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(54) **VIBRATIONLESS MOINEAU SYSTEM**

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***E21B 4/16*** (2006.01)

(52) **U.S. Cl.**
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See application file for complete search history.

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(57) **ABSTRACT**

A method of operating a Moineau system to substantially eliminate vibrations, the method includes rotating a first rotational member, and rotating a second rotational member. Each of the first rotational member and the second rotational member includes a plurality of lobes. A first rotational speed of one of the first rotational member and the second rotational member is selected based on 1) a second rotational speed of the other of the first rotational member and the second rotational member and 2) the number of lobes of one of the first rotational member and the second rotational member to maintain eccentric force of one of the first and second rotational members below a predetermined threshold.

**20 Claims, 5 Drawing Sheets**

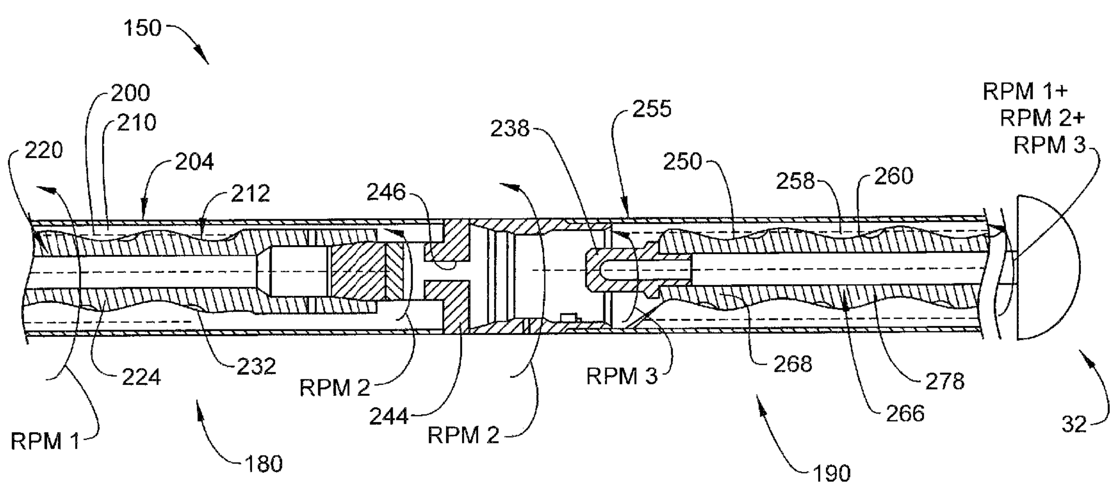

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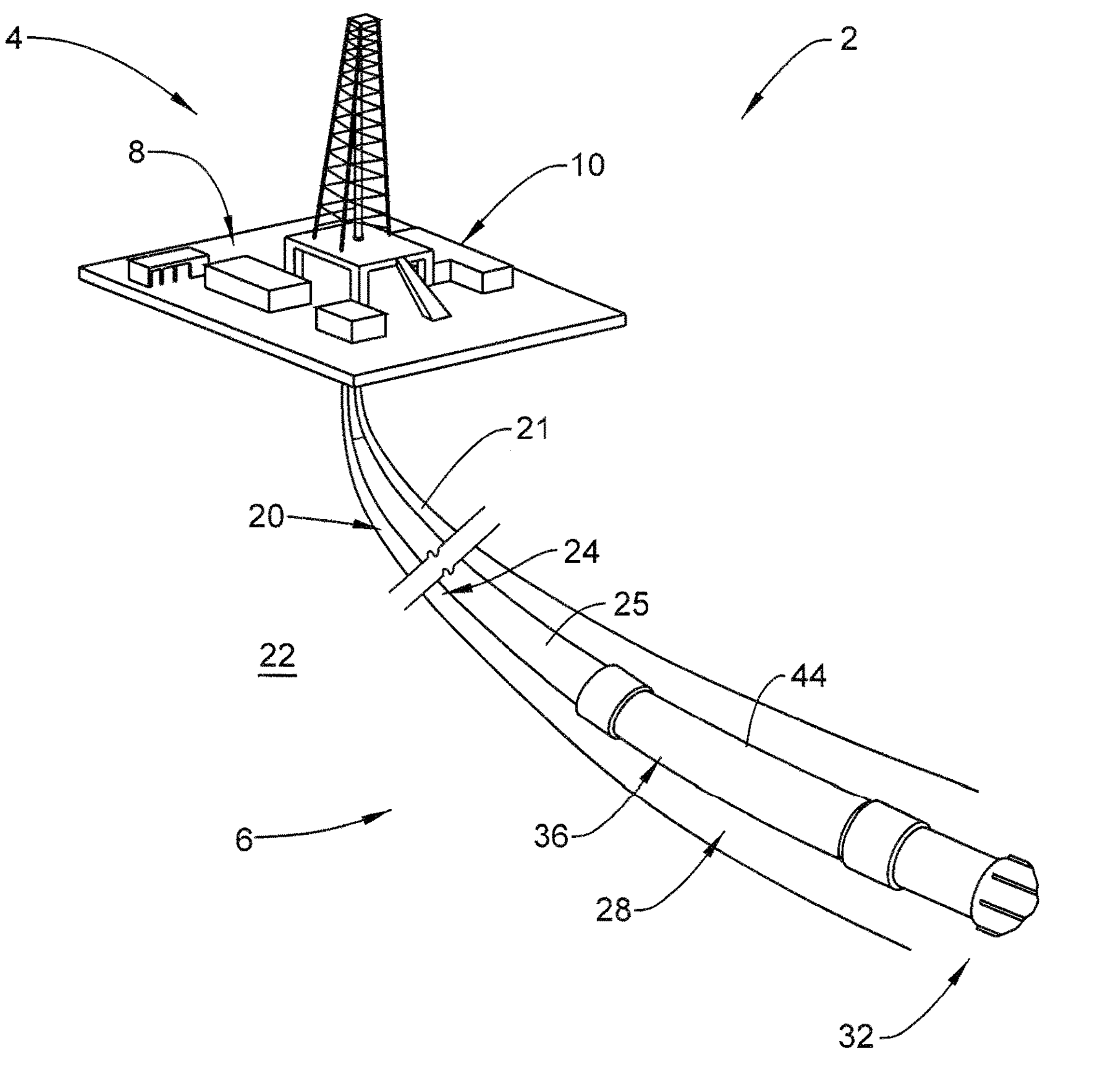
FIG. 1



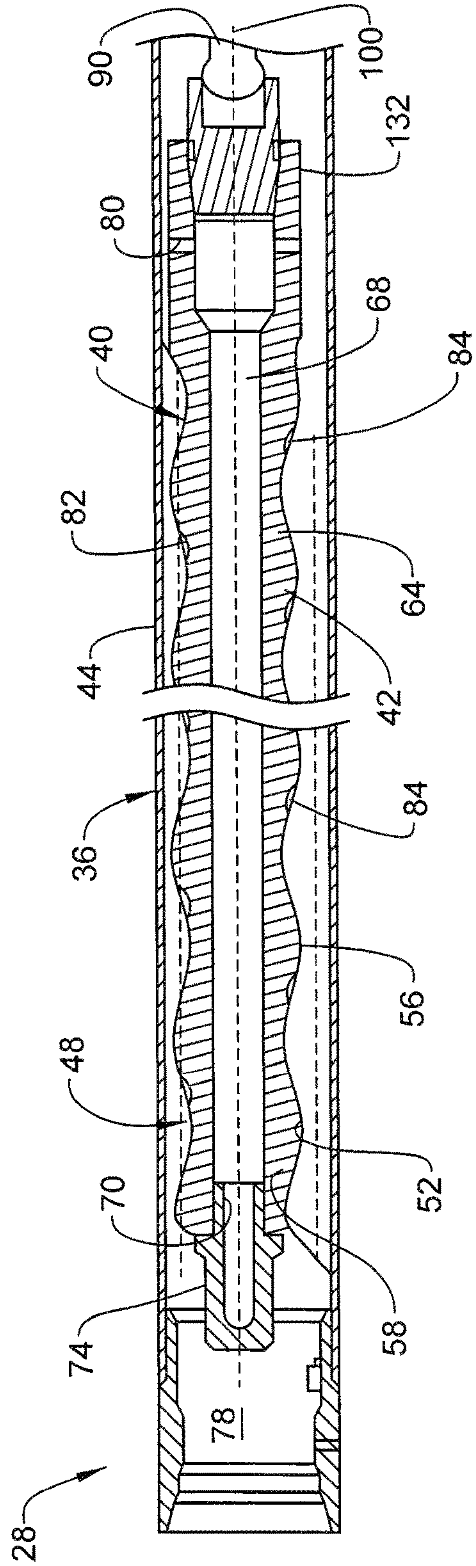



FIG. 2

FIG. 3

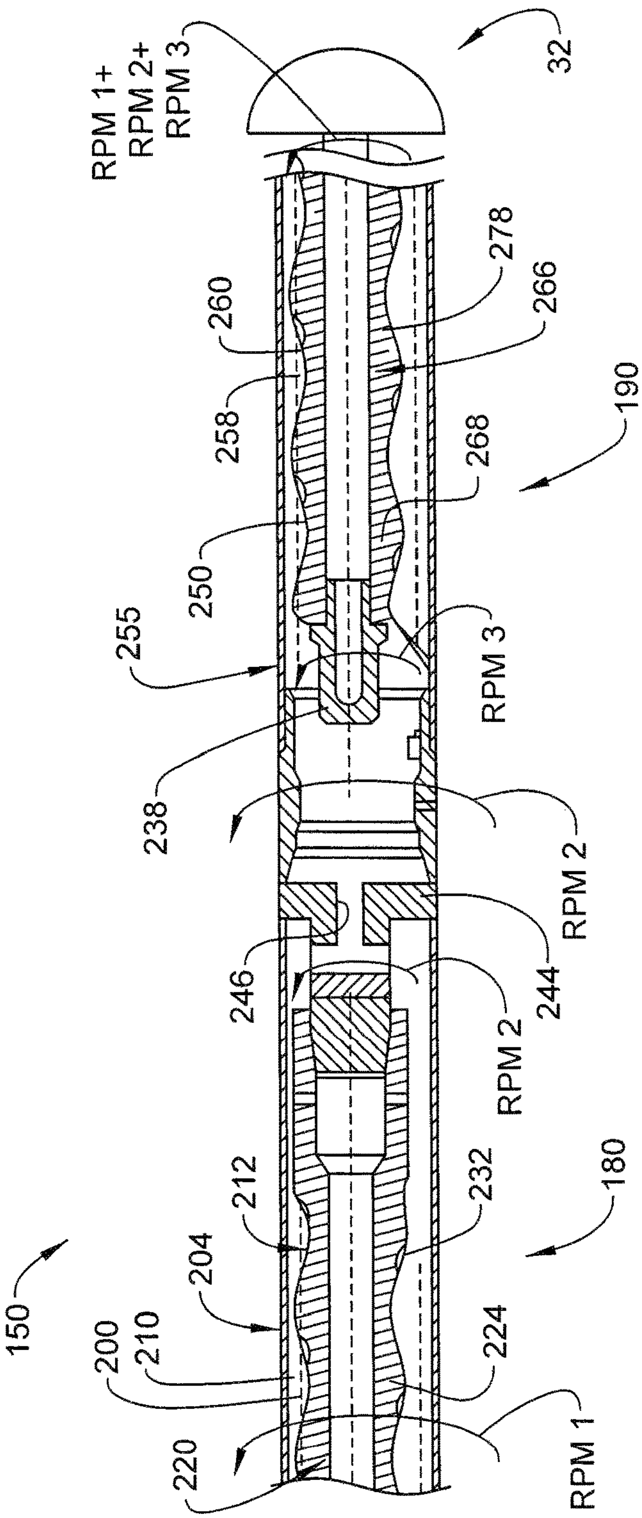

32
RPM 1+
RPM 2+
RPM 3
278
266
260
258
190
268
250
255
RPM 3
238
RPM 2
RPM 2
244
246
180
232
212
204
150
200
210
224
220
RPM 1

FIG. 4

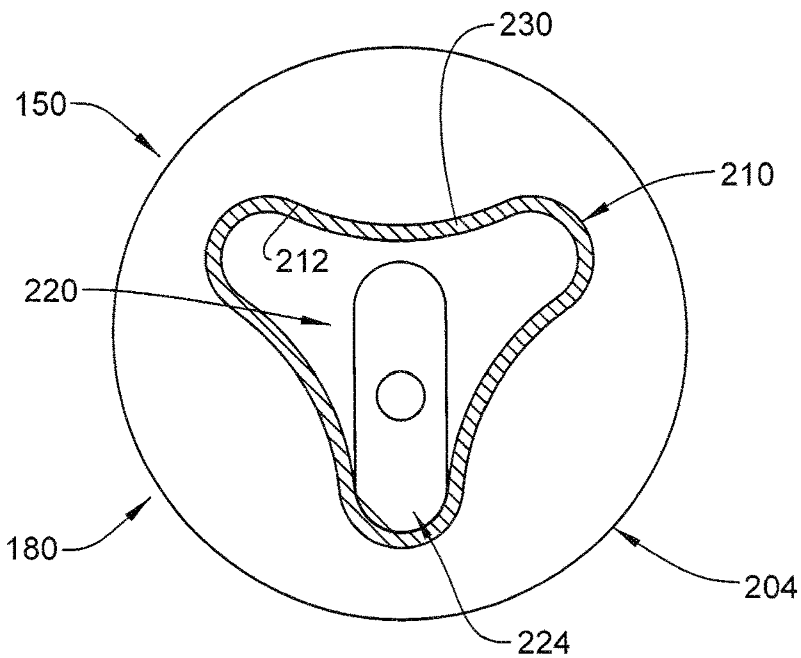
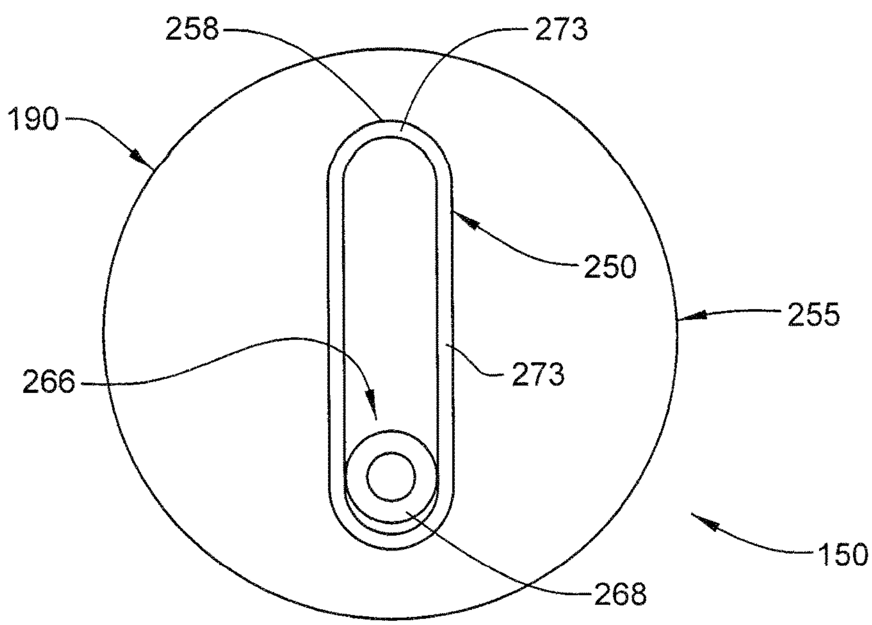

230
150
210
212
220
180
204
224

FIG. 5


258
273
190
250
255
266
273
150
268

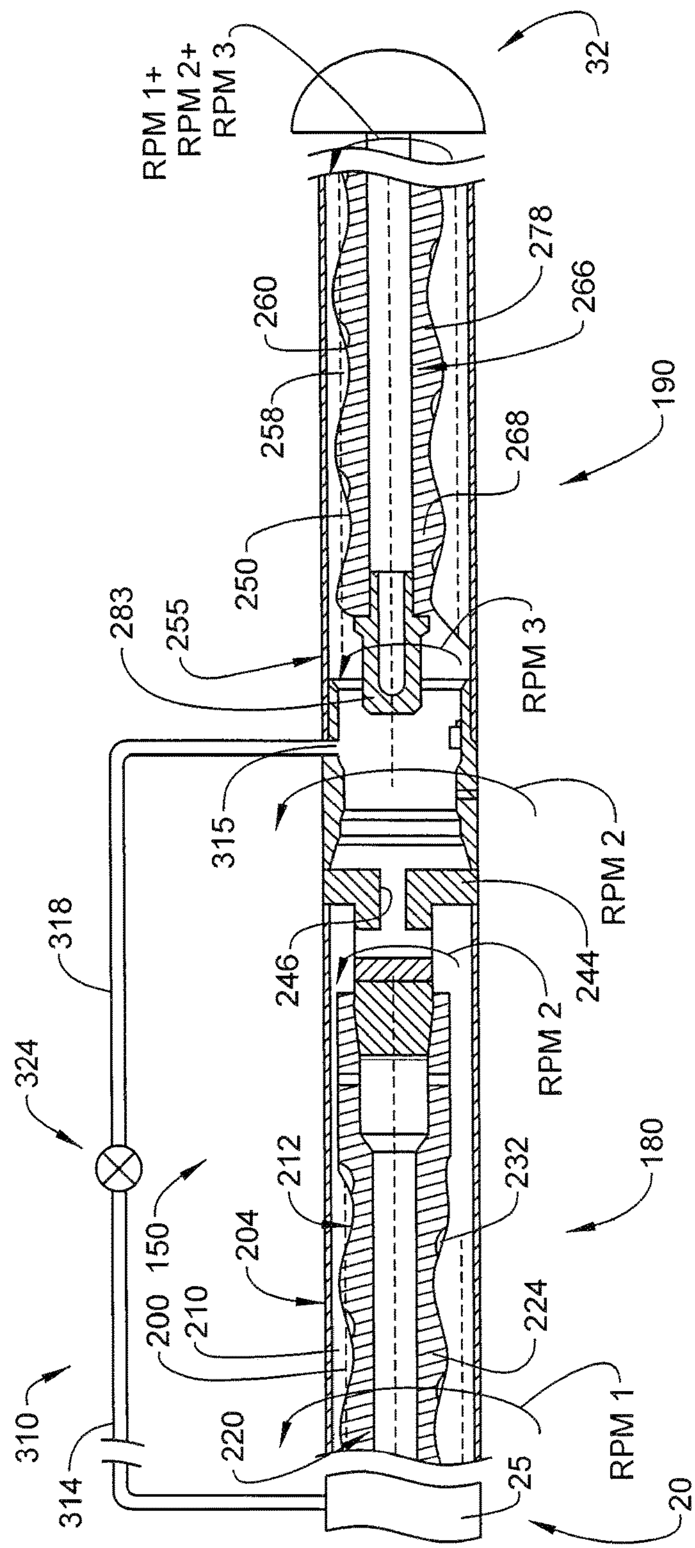

32
RPM 1+
RPM 2+
RPM 3
278
266
260
258
190
268
250
255
283
RPM 3
315
RPM 2
RPM 2
244
246
RPM 2
318
324
212
232
180
150
204
210
200
224
310
220
RPM 1
314
25
20

FIG. 6

# VIBRATIONLESS MOINEAU SYSTEM

## BACKGROUND

Downhole operations often include a downhole string, also referred to as a drill string that extends from an uphole system into a formation. The uphole system may include a platform, pumps, and other systems that support resource exploration, development, and extraction. During resource exploration operations, a drill bit is guided through the formation to form a well bore. The drill bit may be driven directly from the platform or both directly and indirectly through a flow of downhole fluid, which may take the form of drilling mud passing through a motor. A downhole motor includes a stator having a plurality of lobes and a rotor having another plurality of lobes. The stator is rotated by the downhole string and the rotor by the flow of fluid. The number of lobes on the stator is one fewer than the number of lobes on the stator. In this manner, the flow of fluid drives the rotor eccentrically while the motor drives the drill bit concentrically.

The eccentric rotation of the rotor often leads to vibrations, especially when operating the drill bit at high speeds. The vibrations produced by the downhole motor are not only detrimental to the motor itself, but may also interfere with drilling operations. The vibrations may lead to a reduced overall service life of the downhole motor. Components of the downhole motor, over time, may delaminate due to prolonged exposure to vibrations. Further, the vibrations may exist at a frequency that could lead to interferences with signals passing from the drill string to uphole operators. According, resource exploration companies would be receptive to improvements in downhole motor design and operation.

## SUMMARY

A method of operating a Moineau system to substantially eliminate vibrations, the method includes rotating a first rotational member, and rotating a second rotational member. Each of the first rotational member and the second rotational member includes a plurality of lobes. A first rotational speed of one of the first rotational member and the second rotational member is selected based on 1) a second rotational speed of the other of the first rotational member and the second rotational member and 2) the number of lobes of one of the first rotational member and the second rotational member to maintain eccentric force of one of the first and second rotational members below a predetermined threshold.

A vibrationless Moineau system includes a first downhole motor including a first stator having a first number of stator lobes, and a first rotor having a first number of rotor lobes, and a second downhole motor including a second stator operatively connected to the first rotor. The second stator has a second number of stator lobes. A second rotor has a second number of rotor lobes. The first and second downhole motors are selectively operated to substantially maintain eccentric forces on at least one of the first rotor and the second rotor below a predetermined threshold.

A resource exploration system includes a surface system, and a downhole system including a downhole string operatively connected to the surface system. The downhole string includes a vibrationless Moineau system including a first downhole motor having a first stator including a first number of stator lobes, and a first rotor including a first number of rotor lobes. A second downhole motor includes a second stator operatively connected to the first rotor. The second stator has a second number of stator lobes. A second rotor has a second number of rotor lobes. The first and second downhole motors are selectively operated to substantially maintain eccentric forces on at least one of the first rotor and the second rotor below a predetermined threshold.



## BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings wherein like elements are numbered alike in the several Figures:

FIG. **1** depicts a resource exploration system having an uphole system operatively connected to a downhole string including a downhole motor system, in accordance with an exemplary embodiment;

FIG. **2** depicts a cross-sectional view of a downhole motor system, in accordance with an aspect of an exemplary embodiment,

FIG. **3** depicts a schematic representation of the downhole motor system, in accordance with an aspect of an exemplary embodiment;

FIG. **4** depicts a cross-sectional side view of a first downhole motor of the downhole motor system, in accordance with an aspect of an exemplary embodiment;

FIG. **5** depicts a cross-sectional side view of a second downhole motor of the downhole motor system, in accordance with an aspect of an exemplary embodiment; and

FIG. **6** depicts a schematic representation of the downhole motor system, in accordance with another aspect of an exemplary embodiment.

## DETAILED DESCRIPTION

A resource exploration system, in accordance with an exemplary embodiment, is indicated generally at **2**, in FIG. **1**. Resource exploration system **2** should be understood to include well drilling operations, resource extraction and recovery, $CO_2$ sequestration, and the like. Resource exploration system **2** may include a surface system **4** operatively connected to a downhole system **6**. Surface system **4** may include pumps **8** that aid in completion and/or extraction processes as well as fluid storage **10**. Fluid storage **10** may contain a gravel pack fluid or slurry (not shown) that is introduced into downhole system **6**.

Downhole system **6** may include a downhole string **20** that is extended into a wellbore **21** formed in formation **22**. Downhole string **20** may include a number of connected downhole tools or tubulars **24** that may define a drill pipe **25**. One of tubulars **24** may be connected with a vibrationless Moineau or downhole motor system **28** operatively connected to a drill bit **32**. Vibrationless downhole motor system **28** cooperates with uphole devices (not shown) to rotate drill bit **32** creating well bore **21**.

As shown in FIG. **2**, downhole motor system **28** may take the form of a downhole motor and includes a power section **36** and a bearing assembly (not shown) that operatively connects with drill bit **32** (FIG. **1**). Power section **36** includes a first rotational member defined by a stator **40** and a second rotational member defined by a rotor **42**. Rotor **42** is arranged within stator **40**. Stator **40** includes a stator housing **44** having a number of stator lobes **48** that define an inner lobed contour or profile **52**. Stator housing **44** may be pre-formed with inner lobed profile **52**. Inner lobed profile **52** is lined with an elastomeric liner **56** that includes an inner lobed profile **58**. Elastomeric liner **56** may be secured within stator housing **44** with any suitable process such as molding, vulcanization, and the like.

Rotor **42** includes a number of rotor lobes **64**. It is to be understood that the number of stator lobes **48** is one more than the number of rotor lobes **64**. Rotor **42** is rotatably disposed inside of stator **40** and may include a rotor bore **68** that terminates at a location **70** below an upper end **74**. Rotor bore **68** remains in fluid communication with drilling fluid **78** which may exit through a port **80**. It is to be understood that drilling fluid **78** may take on a number of forms including drilling mud or other types of fluids, foams, gases or the like introduced into downhole motor system **28** through downhole string **20** (FIG. **1**).

Stator lobes **48** and rotor lobes **64** possess a helical angle (not separately labeled) causing a seal, such as indicated at **82** at multiple discrete locations between stator **40** and rotor **42**. Seals **82** create multiple axial fluid chambers or cavities, one of which is indicated at **84**. Drilling fluid **78** supplied under pressure from surface system **4** flows through axial fluid cavities **84** causing rotor **42** to rotate inside stator **40** in a planetary fashion. The number and design of stator lobes **48** and rotor lobes **64** define output characteristics of downhole motor **28**. More specifically, a ratio between rotations of stator housing **44** controlled by drill string **20** and rotor **42** as controlled by drilling fluid pressure defines an output torque of downhole motor **28** that is passed to drill bit **32** through a flex shaft **90**.

In accordance with an exemplary aspect, rotor **42** and stator **40** may be formed of metal or alloys thereof or any other material that is suitable for downhole motor **28** in the form of a Moineau system. It is to be understood that a Moineau system has at least two rotating parts, also referred to as a first rotational member and a second rotational member. The two parts are an outer tubular part with lobes on its inner surface and an inner threaded rod part, either massive or hollow, with lobes on its outer surface.

It is also to be understood that the term "stator" as used herein refers to a slower rotating part of downhole motor **28**, and the term "rotor" refers to a faster rotating part of downhole motor **28**. That is, in accordance with an exemplary aspect, rotor **42** rotates faster than stator **40** in a laboratory system, while the wellbore is stationary in the laboratory system. Depending on the configuration of downhole motor **28**, rotor **42** may be an inner threaded rod part arranged within an outer tubular part such as, for example, stator **40**. Alternatively, stator **40** may be defined by the inner threaded rod part arranged within the outer tubular part such as, for example, rotor **42**. In either example, rotor **42** is at least partially driven by fluid flow through downhole motor system **28**.

In accordance with an exemplary aspect, rotation of stator **40** and rotor **42** is controlled to substantially eliminate vibrations produced by downhole motor **28**. Specifically, downhole motor **28** is operated in a manner that maintains lateral accelerations of rotor **42** below about 15 g. In accordance with another aspect of an exemplary embodiment, downhole motor **28** is operated to maintain lateral accelerations of rotor **42** below about 2 g. In accordance with still another aspect of an exemplary embodiment, downhole motor **28** is operated to maintain lateral accelerations below about 0.5 g. In accordance with yet still another aspect of an exemplary embodiment, downhole motor system **28** is operated to substantially eliminate lateral accelerations of rotor **42**.

Substantially eliminating lateral accelerations of rotor **42** results in substantially eliminating vibrations of downhole motor system **28**. Lateral accelerations of rotor **42** may be described by formula 1. Controlling motor input through drill string **20** and establishing a selected drilling fluid pressure can establish a desired lateral acceleration of rotor **42** and thereby substantially reduce vibrations of downhole motor **28**. For example, rotating downhole string **20** at about 120 RPM and delivering drilling fluid to at a flow rate causing the rotor to rotate at about 60 RM in a downhole motor having a rotor-stator lobe ratio of 2:3 will maintain lateral accelerations below about 0.5 g.

$$F_{ecc}=m_{rotor}*r_{ecc}*\omega^{2}_{ecc} \quad (1)$$

$F_{ecc}$=eccentric force on the motor;

$m_{rotor}$ is the mass of the motor; $r_{ecc}$ defines rotor eccentricity; and $\omega_{ecc}$ defines angular velocity defined by equation 2

$$\omega_{ecc}=\omega_{stator}-(\omega_{rotor}*n_{rotor\ lobes})=0 \quad (2)$$

$$\omega_{stator}=\omega_{rotor}*n_{rotor\ lobes} \text{ or } \omega_{rotor}=\omega_{stator}/n_{rotor\ lobes} \quad (3)$$

$\omega_{stator}$ defines the angular velocity of the stator;

$\omega_{rotor}$ defines the angular velocity of the rotor; and

$n_{rotor\ lobes}$ defines the number of lobes on the rotor.

It is to be understood that motor power provided at drill bit **32** ($P_{motor}$) is a function of angular velocity of downhole motor **28**. ($\omega_{motor}$) and downhole motor torque ($M_{motor}$) are established by drill string **20** as shown in equations 3 and 4 below.

$$\omega_{motor}=\omega_{stator}+\omega_{rotor} \quad (4)$$

$$P_{motor}=M\omega_{motor}=M(\omega_{stator}+\omega_{rotor}) \quad (5)$$

It is also to be understood that controlling motor inputs to reduce vibration may impose limitations on motor power. For example, downhole string **20** may be rotated only at a limited RPM due to operational limitations. In accordance with an exemplary embodiment the rotation of the downhole string determines the RPM of the stator. Table 1 presents assumed stator RPM and the rotor RPM for typical 'rotor lobe'/'stator lobe' configurations to achieve a vibrationless downhole motor. Entries including a leading "x" are not applicable to a drilling operation, because of a resulting low motor power caused by a resulting low angular velocity of the motor.

In accordance with an aspect of an exemplary embodiment, motor power and angular velocity that is too low for drilling operations may be overcome by including another downhole motor in downhole string **20** with the purpose of creating another source of rotation which is different from the rotation of downhole string **20**. The addition of a second downhole motor, as detailed below, would increase motor power and angular velocity to a level that is more applicable to downhole drilling operations.

TABLE 1

| Stator RPM Lobe conf. | 60 | 90 | 120 | 150 | 180 |
|---|---|---|---|---|---|
| ½ | 60 | 90 | 120 | 150 | 180 |
| ⅔ | ×30 | 45 | 60 | 75 | 90 |
| ¾ | ×20 | ×30 | 40 | 50 | 60 |
| ⅚ | ×12 | ×18 | ×24 | ×30 | ×36 |
| ⅞ | ×8.6 | ×13 | ×17 | ×21.4 | ×25.8 |
| 9/10 | ×6.7 | ×10 | ×13.3 | ×16.7 | ×20 |

A downhole motor system, in accordance with another aspect of an exemplary embodiment is illustrated generally at **150** in FIG. **3**, vibrationless downhole motor system **28** includes a first downhole motor **180** operatively connected to a second downhole motor **190**. First downhole motor **180** includes a first rotational member defined by a first stator

**200** having a first stator housing **204** a first number of stator lobes, one of which is indicated at **210** that define a first stator lobe profile **212**. A second rotational member defined by a first rotor **220** is rotatably supported within first stator **200**. First rotor **220** includes a first number of rotor lobes, one of which is indicated at **224** that interact with the first number of stator lobes **210**. The first number of rotor lobes **224** number one fewer than the first number of stator lobes **210**. A first elastomeric liner **230**, see FIG. **4**, is mounted to first stator lobe profile **212** and is selectively engaged by the number or rotor lobes to form multiple discrete axial passages **232** in a manner similar to that described above.

It is to be understood that the terms "first" and "second" are not meant to define a particular order relative to surface system **4**. That is, while second downhole motor **190** is shown positioned downhole relative to first downhole motor **180**, the particular order may vary. Also, it is to be understood that first and second downhole motors **180** and **190** need not be directly adjacent. It is to be understood that first and second downhole motors may be separated by one or more intervening tubulars.

First rotor **220** includes an output member **244** that operatively connects with second downhole motor **190**. Output member **244** may take the form of a dampening member that restricts transmission of vibrations from first downhole motor **180** to second downhole motor **190**. Output member **244** may include a seal (not separately labeled) and is rotationally isolated from first stator housing **204**. Output member **244** includes a passage **250** that receives drilling fluid passing from an area (not separately labeled) between first stator **200** and first rotor **220**. In the exemplary embodiment shown, first downhole motor **180** constitutes a downhole motor having a rotor-stator lobe ratio of 2:3 with the number of first rotor lobes **224** being two (2) in number and the number of first stator lobes **210** being three (3) in number.

In further accordance with an aspect of an exemplary embodiment, second downhole motor **190** includes a third rotational member defined by a second stator **250** having a second stator housing **255** and a first number of stator lobes, one of which is indicated at **258** that define a second stator lobe profile **260**. A fourth rotational member defined by a second rotor **266** is rotatably supported within second stator **250**. Second rotor **266** includes a second number of rotor lobes, one of which is indicated at **268** that interact with the second number of stator lobes **258**. The second number of rotor lobes **268** number one fewer than the second number of stator lobes **258**. A second elastomeric liner **273**, see FIG. **5**, is mounted to second stator lobe profile **260** and is selectively engaged by the second number or rotor lobes **268** to form multiple discrete axial passages **278** in a manner similar to that described above. In the exemplary embodiment shown, second downhole motor **190** constitutes a downhole motor having a rotor-stator ratio of 1:2 with the number of second rotor lobes **268** being one (1) in number and the number of second stator lobes **258** being two (2) in number.

Second stator housing **255** is mechanically linked to output member **244**. In this manner rotational forces or torque developed in first rotor **220** are direct passed to second stator housing **255**. Drilling fluid passing through passage **246** of output member **244** is directed into second stator housing **255**. Second rotor **70** includes a first end portion **283** rotatably supported within second stator **250** through a support bearing (not shown) and a second end portion (also not shown) mechanically linked to drill bit **32**.

In accordance with an aspect of an exemplary embodiment, rotational energy is imparted to first stator **200** through a drilling system (not shown) arranged at surface system **4** (FIG. **1**). The rotational energy imparts a first rotational speed RPM1 to first stator **200**. At the same time, drilling fluids at a selected pressure are pumped through downhole string **20** (FIG. **1**) into first downhole motor **180**. The drilling fluids at the selected pressure interact with first rotor **220** resulting in a second rotational speed RPM 2. First rotor **220** is coupled to second stator housing **255** through output member **244**. In this manner, torque developed at output member **244** is directly transferred to second stator **250**. As such, second stator **250** rotates at the second rotational speed RPM 2 relative to first stator **200**.

Drilling fluids at the selected pressure passing into second downhole motor **190** from passage **246** enter into second stator housing **255**. Those drilling fluids interact with second rotor **266** resulting in a third rotational speed RPM 3 relative to second stator **250**. The drilling fluids then pass from second downhole motor **190** through an outlet portion (not shown). In this manner, first and second downhole motors **180**, **190** may be operated individually at levels below which would produce vibration but at a lower than desired speeds while the operative connection produces a much higher output, e.g., RPM1+RPM2+RPM 3 to drill bit **32**. Accordingly, during operating, vibrationless downhole motor system **28** produced few if any vibrations. That is, lateral acceleration of downhole motor system **150** and, more specifically first rotor **220** and lateral accelerations of second rotor **266** are maintained below about 15 g.

In accordance with another aspect of an exemplary embodiment, downhole motor system **150** is operated to maintain lateral accelerations of rotor **42** below about 2 g. In accordance with still another aspect of an exemplary embodiment, downhole motor system **150** is operated to maintain lateral accelerations below about 0.5 g. In accordance with still another aspect of an embodiment, downhole motor system **150** is operated to substantially eliminate lateral acceleration or rotor **266**. In one example, RPM 1 may be about 120 RPM, RPM 2 may be 60 RPM, and RPM 3 may be 180 RPM resulting in a combined output to drill bit **32** of 360 RPM.

In another embodiment, the downhole motor system may not be operated in a manner to reduce vibration. That is RPMs first rotor **220** and first stator **200** of the downhole motor system may not be adjusted to reduce vibration. Second rotor **266** and second stator **250** of second downhole motor system **190** may be operated in a manner to reduce vibration. More specifically, the RPM of second rotor **266** and second stator **250** may be adjusted to substantially eliminate eccentric forces. This embodiment may be beneficial with respect to reduce vibration near a vibration sensitive part of the downhole string, e.g. a bottom hole assembly. In order to damp vibration of the downhole motor system, damping elements, e.g. heavy weight drill pipes (not shown), may be included in downhole string **20** to dampen vibrations that may originate from the downhole motor system and which may propagate towards the vibration sensitive part of downhole string **20**.

In accordance with an aspect of an exemplary embodiment illustrated in FIG. **6**, wherein like numbers represent corresponding parts in the respective views, vibrationless downhole motor system **28** may include a bypass conduit **310** that delivers fluid from upstream of first downhole motor **180** into second downhole motor **190**. More specifically, bypass conduit **310** includes a first end **314** fluidically connected to downhole string **20** upstream of first downhole motor **180**, a second end **315** fluidically connected to second downhole motor **190** downstream of passage **246** and an intermediate portion **318** extending therebetween.

A valve **324** may be arranged in bypass conduit **310** to selectively control fluid flow therethrough. More specifically, valve **324** may be selectively opened to adjust a flow of drilling fluids into second downhole motor **190** thereby providing additional control of torque developed in second rotor **266** to promote a desired output and/or further reduce vibrations. It is also to be understood that resource exploration system **2** may include a control system (not shown) operable to determine how much fluid may bypass valve **324** and a telemetry system (also not shown) that allows communication between downhole motor(s) and surface system **4**. Telemetry may take the form of a mud pulse telemetry system, an acoustic telemetry system, and electro-magnetic telemetry system or a wired pipe telemetry system.

Embodiment 1

A method of operating a Moineau system to substantially eliminate vibrations, the method comprising: rotating a first rotational member; rotating a second rotational member, each of the first rotational member and the second rotational member including a plurality of lobes; and selecting a first rotational speed of one of the first rotational member and the second rotational member based on: 1) a second rotational speed of the other of the first rotational member and the second rotational member, and 2) the number of lobes of one of the first rotational member and the second rotational member to maintain eccentric force of one of the first and second rotational members below a predetermined threshold.

Embodiment 2

The method of embodiment 1, further comprising: inputting a fluid flow at a selected flow rate into a housing of the Moineau system, the selected flow rate establishing the first rotational speed of the one of the first rotational member and the second rotational member.

Embodiment 3

The method of embodiment 2, further comprising: establishing the second rotational speed of the other of the first rotational member and the second rotational member by rotating a drill string operatively coupled to the other of the first rotational member and the second rotational member.

Embodiment 4

The method of embodiment 1, wherein operating the Moineau system includes operating a downhole motor coupled to a drill string extending into a formation.

Embodiment 5

The method of embodiment 4, wherein operating the downhole motor includes coupling the downhole motor to another downhole motor arranged uphole of the downhole motor.

Embodiment 6

The method of embodiment 5, wherein coupling the downhole motor to the another downhole motor includes connecting the downhole motor to the another downhole motor through a dampening member.

Embodiment 7

The method of embodiment 1, wherein selecting the first rotational speed of the one of the first rotational member and the second rotational member maintains eccentric forces on the one of the first and second rotational members below about 2 g.

Embodiment 8

A vibrationless Moineau system comprising: a first downhole motor including a first stator having a first number of stator lobes, and a first rotor having a first number of rotor lobes; and a second downhole motor including a second stator operatively connected to the first rotor, the second stator having a second number of stator lobes, and a second rotor having a second number of rotor lobes, wherein the first and second downhole motors are selectively operated to substantially maintain eccentric forces on at least one of the first rotor and the second rotor below a predetermined threshold.

Embodiment 9

The vibrationless Moineau system of embodiment 8, wherein the second downhole motor is arranged downhole of the first downhole motor.

Embodiment 10

The vibrationless Moineau system of embodiment 9, wherein the first rotor is operatively connected to the second stator through a dampening member.

Embodiment 11

The vibrationless Moineau system of embodiment 9, wherein a rotational speed of the second stator is selected based upon a rotational speed of the second rotor and one of the second number of stator lobes and the second number of rotor lobes.

Embodiment 12

The vibrationless Moineau system according to embodiment 8, further comprising: a bypass conduit having a first end fluidically connected to the first downhole motor and a second end fluidically connected to the second downhole motor.

Embodiment 13

The vibrationless Moineau system according to embodiment 12, wherein the first end of the bypass conduit is fluidically connected uphole of the first downhole motor.

Embodiment 14

The vibrationless Moineau system according to embodiment 12, further comprising: a valve fluidically connected with the bypass conduit, the valve being selectively controllable to allow fluid to pass from the first end to the second end.

Embodiment 15

The vibrationless Moineau system according to embodiment 8, further comprising: a drill bit operatively connected to the second rotor.

Embodiment 16

The vibrationless Moineau system according to embodiment 8, wherein the first and second downhole motors are selectively operable to maintain eccentric forces on the second rotor below about 2 g.

Embodiment 17

A resource exploration system comprising: a surface system; and a downhole system including a downhole string operatively connected to the surface system, the downhole string including a vibrationless Moineau system comprising: a first downhole motor including a first stator having a first number of stator lobes, and a first rotor having a first number of rotor lobes; and a second downhole motor including a second stator operatively connected to the first rotor, the second stator having a second number of stator lobes, and a second rotor having a second number of rotor lobes, wherein the first and second downhole motors are selectively operated to substantially maintain eccentric forces on at least one of the first rotor and the second rotor below a predetermined threshold.

Embodiment 18

The resource exploration system according to embodiment 17, wherein the first and second downhole motors are selectively operable to maintain eccentric forces on the second rotor below about 2 g.

Embodiment 19

The resource exploration system according to embodiment 17, wherein the second downhole motor is arranged downhole of the first downhole motor.

Embodiment 20

The resource exploration system according to embodiment 19, further comprising: a bypass conduit having a first end fluidically connected to the downhole string and a second end fluidically connected to the second downhole motor.

The terms “about” and “substantially” are intended to include the degree of error associated with measurement of the particular quantity based upon the equipment available at the time of filing the application. For example, “about” can include a range of ±8% or 5%, or 2% of a given value. It is also to be understood that the term “uphole” denotes a direction along the downhole string leading to the surface and the term “downhole” denotes a direction along the downhole string leading into the formation.

While one or more embodiments have been shown and described, modifications and substitutions may be made thereto without departing from the spirit and scope of the invention. Accordingly, it is to be understood that the present invention has been described by way of illustrations and not limitation.



What is claimed is:

**1**. A method of operating a Moineau system including a first downhole motor mechanically linked in series to a second downhole motor to substantially eliminate vibrations, the method comprising:

rotating a first rotational member of the first downhole motor;

rotating a second rotational member of the first downhole motor coupled to a third rotational member of the second downhole motor, each of the first rotational member and the second rotational member including a plurality of lobes; and

selecting a first rotational speed of one of the first rotational member and the third rotational member based on: 1) a second rotational speed of the other of the first rotational member and the third rotational member, and 2) the number of lobes of one of the first rotational member and the second rotational member to reduce eccentric force of one of the first and second rotational members.

**2**. The method of claim **1**, wherein operating the Moineau system includes operating a downhole motor coupled to a drill string extending into a formation.

**3**. The method of claim **1**, wherein coupling the first downhole motor to the second downhole motor includes connecting the first downhole motor to the second downhole motor through a dampening member.

**4**. The method of claim **1**, wherein selecting the first rotational speed of the one of the first rotational member and the second rotational member maintains eccentric forces on the one of the first and second rotational members below about 2 g.

**5**. The method of claim **1**, wherein reducing eccentric force comprises maintaining eccentric force below a predetermined threshold.

**6**. The method of claim **1**, further comprising: inputting a fluid flow at a selected flow rate into a housing of the Moineau system, the selected flow rate establishing the second rotational speed of the third rotational member of the second downhole motor coupled to the second rotational member of the first downhole motor.

**7**. The method of claim **1**, wherein operating the Moineau system comprises inputting a fluid flow at a selected flow rate into the first downhole motor and the second downhole motor.

**8**. A vibrationless Moineau system comprising:

a first downhole motor including a first stator having a first number of stator lobes, and a first rotor having a first number of rotor lobes; and

a second downhole motor connected in series with the first downhole motor, the second downhole motor including a second stator mechanically linked to the first rotor, the second stator having a second number of stator lobes, and a second rotor having a second number of rotor lobes, wherein the first and second downhole motors are selectively operated to reduce eccentric forces on at least one of the first rotor and the second rotor.

**9**. The vibrationless Moineau system of claim **8**, wherein the first rotor is operatively connected to the second stator through a dampening member.

**10**. The vibrationless Moineau system of claim **8**, wherein a rotational speed of the second stator is selected based upon a rotational speed of the second rotor and one of the second number of stator lobes and the second number of rotor lobes.

**11**. The vibrationless Moineau system according to claim **8**, further comprising: a bypass conduit having a first end fluidically connected to the first downhole motor and a second end fluidically connected to the second downhole motor.

**12**. The vibrationless Moineau system according to claim **11**, wherein the first end of the bypass conduit is fluidically connected uphole of the first downhole motor.

**13**. The vibrationless Moineau system according to claim **11**, further comprising: a valve fluidically connected with the bypass conduit, the valve being selectively controllable to allow fluid to pass from the first end to the second end.

**14**. The vibrationless Moineau system according to claim **8**, further comprising: a drill bit operatively connected to the second rotor.

**15**. The vibrationless Moineau system according to claim **8**, wherein the first and second downhole motors are selectively operable to maintain eccentric forces on the second rotor below about 2 g.

**16**. The vibrationless Moineau system of claim **8**, wherein the second downhole motor is arranged downhole of the first downhole motor.

**17**. A resource exploration system comprising:

a surface system; and

a downhole system including a downhole string operatively connected to the surface system, the downhole string including a vibrationless Moineau system comprising:

a first downhole motor including a first stator having a first number of stator lobes, and a first rotor having a first number of rotor lobes; and

a second downhole motor including a second stator mechanically linked in series to the first rotor, the second stator having a second number of stator lobes, and a second rotor having a second number of rotor lobes, wherein the first and second downhole motors are selectively operated to reduce eccentric forces on at least one of the first rotor and the second rotor.

**18**. The resource exploration system according to claim **17**, wherein the first and second downhole motors are selectively operable to maintain eccentric forces on the second rotor below about 2 g.

**19**. The resource exploration system according to claim **17**, further comprising: a bypass conduit having a first end fluidically connected to the downhole string and a second end fluidically connected to the second downhole motor.

**20**. The resource exploration system of claim **17**, wherein the second downhole motor is arranged downhole of the first downhole motor.

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