustrated in FIGS. **6** and **7**.

(34) The elastomeric member **160** has a first resilient portion **186** located between the leg mounting flange **136** and the frame mounting flange **134** and a second resilient portion **188** located on an opposite side of the frame mounting flange **134** relative to the first resilient portion **186**. The first resilient portions **186** and the second resilient portions **188** are configured to be received in the counterbored holes **146**. Referring to FIGS. **6** and **7**, an annular flange **190** of the first resilient portion **186** abuts the lower surface **154** of the annular ring **150** and an annular flange **190** of the second resilient portion **188** abuts the upper surface **152** of the annular ring **150**. The first and second resilient portions **186**, **188** each include a bore **192** configured to respectively receive the first and second cylinder halves **176**, **180** of the first and second limiter portions **170**, **172**. When assembled, the first resilient portion **186** is located between the first limiter portion **170** and the frame mounting flange **134** of the supporting frame **12** and the second resilient portion **188** is located between the second limiter portion **172** and the frame mounting flange **134** of the supporting frame **12**. Thus, the elastomeric member **160** is clamped in the axial space **182** between

first annular flange **174** and the second annular flange **178**.

(35) Referring to FIGS. **6** and **7**, to assemble the vibration isolating joint **140** and couple the supporting frame **12** to the lower unit **34**, the elastomeric members **160** are inserted into the counterbored holes **146** by placing the first resilient portions **186** in a bottom opening of a counterbored hole **146** and the second resilient portion **188** in a top opening of said counterbored hole **146**. The compression limiters **162** are then received in the elastomeric members **160** by inserting the first cylinder halves **176** into the bores **192** of the first resilient portions **186** and the second cylinder halves **180** into the bores **192** of the second resilient portions **188**. The fasteners **164** are then inserted into the elastomeric members **160** and the compression limiters **162** so that the fasteners **164** extend through the first limiter portion **170**, the first resilient portion **186**, the second limiter portion **172**, and the second resilient portion **188**. The fasteners **164** extend through the elastomeric members **160** and the compression limiters **162** to engage the bore **148** formed in the leg mounting flange **136**.

(36) Tightening the fasteners **164** clamps the elastomeric members **160** between the extension leg **44** and the supporting frame **12** until engagement between the fasteners **164** and the compression limiters **162** prevents further tightening of the fasteners **164**. In the non-limiting illustrated embodiments, tightening of the fastener **164** clamps the first resilient portion **186** between the first limiter portion **170** of the compression limiter **162** and the frame mounting flange **134**, and the second resilient portion **188** is clamped between the second limiter portion **172** and the frame mounting flange **134**. The axial space **182** between the first and second annular flanges **174**, **178** of the compression limiters **162** has a length L1 which is preselected to prevent over compression of the elastomeric member **160** by the fastener **164**. Thus, the compression limiters **162** prevent over tightening of the fasteners **164** to prevent over compression of the elastomeric member **160**. The elastomeric members **160**, which are clamped between the extension leg **44** and the supporting frame **12**, advantageously limit the transfer of vibrations from the extension leg **44** to the supporting frame **12**. All vibrations emanating from the electric motor are transferred to the elastomeric member **160** before being transferred to the supporting frame **12**, thereby reducing problematic noise and increasing overall noise quality. The compression limiters **162** prevent over clamping of the elastomeric member during assembly of the extension leg **44** and the motor housing **42**. By limiting compression of the elastomeric members **169**, a predetermined pressure can be loaded onto the elastomeric members. The predetermined load may be selected to limit the transmission of undesirable sound frequencies through the elastomeric members **160** while still supporting the loads needed for propulsion. This may be useful, for example, in order to lower aquatic noise levels to produce less disturbance to boaters, inhabitants, and/or wildlife.

(37) In the non-limiting illustrated embodiments, the isolating connector assemblies **142** are configured so that the elastomeric members **160** are clamped between the first and second annular flanges **174**, **178** of the compression limiters **162** and the frame mounting flange **134**. Other embodiments, however, may be differently configured. For example, a vibration isolating joint may include at least one connector assembly configured to clamp an elastomeric member between a compression limiter and the leg mounting flange. In such an embodiment, the first resilient portion may be clamped between first annular flange of the first limiter portion and the leg mounting flange and the second resilient portion may be clamped between second annular flange of the second limiter portion and the leg mounting flange.

(38) While embodiments of a marine drive **10** illustrated in FIGS. **1-7** include a vibration isolating joint **140** coupling the supporting frame **12** to the extension leg **44**, some embodiments can additionally or alternatively include at least one vibration isolating joint arranged at a different location on a marine drive. For example, FIGS. **8-12** depict an example of the lower unit **204** of a marine drive which generally includes a motor housing **202**, an extension leg **212**, and a vibration isolating joint **240** which couples the extension leg **212** to the motor housing **202**. The extension leg **212** depends on a support frame (see, e.g., FIGS. **1** and **2**), and the motor housing **202** depends

on the extension leg **212**. The motor housing **202** has a front housing portion **214** and a rear housing portion **216** that are coupled by another vibration isolating joint **340**. The front housing portion **214** and the rear housing portion **216** define a motor cavity **218** for containing an electric motor **220** (see, e.g., FIGS. **11** and **12**) and related componentry, which otherwise defines a generally open space that is devoid of fluid.
(39) Referring to FIGS. **8-9**, the front housing portion **214** has a nosecone **222** with a smooth outer surface which transitions to an upwardly extending stem **224** and a downwardly extending skeg **226**. The stem **224** has a perimeter sidewall **228**, which defines a hollow interior **229** and may be monolithic or made of multiple pieces. An anti-ventilation plate **230** is positioned between an upper end and a lower end of the stem **224** and includes a flat tail **232** that extends rearwardly from the perimeter sidewall **228**. In the non-limiting embodiments of FIGS. **8-12**, the anti-ventilation plate **230** is integrally formed with the stem **224**. Some embodiments, however, may include an anti-ventilation plate **230** that is separate from the stem **224** and secured to at least one part of the lower unit (see, e.g., FIGS. **1** and **4**). The motor housing **202** includes a cover plate **206** with a cylindrical stack **208** and a cover plate flange **210**, which extends from and around the lower end of the cylindrical stack **208**. A plurality of bores **209** are formed through the cover plate flange **210**, and each bore **209** in the cover plate flange **210** is arranged in vertical axial alignment with a corresponding bore **211** formed in the motor housing mounting flange **238**. A fastener **213** extends through each of the bores **209** in the cover plate flange **210** and into threaded engagement with the corresponding one of the bores **211** in the motor housing mounting flange **238** to couple the cover plate **206** to the stem **224**. A bore **215** formed in the cylindrical stack may be configured to receive a rigid conduit portion or tube (not shown) that extends from the support frame to the motor housing **202** (see, e.g., **4**) such that the cover plate **206** seals the opening into the hollow interior **229** of the stem **224**, thereby preventing ingress of water into the motor housing **202**.
(40) An upper end of the motor housing **202** includes a motor housing mounting flange **238** which extends from and around the perimeter sidewall **228** of the stem **224** at an upper end of the stem **224**. A radially outer profile of the motor housing mounting flange **238** generally matches the radially outer profile of a leg mounting flange **236** at a lower end of the extension leg **212**. The leg mounting flange **236**, which extends from and around the perimeter of the extension leg **212**, includes a plurality of downwardly extending protrusions **244**. A bore **248** is formed into each of the protrusions **244**, and each bore **248** in the leg mounting flange **236** is arranged in vertical axial alignment with a corresponding bore **246** formed through the motor housing mounting flange **238**. In the non-limiting illustrated embodiments, the bores **246** in the motor housing mounting flange **238** are configured as double counterbored holes **146** so that an annular ring **250** having an upper surface and a lower surface is formed around the interior diameter of the bores **246** (see, e.g., FIG. **10**). In other embodiments, however, at least one bore **246** in the motor housing mounting flange **238** may not be a counterbored hole.
(41) As is described in further detail herein below, the vibration isolating joint **240** couples the leg mounting flange **236** and the motor housing mounting flange **238**, thereby coupling the extension leg **212** to the motor housing **202**. The vibration isolating joint **240** includes a plurality of isolating connector assemblies **242** spaced apart around the leg mounting flange **236** and the motor housing mounting flange **238**. Each isolating connector assembly **242** engages one of the counterbored holes **246** in the motor housing mounting flange **238** and the corresponding one of the bores **248** in the protrusions **244** of the leg mounting flange **236**. A plurality of cutouts **256** are formed into the sides of the cover plate flange **210**, and each cutout **256** is aligned with a corresponding one of the isolating connector assemblies **242**. A portion of the protrusions **244** and/or a portion of the connector assemblies **242** extend through the cutouts **256** so that the connector assemblies **242** extend between the leg mounting flange **236** and the motor housing mounting flange **238** without engaging the cover plate **206**. In the non-limiting embodiment of FIG. **9**, the vibration isolating joint **240** includes four isolating connector assemblies **242**. Other embodiments may include a

different number of isolating connector assemblies **242**, and/or at least one isolating connector assembly **242** may be arranged in a different position than those of the illustrated embodiments. Further still, some embodiments may include at least one connector assembly that is configured to engage part of the cover plate.

(42) Referring to FIGS. **9** and **10**, each isolating connector assembly **242** includes an elastomeric member **260**, a compression limiter **262**, and a fastener **264**. The fastener **264** extends through the elastomeric member **260** and the compression limiter **262** and couples the leg mounting flange **236** and the motor housing mounting flange **238** together. The compression limiters **262** are rigid members that each have a rigid cylinder **266** with a bore **268** through which the fastener **264** extends.

(43) Similarly to the vibration isolating joint **140** of FIGS. **1-7**, the compression limiters **262** include a first limiter portion **270** with a first annular flange **274** and a first cylinder half **276** and a second limiter portion **272** with a second annular flange **278** and a second cylinder half **280**. The first limiter portion **270** is located between the leg mounting flange **236** of the extension leg **212** and the motor housing mounting flange **238** of the motor housing **202**. The second limiter portion **272** is located on an opposite side of the motor housing mounting flange **238** of the motor housing **202**. The first limiter portion **270** and the second limiter portion **272** oppose each other such that the first and second cylinder halves **276**, **280** abut each other to form the rigid cylinder **266**. Together, the first limiter portion **270** and second limiter portion **272** define an axial space **282** between the first and second annular flanges **274**, **278** in which elastomeric member **260** is located, as illustrated in FIG. **10**.

(44) The elastomeric members **260** each have a first resilient portion **286** located between the leg mounting flange **236** and the motor housing mounting flange **238** and a second resilient portion **288** is located on an opposite side of the motor housing mounting flange **238** relative to the first resilient portion **286**. The first resilient portions **286** and the second resilient portions **288** are configured to be received in the counterbored holes **246**. Referring to FIG. **10**, an annular flange **290** of the first resilient portion **286** abuts the upper surface of the annular ring **250** and an annular flange **290** of the second resilient portion **288** abuts the lower surface of the annular ring **250**. The first and second resilient portions **286**, **288** each include a bore **292** configured to respectively receive the first and second cylinder halves **276**, **280** of the first and second limiter portions **270**, **272**. When assembled, the first resilient portion **286** is located between the first limiter portion **270** and the motor housing mounting flange **238** of the motor housing **202** and the second resilient portion **288** is located between the second limiter portion **272** and the motor housing mounting flange **238** of the motor housing **202**. Thus, the elastomeric member **260** is clamped in the axial space **282** between first annular flange **274** and the second annular flange **278**.

(45) With continued reference to FIGS. **9** and **10**, to assemble the vibration isolating joint **240** and couple the extension leg **212** to the motor housing **202**, the elastomeric members **260** are inserted into the counterbored holes **246** by placing the first resilient portions **286** in a top opening of a counterbored hole **246** and the second resilient portion **288** in a bottom opening of said counterbored hole **246**. The compression limiters **262** are then received in the elastomeric members **260** by inserting the first cylinder halves **276** into the bores **292** of the first resilient portions **286** and the second cylinder halves **280** into the bores **292** of the second resilient portions **288**. The fasteners **264** are then inserted into the elastomeric members **260** and the compression limiters **262** so that the fasteners **264** extend through the first limiter portions **270**, the first resilient portions **286**, the second limiter portions **272**, and the second resilient portions **288**. In the non-limiting embodiments of FIGS. **8-10**, the fasteners **64** are configured as threaded dowels with corresponding bolts. Each threaded dowel extends between a first threaded end and a second threaded end. The threaded dowels extend through the elastomeric members **260** and the compression limiters **262** so that a first end of the threaded dowel threadedly engages the bores **248** formed in the protrusions **244** of the leg mounting flange **236**. The second threaded end extends past a lower surface of the

motor housing mounting flange **238** and is configured to receive a nut, which can be tightened to couple the motor housing **202** to the extension leg **212**. Other embodiments, however, may include at least on fastener configured as a bolt and/or another type of fastener.

(46) Tightening the fasteners **264** clamps the elastomeric members **260** between the extension leg **212** and the motor housing **202** until engagement between the fasteners **264** and the compression limiters **262** prevents further tightening of the fasteners **264**. In the non-limiting illustrated embodiments, tightening of the fasteners **264** clamps the first resilient portions **286** between the first limiter portions **270** of the compression limiters **262** and the motor housing mounting flange **238** and the second resilient portion **288** between the second limiter portion **272** and the motor housing mounting flange **238**. The axial space **282** between the first and second annular flanges **274**, **278** of the compression limiters **262** has a length L2 which is preselected to prevent over compression of the elastomeric member **260** by the fastener **264**. Thus, the compression limiters **262** prevent over tightening of the fasteners **264** to thereby prevent over compression of the elastomeric member **260**. The elastomeric members **260**, which are clamped between the extension leg **212** and the motor housing **202**, advantageously limit the transfer of vibrations from the motor housing **202** to the extension leg **212**. All vibrations emanating from the electric motor are transferred to the elastomeric members **260** before being transferred to the extension leg **212**. Because the vibration isolating joint **240** is positioned below the waterline when the marine drive **10** is in operation, the intensity of the vibrations is reduced before traveling into a component that is exposed to open air. This may be particularly useful in reducing problematic noise and increasing overall noise quality of the marine drive. The compression limiters **262** prevent over clamping of the elastomeric member during assembly of the extension leg **212** and the motor housing **202**. By limiting compression of the elastomeric members **260**, a predetermined pressure can be loaded onto the elastomeric members **260**. The predetermined load may be selected to limit the transmission of undesirable sound frequencies through the elastomeric members. In some embodiments, the vibration isolating joint **240** between the motor housing **202** and the extension leg **212** may be configured to limit the transmission of specific frequencies that may be prone to causing undesirable noise when a vibrating component is exposed to open air.

(47) In the non-limiting illustrated embodiments, the isolating connector assemblies **242** are configured so that the elastomeric members **260** are clamped between the annular flanges **274**, **278** of the compression limiters **262** and the motor housing mounting flange **238**. Other embodiments, however, may be differently configured. For example, a vibration isolating joint may include at least one connector assembly configured to clamp an elastomeric member between a compression limiter and the leg mounting flange. In such an embodiment, the first resilient portion may be clamped between first annular flange of the first limiter portion and the leg mounting flange and the second resilient portion may be clamped between second annular flange of the second limiter portion and the leg mounting flange.

(48) Some embodiments of a marine drive may include a motor housing with a vibration isolating joint which couples a first housing portion of the motor housing to a second housing portion of the motor housing. For example, referring to FIGS. **8**, **11** and **12**, the motor housing **202** includes a vibration isolating joint **340** which couples the front housing portion **214** to the rear housing portion **216**. The motor housing **202** generally includes front housing portion **214** and a rear housing portion **216** nested in the front housing portion **214**. The front housing portion **214** and the rear housing portion **216** together define a torpedo housing **217** and a motor cavity **218** for containing an electric motor **220** and related componentry. The electric motor **220** is nested within the rear housing portion **216** and is configured to cause rotation of an output shaft **302** extending from the rear housing portion **216**. A propulsor **304** is coupled to the output shaft **302** so that rotation of the output shaft **302** causes rotation of the propulsor **304**.

(49) Referring to FIGS. **11** and **12**, the rear housing portion **216** is generally cylindrical, having an exterior sidewall **308** which smoothly tapers radially inwardly towards its rear end. The rear

housing portion **216** has a radially outer mounting flange **312** positioned proximate a forward end of the exterior sidewall **308**. The mounting flange **312** includes an upper flange portion **314** extending upwardly from a top side of the exterior sidewall **308** and a lower flange portion **316** extending downwardly from a bottom side of the exterior sidewall **308**. A cylindrical motor support portion **318** extends forward from the mounting flange **312**. The electric motor **220** is generally cylindrical and is contained within the motor support portion **318** of the rear housing portion **216**, in particular being mounted between a rear end cap **320** and a front end wall **322** of the rear housing portion **216**. Annular grooves **324** formed around the surface of the motor support portion **318** are configured to receive O-rings **326** to form a seal between the front housing portion **214** and the rear housing portion **216**. Annular dynamic seals **328** surround the output shaft **302** and dynamically seal the rear housing portion **216** via the rear end cap **320** to the output shaft **302** and preferably prevents ingress of water to the motor cavity **218**.

(50) The front housing portion **214** has a rear-facing annular body portion **330** which receives the motor support portion **318** of the rear housing portion **216** such that an outer surface of the motor support portion **318** abuts an interior surface of the annular body portion **330**. The annular body portion **330** of the front housing portion **214** includes a mounting base **332** with an upper base portion **334** and a lower base portion **336** respectively positioned at the top and bottom sides of annular body portion **330**. The upper flange portion **314** and the lower flange portion **316** each include bore **346** formed longitudinally through said flange portions **314**, **316**. The bores **346** in the mounting flange **312** are arranged in axial alignment with a corresponding bore **348** formed through the upper base portion **334** and the lower base portion **336** of the mounting base **332**. In the non-limiting illustrated embodiments, the bores **346** in the mounting flange **312** are configured as double counterbored holes **346** so that an annular ring **350** having an front surface and a rear surface is formed around the interior diameter of the bores **346**. In other embodiments, however, at least one bore **346** in the mounting flange **312** may not be a counterbored hole.

(51) As is described in further detail herein below, the novel vibration isolating joint **340** couples the mounting flange **312** to the mounting base **332**, thereby coupling front housing portion **214** to the rear housing portion **216**. In the non-limiting illustrated embodiment, the vibration isolating joint **340** includes two isolating connector assemblies **342** which each engage one of the counterbored holes **346** in the mounting flange **312** and the corresponding one of the bores **348** in the mounting base **332**. In particular, the illustrated vibration isolating joint **340** comprises an upper isolating connector assembly **342** that couples the upper flange portion **314** to the upper base portion **334** and a lower isolating connector assembly **342** that couples the lower flange portion **316** to the lower base portion **336**. Other embodiments, however, may include a mounting flange and mounting base configured to be engaged by a different number of isolating connector assemblies **342**, and/or at least one isolating connector assembly **342** may be arranged in a different position than those of the illustrated embodiments.

(52) With continued reference to FIGS. **11** and **12**, each isolating connector assembly **342** includes an elastomeric member **360**, a compression limiter **362**, and a fastener **364**. The fastener **364** extends through the bore **346** in the mounting flange **312** and into threaded engagement with the bore **348** in the mounting base **323** to couple the front housing portion **214** to the rear housing portion **216**. Similarly to the vibration isolating joints **140**, **240** of FIGS. **1-10**, the compression limiters **362** are rigid members that each have a rigid cylinder **366** with a bore **368** through which the fastener **364** extends. The compression limiters **362** include a first limiter portion **370** and a second limiter portion **372**. The first limiter portion **370** includes a first annular flange **374** and a first cylinder half **376**, and the second limiter portion **372** includes a second annular flange **378** and a second cylinder half **380**. The first limiter portion **370** is located between the mounting flange **312** of the rear housing portion **216** and the mounting base **332** of front housing portion **214**. The second limiter portion **372** is located on an opposite side of the mounting flange **312** of the rear housing portion **216**. The first limiter portion **370** and the second limiter portion **372** oppose each

other such that the first and second cylinder halves **376**, **380** abut each other to form the rigid cylinder **366**. Together, the first limiter portion **370** and second limiter portion **372** define an axial space **382** between the first and second annular flanges **374**, **378** in which elastomeric member **360** is located, as illustrated in FIG. **12**.

(53) The elastomeric members **360** each have a first resilient portion **386** located between the mounting flange **312** and the mounting base **332** and a second resilient portion **388** located on an opposite side of the mounting flange **312** relative to the first resilient portion **386**. The first resilient portions **386** and the second resilient portions **388** are configured to be received in the counterbored holes **346**. Referring to FIGS. **11** and **12**, an annular flange **390** of the first resilient portion **386** abuts the front surface of the annular ring **350** and an annular flange **390** of the second resilient portion **388** abuts the rear surface of the annular ring **350**. The first and second resilient portions **386**, **388** each include a bore **392** configured to respectively receive the first and second cylinder halves **376**, **380** of the first and second limiter portions **370**, **372**. When assembled, the first resilient portion **386** is located between the first limiter portion **370** and the mounting flange **312** of the rear housing portion **216** and the second resilient portion **388** is located between the second limiter portion **372** and the mounting flange **312** of the rear housing portion **216**. Thus, the elastomeric member **360** is clamped in the axial space **382** between the first annular flange **374** and the second annular flange **378**.

(54) The vibration isolating joint further may additionally or alternatively include an annular O-ring seal disposed inside the front housing portion **214** and between the rear housing portion **216** and the front housing portion **214**. In the non-limiting illustrated embodiment, each of the O-rings **326** received in the annular grooves **324** is one of a pair of annular O-ring seals disposed inside the front housing portion **214** and between the motor support portion **318** of the rear housing portion **216** and the front housing portion **214**. Other embodiment may include at least one additional O-ring, or at least one of the O-rings may be omitted.

(55) With continued reference to FIGS. **11** and **12**, to assemble the vibration isolating joint **340** and couple the front housing portion to the rear housing portion **216**, the elastomeric members **360** are inserted into the counterbored holes **346** by placing the first resilient portions **386** in a front opening of a counterbored hole **346** and the second resilient portion **388** in a rear opening of said counterbored hole **346**. The compression limiters **362** are then received in the elastomeric members **360** by inserting the first cylinder halves **376** into the bores **392** of the first resilient portions **386** and the second cylinder halves **380** into the bores **392** of the second resilient portions **388**. The fasteners **364** extend through the elastomeric members **360** and the compression limiters **362** to engage the bores **348** formed in the mounting base **332**.

(56) Tightening the fasteners **364** clamps the elastomeric members **360** between the front housing portion **214** and rear housing portion **216** until engagement between the fasteners **364** and the compression limiters **362** prevents further tightening of the fasteners **364**. In the non-limiting illustrated embodiments, tightening of the fasteners **364** clamps the first resilient portions **386** between the first limiter portions **370** of the compression limiters **362** and the mounting flange **312** and the second resilient portion **388** between the second limiter portion **372** and the mounting flange **312**. The axial space **382** between the first and second annular flanges **374**, **378** of the compression limiters **362** has a length L3 which is preselected to prevent over compression of the elastomeric member **360** by the fastener **364**. Thus, the compression limiters **362** prevent over tightening of the fasteners **364** to thereby prevent over compression of the elastomeric member **360**. The elastomeric members **360**, which are clamped between the mounting flange **312** the mounting base **332**, advantageously limit the transfer of vibrations from the rear housing portion **216** to the front housing portion **214**. All vibrations emanating from the electric motor **220** are transferred to the elastomeric members **360** before being transferred to the extension leg. When used alone or in conjunction the other vibration isolating joints **140**, **240** and vibration isolating features disclosed herein, this may be particularly useful in reducing problematic noise and

increasing overall noise quality of the marine drive. The compression limiters **362** prevent over clamping of the elastomeric member during assembly of the motor housing **202**. By limiting compression of the elastomeric members **360**, a predetermined pressure can be loaded onto the elastomeric members. The predetermined load may be selected to limit the transmission of undesirable sound frequencies through the elastomeric members **360** from the rear housing portion **216** to the front housing portion **214**.

(57) In addition or as an alternative to a vibration isolating joint, such as the vibration isolating joints **140**, **240**, **340** of FIGS. **1-12**, embodiments of a marine drive may be configured with noise isolating features within the motor housing. For example, FIGS. **13-15** illustrate a non-limiting embodiment of a motor housing **402** including vibration isolating elastomeric isolators **440**, **468**, configured to isolate vibrations emanating from an electric motor **420** and limit the transfer of those vibrations from the electric motor **420** to the motor housing **402**. The motor housing **402** generally includes front housing portion **414** and a rear housing portion **416** which together define a motor cavity **418** for containing the electric motor **420** and related componentry. The electric motor **420** is nested within the rear housing portion **416** and is configured to cause rotation of an output shaft **404** extending from the rear housing portion **416**. A propulsor **406** is coupled to the output shaft **404** so that rotation of the output shaft **404** causes rotation of the propulsor **406**. In the illustrated embodiments, the propulsor **406** is secured to the output shaft **404** by a nut **407**. Some embodiments, however, may include a propulsor that is secured to the output shaft using a different attachment method.

(58) Referring to FIGS. **14** and **15**, the rear housing portion **416** has a generally cylindrical section **426** at the front axial end of the rear housing portion **416** and a truncated conical section **428** at the rear axial end of the rear housing portion **416**. An exterior side wall **430** of the rear housing portion **416** smoothly tapers radially inwardly towards its rear axial end. In the illustrated embodiments, the truncated conical section **428** has an oblique truncated conical shape such that an upper portion of the exterior side wall **430** has a larger taper angle and tapers further radially inward than a lower portion of the exterior side wall **430**. Other embodiments of a rear housing portion, however, may have a symmetric truncated conical section or any other inwardly tapering shape. The rear housing portion **416** has a radially outer mounting flange positioned proximate a forward end of rear housing portion **416**. The outer mounting flange includes an upper flange portion **432** extending upwardly from a top side of the exterior side wall **430** and a lower flange portion **434** extending downwardly from a bottom side of the exterior side wall **430**.

(59) The electric motor **420** is configured to be nested within the front housing portion **414** and the rear housing portion **416**. The electric motor **420** has a generally cylindrical front section **436** and a truncated conical rear section **438** with a conical radially outer surface **439** which smoothly tapers radially inwardly towards its rear end. A first elastomeric isolator **440** is located radially between the electric motor **420** and the rear housing portion **416**. The first elastomeric isolator **440** has a truncated conical shape that extends between a narrow end **442** and a wide end **444**. The first elastomeric isolator **440** is nested in the rear housing portion **416** such that a conical radially outer surface **446** of the first elastomeric isolator **440** abuts a conical inner surface **448** of the rear housing portion **416**. The electric motor **420** is nested within the truncated conical shape of the first elastomeric isolator **440** such that the first elastomeric isolator **440** is positioned on a first axial end of the electric motor **420**. A conical inner surface **450** of the first elastomeric isolator **440** abuts a conical radially outer surface **452** of the electric motor **420**, and the output shaft **404** of the electric motor **420** protrudes from the narrow end **442** of the first elastomeric isolator **440** and a rear opening **417** of the rear housing portion **416**. In the illustrated nested configuration, the first elastomeric isolator **440** is sandwiched between the electric motor **420** and the rear housing portion **416** such that the first elastomeric isolator provides a watertight seal between the electric motor **420** and the rear housing portion **416**. In some embodiments the first elastomeric isolator may be bonded to the electric motor **420**. In other embodiments, the first elastomeric isolator **440** may be

clamped in between the electric motor **420** and the rear housing portion **416** without adhesives or bonding.
(60) The front housing portion **414** has a nosecone **415** with a smooth outer surface which transitions to an upwardly extending stem **456** and a downwardly extending skeg **458**. A rear-facing annular body portion **460** of the front housing portion **414** is configured to receive a second axial end of the electric motor **420** in a nested arrangement. A second elastomeric isolator **468** isolator is located on the second axial end of the electric motor **420** which is opposite the first axial end of the electric motor **420**. The second elastomeric isolator **468** is positioned radially between the electric motor **420** and the front housing portion **414**. A cylindrical portion of the second elastomeric isolator **468** extends radially around the electric motor **420**, and an annular lip **472** of the second elastomeric isolator **468** abuts a front surface of the electric motor **420** between the electric motor **420** and a front end wall **419** of the motor cavity **418**. The annular lip defines a pilot hole **473** of the second elastomeric isolator **468**, and the second axial end of the electric motor **420** extends through the pilot hole **473**.
(61) With continued reference to FIGS. **14** and **15**, the annular body portion **460** of the front housing portion **414** includes a mounting base with an upper base portion **474** and a lower base portion **464** respectively positioned at the top and bottom sides of annular body portion **460**. The upper flange portion **432** and the lower flange portion **434** each include bores **478** formed longitudinally through said flange portions **432**, **434**. The bores **478** in the mounting flange are arranged in axial alignment with corresponding bores **480** formed through the upper base portion **474** and the lower base portion **476** of the mounting base, respectively. Fasteners **482** extend through the bores **478** in the upper and lower flange portions **432**, **434** to engage the corresponding bores **480** in the upper and lower base portions **474**, **476**, thereby fastening the rear housing portion **416** to the front housing portion **414** along a split line **484**. An elastomeric O-ring seal **486** extends radially around the electric motor **420** and is disposed between the front housing portion **414** and the rear housing portion **416** and along the split line **484** to provide a watertight seal therebetween.
(62) To assemble the motor housing **402**, the first elastomeric isolator **440** is inserted into the rear housing portion **416** and the electric motor is subsequently nested in the rear housing portion **416** such that the first elastomeric isolator **440** is inserted radially between the electric motor **420** and the rear housing portion **416** with the output shaft **404** axially extending from the back end of the rear housing portion **416**. The second elastomeric isolator **468** is received in the front housing portion **414** and the second axial end of the electric motor **420** is nested in the front housing portion **414** such that the second elastomeric isolator **468** is inserted radially between the electric motor **420** and the front housing portion **414**. In some embodiments at least one additional elastomeric O-ring seal (not shown) may be located in the front housing portion **414** and/or the rear housing portion **416** so as to provide a watertight seal between the electric motor **420** and the front housing portion **414** and/or the rear housing portion **416**.
(63) The elastomeric O-ring seal **486** is sandwiched between the front housing portion **414** and the rear housing portion **416** at the split line **484**, and the fasteners **482** are inserted through the bores **478** formed through the upper and lower portions **432**, **434** of the mounting flange to threadedly engage the corresponding bores **480** formed in the upper and lower portions **474**, **476** of the mounting base, thereby fastening the front housing portion **414** to the rear housing portion **416**. As the fasteners **482** are tightened, the first elastomeric isolator **440** is compressed between the rear housing portion **416** and the electric motor **420**, the second elastomeric isolator **468** is compressed between the front housing portion **414** and the electric motor **420**, and the elastomeric O-ring seal **486** is compressed between the front housing portion **414** and the rear housing portion **416**. When compressed the first elastomeric isolator **440** is sandwiched between the electric motor **420** and the rear housing portion **416** to provide a watertight seal between the electric motor **420** and the rear first housing portion **416**. Similarly, the elastomeric O-ring seal **486** is sandwiched between the front housing portion **414** and the rear housing portion **416** to provide a watertight seal between the

front housing portion **414** and the rear first housing portion **416**.
(64) As previously mentioned, the elastomeric isolators **440**, **468** are configured to isolate vibrations of the electric motor **420** and limit the transfer of said vibrations between various different parts of the marine drive. Positioned between the electric motor **420** and the rear housing portion **416**, the first elastomeric isolator **440** is configured to isolate vibrations emanating from the electric motor **420** and limit transfer of said vibrations to the rear housing portion **416**. The second elastomeric isolator **468** is similarly configured to isolate vibrations emanating from the electric motor **420** and limit transfer of said vibrations to the front housing portion **414**. In some embodiments, the elastomeric O-ring seal **486** may be configured as a third elastomeric isolator that is configured to isolate vibrations created by the electric motor **420** and limit transfer of said vibrations between the front housing portion **414** and the rear housing portion **416**. Providing multiple elastomeric isolators may advantageously provide redundant vibration isolation to reduce the level of sound produced by the electric motor.
(65) In some non-limiting embodiments, at least one of the elastomeric isolators **440**, **468** may be tuned to isolate a selected range of vibration frequencies emanating from the electric motor **420** and/or between the front housing portion **414** and the rear housing portion **416**. This may be useful, for example, in order to effectively isolate sound-creating vibrations and improve the overall sound quality of the marine drive. Each of the elastomeric isolators **440**, **468**, may be formed from a material selected in order to isolate selected frequency ranges. The first elastomeric isolator **440** may have a first stiffness that isolates a first range of vibration frequencies, the second elastomeric isolator **468** may have a second stiffness that isolates a second range of vibration frequencies, the third elastomeric isolator **486** (i.e., the O-ring seal **486**) may have a third stiffness that isolates a third range of vibration frequencies. In some embodiments each of the elastomeric isolators **440**, **468** may be configured to isolate different ranges of vibration frequencies, while other embodiments may include at least two elastomeric isolators have materials selected to isolate the same range of vibration frequencies and/or overlapping ranges of vibration frequencies.
(66) In the present disclosure, certain terms have been used for brevity, clarity, and understanding. No unnecessary limitations are to be implied therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes only and are intended to be broadly construed. The different systems and methods described herein may be used alone or in combination with other systems and devices. Various equivalents, alternatives and modifications are possible within the scope of the appended claims.

Claims

1. A marine drive for propelling a marine vessel in a body of water, the marine drive comprising: a supporting frame configured to support the marine drive with respect to the marine vessel; an extension leg depending on the supporting frame; a motor housing depending on the extension leg, the motor housing for containing an electric motor; and a vibration isolating joint that couples the extension leg to the motor housing, the vibration isolating joint comprising an isolating connector assembly having: an elastomeric member that is clamped between the extension leg and motor housing and configured to limit transfer of vibrations from the motor housing to the extension leg, and a compression limiter that prevents over clamping of the elastomeric member during assembly of the extension leg and the motor housing.
2. The marine drive according to claim 1, wherein the isolating connector assembly further comprises a fastener, wherein tightening the fastener clamps the elastomeric member between the extension leg and the motor housing, and wherein the compression limiter prevents over tightening of the fastener to thereby prevent over compression of the elastomeric member.
3. The marine drive according to claim 1, wherein the extension leg comprises a leg mounting flange at a lower end of the extension leg, wherein the motor housing comprises a motor housing

mounting flange at an upper end of the motor housing, and further wherein the vibration isolating joint couples the leg mounting flange and the motor housing mounting flange together.
4. The marine drive according to claim 3, wherein the motor housing comprises a stem and wherein the stem comprises the motor housing mounting flange at an upper end of the stem.
5. The marine drive according to claim 3, wherein the motor housing comprises a cover plate having a cylindrical stack and a cover plate flange, and wherein the cover plate flange is coupled to the motor housing mounting flange and the cylindrical stack includes a bore configured to receive a tube that extends from the support frame to the motor housing through the cover plate.
6. The marine drive according to claim 2, wherein the fastener extends through the elastomeric member and through the compression limiter.
7. The marine drive according to claim 2, wherein the compression limiter is a rigid member having a bore through which the fastener extends.
8. The marine drive according to claim 2, wherein the compression limiter comprises a rigid cylinder through which the fastener extends.
9. The marine drive according to claim 3, wherein the isolating connector assembly further comprises a fastener, wherein tightening the fastener clamps the elastomeric member between the extension leg and the motor housing, wherein the compression limiter prevents over tightening of the fastener to thereby prevent over compression of the elastomeric member, wherein the elastomeric member comprises a first resilient portion located between the leg mounting flange and the motor housing mounting flange, and wherein the fastener extends through the first resilient portion.
10. The marine drive according to claim 9, wherein tightening of the fastener clamps the first resilient portion between the compression limiter and one of the leg mounting flange and the motor housing mounting flange until engagement between the fastener and the compression limiter prevents further tightening of the fastener.
11. The marine drive according to claim 9, wherein the elastomeric member comprises a second resilient portion located on an opposite side of one of the leg mounting flange and the motor housing mounting flange relative to the first resilient portion, and wherein the fastener extends through the second resilient portion.
12. The marine drive according to claim 11, wherein tightening of the fastener clamps the second resilient portion between the compression limiter and the one of the leg mounting flange and the motor housing mounting flange until engagement between the fastener and the compression limiter prevents further tightening of the fastener.
13. The marine drive according to claim 1, wherein the compression limiter comprises a first limiter portion located between the extension leg and the motor housing and a second limiter portion located on an opposite side of one of the extension leg and the motor housing relative to the first limiter portion, and wherein the elastomeric member comprises a first resilient portion located between the first limiter portion and the one of the extension leg and the motor housing and a second resilient portion located between the second limiter portion and the one of the extension leg and the motor housing.
14. The marine drive according to claim 13, wherein the first limiter portion comprises a first annular flange and a first cylinder half through which a fastener extends and wherein the second limiter portion comprises a second annular flange and a second cylinder half through which the fastener extends, and wherein the first limiter portion and the second limiter portion are opposing each other, and further wherein the elastomeric member is clamped between first annular flange and the second annular flange by the fastener.
15. The marine drive according to claim 13, wherein the isolating connector assembly further comprises a fastener, wherein tightening the fastener clamps the elastomeric member between the extension leg and the motor housing, wherein the compression limiter prevents over tightening of the fastener to thereby prevent over compression of the elastomeric member, and wherein together

the first limiter portion and the second limiter portion define an axial space in which the elastomeric member is located, the axial space having a length that is preselected to prevent over compression of the elastomeric member by the fastener.

16. The marine drive according to claim 13, wherein the isolating connector assembly further comprises a fastener, wherein tightening the fastener clamps the elastomeric member between the extension leg and the motor housing, wherein the compression limiter prevents over tightening of the fastener to thereby prevent over compression of the elastomeric member, and wherein the extension leg comprises a leg mounting flange and the motor housing comprises a motor housing mounting flange, and further wherein the fastener couples the motor housing mounting flange and the leg mounting flange together.

17. The marine drive according to claim 3, wherein the isolating connector assembly is one of a plurality of isolating connector assemblies that is spaced apart around the leg mounting flange and the motor housing mounting flange.

18. The marine drive according to claim 17, wherein the leg mounting flange further comprises protrusions extending downwardly from a bottom side of the leg mounting flange, and wherein the plurality of the isolating connector assemblies extends through the motor housing mounting flange and into the protrusions.

19. The marine drive according to claim 1, wherein the isolating connector assembly further comprises a fastener that extends through the motor housing and into engagement with the extension leg, and wherein tightening the fastener clamps the elastomeric member between the extension leg and the motor housing, and wherein the compression limiter prevents over tightening of the fastener to thereby prevent over compression of the elastomeric member.

20. The marine drive according to claim 1, wherein the vibration isolating joint is configured so that all vibrations emanating from the electric motor are transferred to the elastomeric member before being transferred to the extension leg.