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Brevet européen

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Etats contractants désignés
dans le fascicule de brevet.

Europäisches Patent Nr.
European patent No.
Brevet européen n°

2961892

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14.08.19

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(19)



(11)

EP 2 961 892 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
14.08.2019 Bulletin 2019/33

(51) Int Cl:
F16N 7/40 ^(2006.01) **F28F 3/12** ^(2006.01)
B06B 1/16 ^(2006.01) **F28D 15/00** ^(2006.01)
F16N 39/02 ^(2006.01) **F16H 57/04** ^(2010.01)
F16C 37/00 ^(2006.01)

(21) Application number: **14756508.9**

(22) Date of filing: **11.02.2014**

(86) International application number:
PCT/US2014/015668

(87) International publication number:
WO 2014/133742 (04.09.2014 Gazette 2014/36)

(54) BEARING COOLING SYSTEM FOR VIBRATORY PILE DEVICES

LAGERKÜHLSYSTEM FÜR VIBRATIONSRRAMMEN

SYSTÈME DE REFRROIDISSEMENT DE PALIER POUR DISPOSITIFS VIBRANTS

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
 GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
 PL PT RO RS SE SI SK SM TR**

(30) Priority: **01.03.2013 US 201313782938**

(43) Date of publication of application:
06.01.2016 Bulletin 2016/01

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Description**TECHNICAL FIELD**

[0001] The present invention relates generally to cooling systems used to draw heat from moving parts in equipment. More specifically, the present invention relates to a cooling system that draws heat away from the bearings and facilitates cooling the lubricant used in the lubrication of vibratory equipment such as pile drivers, wick drain devices and the like.

BACKGROUND

[0002] Most vibratory devices, such as material tamping devices, pile drivers, vibrating tables, wick drain devices and fruit-tree shakers and the like, create desirable vibration by rotating eccentrics. In these devices, due to the wear and tear and heat resulting from vibrating machinery, it is desirable to have continuous lubrication of various internal components such as the meshing gears, bearings, and the eccentrics. Such lubrication serves to cool the intermeshing and interacting internal components that generate heat by their movement and interactions between parts. In much the same way as an automobile engine will cease up without oil to lubricate and cool the engine, pile drivers, wick drains and the like would quickly overheat and possibly cease up without lubrication to cool and lubricate its internal parts. Hereofore, the continuous lubrication used to cool and lubricate a pile driver or vibratory wick drain device has been of two types, one by fluttering and the other by nebulization.

[0003] Generally, "nebulized" lubrication involves throwing lubricant sprays onto the bearings and other components susceptible to heat and wear. The excess lubricant (e.g., oil) is collected in a recovery basin and then returned from the basin to the spraying nozzles by a motorized pump. This type of lubrication is performed in a free atmosphere. In some embodiments of nebulized lubrication, the bearings are force-lubricated by directing the lubricant directly into sealed bearings and returning excess lubricant to a recovery basin that is separated from the interior of the gear box by a wall that keeps the lubricant out of the interior of the gear box.

[0004] A drawback to nebulized lubrication is that it typically requires a vibration-tolerant motor to drive the pump, which adds significant weight and cost to the system and requires a power source for the motor, reducing the overall efficiency of the vibratory device. Additionally, because the meshing gears, bearings, and eccentrics are enclosed within the gear box, they are hidden from the operator's view. Consequently, if the motorized pump or any part of the pumping system fails, the operator frequently will not know of the failure until after serious damage to the vibratory device has occurred. Vibratory devices have been known to cease up due to lack of lubrication when the lubricant pumping system unknowingly

fails.

[0005] Lubrication "by fluttering" has been performed both in a free atmosphere and under vacuum. Generally, this type of lubrication involves driving the eccentrics into rotation within a lubricant container or reservoir. The lubricant is thrown by the centrifugal force of the eccentrics. Particularly with eccentrics that have a semi-circular profile, rotation of the eccentric around its axis causes the eccentric to impact against the lubricant within the container or reservoir. This causes lubricant splash within the gear box (or housing) and forces the lubricant against the interior walls of the gear box. At startup of the vibratory device, this impact is generally rather strong, although it depends on the diameter of the eccentric, its thickness, and the level of and viscosity of the lubricant. Such impact, retards the rotating momentum of the eccentric and absorbs energy making the vibratory device less efficient than it could be if this impact were significantly reduced or eliminated. So long as the lubricant is regularly changed and appropriate levels of lubricant are maintained, the lubricant is always present within the gear box. However, during operation of the vibratory device following startup, the lubricant is so violently agitated, both by the vibration and from eccentric impact, that much, if not all, of the lubricant becomes a fine mist of lubricant globules suspended within the interior volume of the gear box.

[0006] Because the bearings are most susceptible to overheating and wear, lubrication of the bearings is usually the highest priority with vibratory devices. Although the fine mist of lubricant lubricates the internal components of the vibratory device, including the bearings, the gear box is an enclosure that holds the heat generated within the gear box. With most uses of vibratory devices the rapid heating of the device is not a serious problem because most vibratory devices are designed for intermittent duty (e.g., it takes a short period of time to drive a pile and then the vibratory device is allowed to rest from vibrating and cool down until another pile is attached and ready to be driven). However, the need for continuous duty vibratory devices is increasing. For example, vibratory wick drain devices operate almost continuously because there is such a short time between driving each wick drain. Also, as the advantages and various uses of vibratory devices become better known, the need for continuous duty pile drivers is increasing. CN202369991 provides a vibration machine with a combined coolant and lubricant. US7005765 provides another example of a prior art cooling system.

SUMMARY OF THE INVENTION

[0007] The vibratory assembly of the present disclosure utilizes a cooling system that does not expose the cooling fluid to the lubricant, so that the cooling fluid will not contaminate the lubricant. Whether the vibratory assembly utilizes "nebulized" lubrication, a lubricant reservoir, or force lubrication, the vibratory assembly can be

cooled without contamination. The cooling system can be retrofit to an existing vibratory assembly or it can be implemented during the initial manufacture of the vibratory assembly.

[0008] The present invention provides a vibratory assembly as defined in appended claim 1. and a method according to claim 17.

[0009] In one embodiment of the vibratory assembly of the present disclosure, the housing has bearing openings and a bearing cover for each bearing opening. In most exciters, there is a bearing opening and a bearing cover for each bearing used with the rotatable eccentric weights. For exciters with two eccentric weights, there are four bearings typically, two bearings for each eccentric weight. Hence, for exciters with four or six eccentric weights, there are eight or twelve bearings, respectively, two bearings for each eccentric weight.

[0010] Each bearing jacket manifold is disposed to cover one of the bearing openings and is positioned between the bearing cover and the bearing opening such that the bearing-side surface is exposed to the interior of the housing near the bearing associated with the bearing opening. Further, in this disposition, bearing jacket manifolds are not structurally stressed nor vulnerable to physical harm. Also, the configuration and disposition of the bearing jacket manifolds eliminates transfer of fluid mishaps (i.e., cooling fluid leaking into, mixing with, and contaminating the lubricant).

[0011] The bearing jacket manifold is made of a metal having thermal conductivity greater than the thermal conductivity of whatever metal the housing is made. In some embodiments, the thermal conductivity of the metal of which the bearing jacket manifold is made is at least 10% greater than the thermal conductivity of whatever metal the housing is made. By way of example, the metal of which the bearing jacket manifold is made may be selected from a group of metals comprising aluminum, copper, iron, nickel, silver, zinc, and alloys thereof, or any other suitable metal or metal alloy with advantageous conductivity.

[0012] Most vibratory assemblies have a housing with a top plate and side walls. The plate manifold is disposed subtending the top plate between the top plate and the side walls such that the underside surface is exposed to the interior of the housing. Further, in this disposition, a plate manifold is not structurally stressed nor vulnerable to physical harm. Also, the configuration and disposition of the plate manifold eliminates transfer of fluid mishaps (i.e., cooling fluid leaking into, mixing with, and contaminating the lubricant).

[0013] Similarly, the plate manifold is made of a metal having thermal conductivity greater than the thermal conductivity of whatever metal the housing is made. In some embodiments, the thermal conductivity of the metal of which the plate manifold is made is at least 10% greater than the thermal conductivity of whatever metal the housing is made. Again, by way of example, the metal of which the plate manifold is made may be selected from a group

of metals comprising aluminum, copper, iron, nickel, silver, zinc, and alloys thereof, or any other suitable metal or metal alloy with advantageous conductivity. Additionally, the underside surface of the plate manifold may have undulations or fins that increase the total surface area of the underside surface that is exposed to the interior of the housing. These undulations or fins can be of any suitable configuration. For example, fins may be transverse or longitudinal ridges, zig-zag ridges, etc,

[0014] An exemplary vibratory assembly of the present disclosure may have a housing with a top plate, side walls, at least one bearing opening, a bearing cover for each bearing opening, and a heat exchanging assembly. The heat exchanging assembly has a plate manifold, at least one bearing jacket manifold, and at least one connector that connects the plate manifold to each bearing jacket manifold. The plate manifold has an underside surface, a plate pressure inlet disposed at a plate inlet end of the tortuous pathway portion of the closed loop conduit, and a plate return outlet at a plate outlet end of the tortuous pathway portion of the closed loop conduit. Each bearing jacket manifold has a bearing-side surface, a pressure inlet disposed at a bearing inlet end of the tortuous pathway portion of the closed loop conduit, and a return outlet at a bearing outlet end of the tortuous pathway portion of the closed loop conduit. Each connector connects the plate manifold to a corresponding bearing jacket manifold such that the cooling fluid flowing through the closed loop conduit passes through the plate manifold and the associated bearing jacket manifold. Each connector has a first flow conduit and a second flow conduit. The first flow conduit is configured for transporting cooling fluid from the tortuous pathway portion of the closed loop conduit within the plate manifold to the pressure inlet of the tortuous pathway portion within the corresponding bearing jacket manifold. The second flow conduit is configured for transporting cooling fluid from the return outlet of the tortuous pathway portion of the closed loop conduit within the bearing jacket manifold to the tortuous pathway portion within the plate manifold. The plate manifold is disposed subtending the top plate between the top plate and the side walls such that the underside surface is exposed to the interior of the housing. Each bearing jacket manifold is disposed between one of the bearing openings and a corresponding bearing cover such that the bearing-side surface is exposed to the interior of the housing near the bearing. The cooling fluid flows under the force of the fluid pump through the plate pressure inlet into the tortuous pathway portion of the plate manifold, through the first flow conduit of the connector, into the tortuous pathway portion within one of the bearing jacket manifolds, through the second flow conduit of the connector, into the tortuous pathway portion within the plate manifold, exits through the plate return outlet, and returns to the fluid pump.

[0015] The cooling fluid can be any easily pumpable fluid with suitable heat transfer capabilities. By way of example, the cooling fluid can be water, antifreeze, com-

binations thereof, or any other suitable fluid with favorable heat transfer capabilities.

[0016] Further, the cooling system may also comprise at least one of a fluid storage unit, cooling fans, an in-line heat exchanger, or any other feature to assist in removing heat from the cooling fluid.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Exemplary embodiments of the invention will become more fully apparent from the following description and appended claims, taken in conjunction with the accompanying drawings. Understanding that these drawings depict only exemplary embodiments and are, therefore, not to be considered limiting of the invention's scope, the exemplary embodiments of the invention will be described with additional specificity and detail through use of the accompanying drawings in which:

Figure 1 is perspective view of a known exemplary vibratory assembly showing a suppressor housing, an exciter, and a clamp attachment;

Figure 2 is an exploded perspective view of the exciter of a known exemplary vibratory assembly with some components omitted for clarity;

Figure 3 is a contorted transverse sectional view along line 3-3 of Figure 1 showing the lubricant reservoir within the housing;

Figure 4 is a perspective view of an exemplary six-eccentric exciter with a bearing cooling system;

Figure 5 is a schematic of an exemplary six-eccentric exciter with a bearing cooling system showing examples of the components to assist with the circulation and cooling of the cooling fluid;

Figure 6 is a perspective view of the top side of an exemplary plate manifold showing the tortuous pathway;

Figure 7 is a perspective view of the underside of an exemplary plate manifold showing longitudinal fins;

Figure 8 is a plan view of the pathway side of an exemplary bearing jacket manifold;

Figure 9 is a plan view of an elastomeric seal for sealing the connection between the pathway side of an exemplary bearing jacket manifold to a bearing cover;

Figure 10 is a plan view of the bearing side of an exemplary bearing jacket manifold;

Figure 11 is a perspective view of the exterior side

of a bearing cover and an exemplary connector;

Figure 12 is a perspective view of the interior side of a bearing cover; and

Figure 13 is a perspective view of an alternative embodiment of a bearing jacket manifold.

DETAILED DESCRIPTION

[0018] The presently preferred embodiments of the present disclosure will be best understood by reference to the drawings, wherein like parts are designated by like numerals throughout. It will be readily understood that the components of the present bearing cooling system for vibratory devices, as generally described and illustrated in the figures herein, could be arranged and designed in a wide variety of different configurations and could be implemented on various other types of vibratory devices. Thus, the following more detailed description of embodiments of the present invention, as represented in Figures 1-15, is not intended to limit the scope of the invention, but is merely representative of presently preferred embodiments of the invention.

[0019] The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any embodiment described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments. While the various aspects of the embodiments are presented in drawings, the drawings are not necessarily drawn to scale unless specifically indicated.

[0020] In this application, the phrases "connected to", "coupled to", and "in communication with" refer to any form of interaction between two or more entities, including mechanical, capillary, electrical, magnetic, electromagnetic, pneumatic, hydraulic, fluidic, and thermal interactions.

[0021] The phrases "attached to", "secured to", and "mounted to" refer to a form of mechanical coupling that restricts relative translation or rotation between the attached, secured, or mounted objects, respectively. The phrase "slidably attached to" refer to a form of mechanical coupling that permits relative translation, respectively, while restricting other relative motions. The phrase "attached directly to" refers to a form of securement in which the secured items are in direct contact and retained in that state of securement.

[0022] The term "abutting" refers to items that are in direct physical contact with each other, although the items may not be attached together. The term "grip" refers to items that are in direct physical contact with one of the items firmly holding the other. The term "integrally formed" refers to a body that is manufactured as a single piece, without requiring the assembly of constituent elements. Multiple elements may be integrally formed with each other, when attached directly to each other from a single work piece. Thus, elements that are "coupled to"

each other may be formed together as a single piece.

[0023] Figures 1 and 2 are perspective views of known exemplary vibratory assemblies, provided to demonstrate a representative environment in which the various embodiments of the bearing cooling system of the present disclosure may operate. The bearing cooling system, or a simple modification thereof, will work with most vibratory devices such as material tamping devices, pile drivers, vibrating tables, vibratory wick drain devices and fruit-tree shakers and the like. For clarity of description and brevity, this disclosure will be directed to use of the bearing cooling system on an exemplar vibratory pile driver (shown in Figures 1 and 2). A person of ordinary skill in the art will be able to modify and implement embodiments of the bearing cooling system of this disclosure with other vibratory devices.

[0024] Figure 1 is a perspective view of an exemplary vibratory assembly 20 showing a suppressor housing 22, an exciter 24, and a clamp attachment 26. Vibratory assemblies 20 for imparting a vibratory force to a pile typically comprise a suppressor housing 22 to absorb vibration so that it does not travel up the cable to the crane boom, an exciter 24 that creates the vibratory force, and a clamp attachment 26 for connecting the vibrator assembly 20 to the pile to be driven or extracted. The operation and components of vibratory assemblies 20 are well known in the industry and, for brevity, will not be described in detail in this disclosure, except to the extent that the bearing cooling system of this disclosure affects the operation or involves components of the vibratory assembly 20. Routinely, the exciter 24 has a housing 28 (also known as and sometimes referred to herein as a "gear box") with a top plate 30, side walls 32, a bottom plate 34 and bearing covers 35 that houses the eccentrics 36 rotatable on shafts 38 to create vibration, a gear drive 40 to rotate the eccentrics 36, and lubricant 42 (see Figure 3) to lubricate internal components of the vibratory assembly 20, such as the bearings 44, eccentrics 36, and gears 46. The exciter 24 also has a drive motor 48 that rotates the gear drive 40 that engages the eccentrics 36 in a gear tooth meshing engagement so that the eccentrics 36 rotate at high speed. The vibratory assembly 20 typically has a lubricant reservoir 50 (see Figure 3) in the bottom portion of the housing 28. At startup, the eccentrics 36 impact the lubricant reservoir 50 with each revolution causing lubricating splash within the interior of the housing 28.

[0025] For maintenance purposes, most exciters 24 have some means for draining the lubricant from the housing 28 so that the lubricant 42 can be changed. This draining means can be as simple as a drain hole in the side of the housing 28 or as sophisticated as a gun drilled lubricant drain portal 52 extending within the bottom plate 34 of the housing 28 to a position along the bottom of lubricant reservoir 50. As shown in phantom lines in Figures 1.-3, exemplar lubricant drain portals 52 are illustrated. During use of the vibratory assembly 20, the lubricant drain portals 52 are closed by plugs 54 secured

at the exterior of the housing 28. Hence, during use, the lubricant 42 remains within the housing 28 and the heat generated builds within the housing 28 and is not relieved until the exciter 24 is turned off and can cool.

[0026] To drain used lubricant 42 from the vibratory assembly 20 so that the lubricant 42 can be changed out for fresh, clean lubricant 42, the plug(s) 54 is/are removed. Once drained, the plug(s) 54 can be re-secured and the lubricant reservoir 50 can be refilled with fresh, clean lubricant 42. Filling the lubricant reservoir 50 also fills the lubricant drain portal 52 with lubricant 42.

[0027] A typical exciter 24 has a housing 28 with an interior 56 having a reservoir portion 58 for receiving the lubricant 42, at least a first eccentric weight 60 secured to a first shaft 62 rotatable in a predetermined direction (either clockwise or counter-clockwise) about the longitudinal axis of the first shaft 62 and a second eccentric weight 64 secured to a second shaft 66 rotatable in an opposite direction (either counter-clockwise or clockwise) about the longitudinal axis of the second shaft 66, a drive motor 48 for rotating the first eccentric weight 60 and the second eccentric weight 64 to cause vibration of the housing 28. Larger exciters 24 may have additional pairs of oppositely rotating eccentrics 36, for example, four or six eccentrics 36 configured in a horizontal line (see for example, Figure 4) or vertically stacked in pairs are common. Usually, only the lowermost eccentrics 36 impact the lubricant reservoir (see Figure 3 for context, with most existing vibratory devices, the eccentrics 36 extend well into the lubricant reservoir 50).

[0028] An exemplary vibratory assembly 20 of the present disclosure, as best shown in Figures 4 and 5, utilizes an exemplary bearing cooling system (generally designated 68) that does not expose the cooling fluid 70 (see Figure 5) to the lubricant 42, so that the cooling fluid 70 will not contaminate the lubricant 42. For brevity, the vibratory assembly 20 described utilizes a lubricant reservoir 50. However, it should be understood that bearing cooling systems 68 as disclosed and suggested herein can be used with vibratory assemblies 20 with nebulized lubrication, force lubrication, or other types of lubrication with slight modifications that those of ordinary skill in the art could readily make. The bearing cooling system 68 can be retrofitted to an existing vibratory assembly 20 or it can be implemented during the initial manufacture of the vibrator's assembly 20.

[0029] A typical vibratory assembly 20 that contains lubricant 42 comprises an exciter 24 having various internal components and a housing 28 with an interior 56 having a reservoir portion 58 for receiving the lubricant 42 in a lubricant reservoir 50. The internal components may comprise bearings 44 and at least an eccentric weight 36, 60 rotatable in a clockwise direction and another eccentric weight 36, 64 rotatable in a counter-clockwise direction. The rotation of these eccentric weights 36 causes vibration of the housing 28. The vibrator's assembly 20 of this disclosure also has a bearing cooling system 68 comprising a heat exchanging assembly (generally

designated 72), a cooling fluid 70, and a fluid pump 74. The heat exchanging assembly 72 has at least one surface that is exposed to the interior 56 of the housing 28 and the lubricant 42 contained within the interior 56 of the housing 28. The heat exchanging assembly 72 has a tortuous pathway 76 not exposed to the interior 56 of the housing 28. The tortuous pathway 76 is at least a portion of a closed loop conduit through which the cooling fluid 70 flows under the force of the fluid pump 74.

[0030] In one embodiment of the vibratory assembly 20 of the present disclosure, the housing 28 has bearing openings 33 and a bearing cover 35 for each bearing opening 33. In most exciters 24, there is a bearing opening 33 and a bearing cover 35 for each bearing 44 used with the rotatable eccentric weights 36. For exciters 28 with two eccentric weights 36, there are four bearings 44 typically, two bearings 44 for each eccentric weight 36. Hence, for exciters 24 with four or six eccentric weights 36, there are eight or twelve bearings 44, respectively, two bearings 44 for each eccentric weight 36.

[0031] The heat exchanging assembly 72 comprises a plate manifold 94 and/or at least one bearing jacket manifold 82. Each bearing jacket manifold 82, as best shown in Figure 8, has a bearing-side surface 84, a pressure inlet 86 disposed at a bearing inlet end 88 of the tortuous pathway 76 portion of the closed loop conduit and a return outlet 90 at a bearing outlet end 92 of the tortuous pathway 76 portion of the closed loop conduit. Each bearing jacket manifold 82 is disposed to cover one of the bearing openings 33 and is positioned between the bearing cover 35 and the bearing opening 33 such that the bearing-side surface 84 is exposed to the interior 56 of the housing 28 near the bearing 44 associated with the bearing opening 33. In this disposition, cooling fluid 70 may flow under the force of the fluid pump 74 into the bearing jacket manifold 82, through the pressure inlet 86, along the tortuous pathway 76, and exits through the return outlet 90. When the exciter 24 is in use, the lubricant 42 will splash against the bearing-side surface 84. This contact of warm or hot lubricant 42 with the bearing-side surface 84 causes a heat transfer from the lubricant 42 to the bearing jacket manifold 82 and then to the cooling fluid 70 circulating through the bearing jacket manifold 82. Heat is thereby removed from the exciter 24 to be dissipated remote from the exciter 24. By so cooling the exciter 24, it may be used for extended periods of time or may even permit continuous duty.

[0032] Further, in this disposition, bearing jacket manifolds 82 are not structurally stressed nor vulnerable to physical harm. Also, the configuration and disposition of the bearing jacket manifolds 82 eliminates transfer of fluid mishaps (i.e., cooling fluid 70 leaking into, mixing with, and contaminating the lubricant 42).

[0033] The bearing jacket manifold 82 is made of a metal having thermal conductivity greater than the thermal conductivity of whatever metal the housing 28 is made. In some embodiments, the thermal conductivity of the metal of which the bearing jacket manifold 82 is

made is at least 10% greater than the thermal conductivity of whatever metal the housing 28 is made. By way of example, the metal of which the bearing jacket manifold 82 is made may be selected from a group of metals comprising aluminum, copper, iron, nickel, silver, zinc, and alloys thereof, or any other suitable metal or metal alloy with advantageous thermal conductivity.

[0034] Most vibratory assemblies 20 have a housing with a top plate 30 and side walls 32. Consequently, the heat exchanging assembly 72 may comprise a plate manifold 94 having an underside surface, a plate pressure inlet 98 disposed at a plate inlet end 100 of the tortuous pathway 76 portion of the closed loop conduit and a plate return outlet 102 at a plate outlet end 104 of the tortuous pathway 76 portion of the closed loop conduit. The plate manifold 94 is disposed subtending the top plate 30 between the top plate 30 and the side walls 32 such that the underside surface is exposed to the interior 56 of the housing 28. In this disposition, the plate manifold 94 will not experience undue stress and the cooling fluid 70 may flow under the force of the fluid pump 74 into the plate manifold 94, through the plate pressure inlet 98, along the tortuous pathway 76, and exits through the plate return outlet 102. When the exciter 24 is in use, the lubricant 42 will splash against the underside surface. This contact of warm or hot lubricant 42 with the underside surface causes a heat transfer from the lubricant 42 to the plate manifold 94 and then to the cooling fluid 70 circulating through the plate manifold 94. Heat is thereby removed from the exciter 24 to be dissipated remote from the exciter 24, as will be described below. By so cooling the exciter 24, it may be used for extended periods of time or may even permit continuous duty.

[0035] For vibratory pile drivers, a pump 74 that can pump cooling fluid 70 at 20 gallons per minute to 40 gallons per minute should be sufficient to allow continuous duty for the pile driving exciter 24. Of course the pumping rate for the pump 74 will depend on the nature of the vibratory assembly 20 being used, larger units will require an increased rate and smaller unit may work suitably with a lesser rate. A person of ordinary skill in the art will be able to easily determine what rate of cooling fluid 70 flow will be suitable.

[0036] Further, in this disposition, a plate manifold 94 is not structurally stressed nor vulnerable to physical harm. Also, the configuration and disposition of the plate manifold 94 eliminates transfer of fluid mishaps (i.e., cooling fluid 70 leaking into, mixing with, and contaminating the lubricant 42).

[0037] Similarly, the plate manifold 94 is made of a metal having thermal conductivity greater than the thermal conductivity of whatever metal the housing 28 is made. In some embodiments, the thermal conductivity of the metal of which the plate manifold 94 is made is at least 10% greater than the thermal conductivity of whatever metal the housing 28 is made. Again, by way of example, the metal of which the plate manifold 94 is made may be selected from a group of metals comprising alu-

minum, copper, iron, nickel, silver, zinc, and alloys thereof, or any other suitable metal or metal alloy with advantageous conductivity. Additionally, the underside surface of the plate manifold 94 may have undulations or fins 106 that increase the total surface area of the underside surface 94 that is exposed to the interior 56 of the housing 28. These undulations or fins 106 can be of any suitable configuration. For example, fins 106 may be transverse or longitudinal ridges, zig-zag ridges, etc.

[0038] As shown in Figures 4 and 5, an exemplary vibratory assembly 20 of the present disclosure may have a housing 28 with a top plate 30, side walls 32, at least one bearing opening 33, a bearing cover 35 for each bearing opening 33, and a heat exchanging assembly 72. The heat exchanging assembly 72 has a plate manifold 94, at least one bearing jacket manifold 82, and at least one connector 108 that connects the plate manifold 94 to each bearing jacket manifold 82. Referring now to Figures 6 and 7, the plate manifold 94 has an underside surface, a plate pressure inlet 98 disposed at a plate inlet end 100 of the tortuous pathway 76 portion of the closed loop conduit, and a plate return outlet 102 at a plate outlet end 104 of the tortuous pathway 76 portion of the closed loop conduit. Each bearing jacket manifold 82 has a bearing-side surface 84, a pressure inlet 86 disposed at a bearing inlet end 88 of the tortuous pathway 76 portion of the closed loop conduit, and a return outlet 90 at a bearing outlet end 92 of the tortuous pathway 76 portion of the closed loop conduit 78. Each connector 108 connects the plate manifold 94 to a corresponding bearing jacket manifold 82 such that the cooling fluid 70 flowing through the closed loop conduit passes through the plate manifold 94 and each associated bearing jacket manifold 82. Each connector 108 has a first flow conduit 110 and a second flow conduit 112. The first flow conduit 110 is configured for transporting cooling fluid 70 from the tortuous pathway 76 portion of the closed loop conduit within the plate manifold 94 to the pressure inlet 86 of the tortuous pathway 76 portion within the corresponding bearing jacket manifold 82. The second flow conduit 112 is configured for transporting cooling fluid 70 from the return outlet 90 of the tortuous pathway 76 portion of the closed loop conduit within the bearing jacket manifold 82 to the tortuous pathway 76 portion within the plate manifold 94.

[0039] The plate manifold 94 is disposed subtending the top plate 30 between the top plate 30 and the side walls 32 such that the underside surface 96 is exposed to the interior 56 of the housing 28. Each bearing jacket manifold 82 is disposed between one of the bearing openings 33 and a corresponding bearing cover 35 such that the bearing-side surface 84 is exposed to the interior 56 of the housing 28 near the associated bearing 35.

[0040] The cooling fluid 70 flows under the force of the fluid pump 74 through the plate pressure inlet 98 into the tortuous pathway 76 portion of the plate manifold 94, through the first flow conduit 110 of the connector 108, into the tortuous pathway 76 portion within one of the bearing jacket manifolds 82, through the second flow

conduit 112 of the connector 108, into the tortuous pathway 76 portion within the plate manifold 94, exits through the plate return outlet 102, and returns to the fluid pump 74. Since the connectors 108 are exposed to the outside environment encountered by a vibratory assembly 20, it is preferred that the connectors 108 are made of a steel that can withstand the type of wear, tear, and rough handling that a vibratory assembly 20 is likely to experience.

[0041] The cooling fluid 70 can be any easily pumpable fluid with suitable heat transfer capabilities. By way of example, the cooling fluid can be water, antifreeze, combinations thereof, or any other suitable fluid with favorable heat transfer capabilities.

[0042] Further, as shown in Figure 5, the bearing cooling system 68 may also comprise a heat removal portion 80 that may comprise at least one of a fluid storage unit 114, cooling fans 116, an in-line heat exchanger 118, or any other feature to assist in removing heat from the cooling fluid 70. It should be understood that multiple fluid storage units 114, cooling fans 116, and in-line heat exchangers 118 can be used and can be used in any combination or configuration. For example, cooling fans 116 could be implemented to cool the cooling fluid 70 within one or more fluid storage units 114 or the fans could be used to cool the cooling fluid 70 passing the closed loop conduit outside of the exciter 24.

[0043] Additionally, it should be understood that the bearing cooling system 68 contemplated herein may have a number of different configurations. For example, with some vibratory assemblies 20, the heat exchanging assembly 72 may comprise only a plate manifold 94. With other vibratory assemblies 20, the heat exchanging assembly 72 may comprise only bearing jacket manifolds 82, one or more. With still other vibratory assemblies 20, the heat exchanging assembly 72 may comprise a plate manifold 94, one or more bearing jacket manifolds 82, and a base plate manifold (not shown, but essentially the same as the plate manifold 94 but disposed between the side walls 32 and the bottom plate 34). Such a base plate manifold would likely require one or more drain holes that correspond to and align with any lubricant drain portals 52 that the exciter may have.

[0044] Returning to the drawings for additional disclosure, Figure 4 is a perspective view of an exemplary six-eccentric exciter 24 with a bearing cooling system 68. As depicted, the exciter 24 has six eccentrics 36 (not visible) and a heat exchanging assembly 72 that includes a plate manifold 94 and at least six bearing jacket manifolds 82 (there could be up to six more bearing jacket manifolds 82 on the reverse side of the exciter 24). Connecting each of the bearing jacket manifolds 82 to the plate manifold 94 is a connector 108 through which cooling fluid 70 passes into the bearing jacket manifold 82, through the tortuous pathway 76 of the bearing jacket manifold 82, then out of the bearing jacket manifold 82 back into the plate manifold 94. Under pressure from the fluid pump 74, the cooling fluid 70 enters the plate manifold 94 at the plate pressure inlet 98, circulates through the tortuous

pathways 76 of the plate manifold 94 and the bearing jacket manifolds 82, and exits through the plate return outlet 102 to be cooled at the heat removal portion 80 of the bearing cooling system 68. Since the plate manifold 94 and the bearing jacket manifolds 82 are made of a material (e.g., aluminum) having thermal conductivity greater than the material (e.g., steel) of which the housing 28 is made, and the underside surface 96 of the plate manifold 94 and the bearing-side surfaces 84 of each bearing jacket manifold 82 are exposed to the interior 56 of the housing 28 and the lubricant 42 splashing therein, heated lubricant 42 will impact or otherwise contact the underside surface 96 and the bearing-side surfaces 84. During this contact heat will transfer from the heated lubricant 42 to the plate manifold 94 and the bearing jacket manifolds 82, and then to the cooling fluid 70 passing through the manifolds 82, 94. The heat will be carried out of the exciter 24 to be dissipated or otherwise harnessed in the heat removal portion 80.

[0045] Oil of the type that serves as a lubricant 42, typically has very poor heat transfer capability by comparison to other fluids. Hence, heat can be removed much more efficiently by circulating a cooling fluid 70 rather than the lubricant 42. Although the cooling fluid 70 can be any fluid with better heat transfer capability than the lubricant 42, it is preferred that the cooling fluid 70 is water, anti-freeze, a combination thereof, or a fluid having similar or better heat transfer capability than water, anti-freeze, or a combination thereof. Additionally, it is preferred that the cooling fluid 70 is more easily pumped by the fluid pump 74 than the lubricant.

[0046] Figure 5 is a schematic of an exemplary six-eccentric exciter 24 with a bearing cooling system 68 showing both an exemplary heat exchanging assembly 72 and a heat removal portion 80. The exciter 24 in Figure 5 is the same as described above regarding Figure 4, and that description will not be repeated here. However, Figure 5 also depicts an exemplary heat removal portion 80 of the bearing cooling system 68.

[0047] The arrows show the direction of flow for the cooling fluid 70 through the exemplar heat removal portion 80. The heat removal portion 80 of the bearing cooling system 68 that is depicted illustrates an in-line heat exchanger 118, cooling fans 116, and a fluid storage unit 114. The fluid pump 74 draws cooling fluid 70 from the fluid storage unit 114 and pumps the cooling fluid 70 under pressure through the bearing cooling system 68. As the cooling fluid 70 is pumped into the heat exchanging assembly 72, comprising the plate manifold 94 and the bearing jacket manifold(s) 82, it is relatively cool and capable of drawing heat from the exciter 24, and particularly the bearings 44. Although Figure 5 depicts a single in-line heat exchanger 118, a single set of cooling fans 116, and a single fluid storage unit 114, it should be understood that any number of these cooling components may be used and they can be configured in any suitable configuration. For example, cooling fans 116 may be positioned to cool the cooling fluid 70 in one or

more fluid storage units 114, etc.

[0048] Figure 6 is a perspective view of the top side of an exemplary plate manifold 94 showing an exemplary tortuous pathway 76 that directs the flow of the cooling fluid 70 through the plate manifold 94 from the plate pressure inlet 98 at the plate inlet end 100 ultimately to the plate return outlet 102 at the plate outlet end 104. Since the tortuous pathway 76 is on the top side of the plate manifold 94 which sealed (using a sealing gasket not shown) to the top plate 30 of the exciter 24, there is no danger that the cooling fluid 70 will enter the interior 56 of the housing 28 and contaminate the lubricant 42.

[0049] The underside surface of the exemplary plate manifold 94 is shown in Figure 7. This exemplary plate manifold 94 has longitudinal fins 106. The longitudinal fins 106 increase the surface area of the underside surface that is exposed to the interior 56 of the housing 28 and the splash of lubricant 42 during use of the exciter 24. As heat is generated during the use of the exciter 24, particularly by the bearings 44, the lubricant 42 heats up and is splashed against the underside surface. Because the plate manifold 94 is made of a material with better thermal conductivity than the housing 28, heat transfers from the lubricant 42 to the plate manifold 94. During the circulation of the cooling fluid 70 within the closed loop conduit it will pass through the plate manifold 94 and heat is transferred from the plate manifold 94 to the cooling fluid 70. The cooling fluid 70 eventually exits the plate manifold 94 to be cooled at the heat removal portion 80 of the bearing cooling system 68.

[0050] Although the underside surface is depicted as longitudinal fins 106, the underside surface of the plate manifold 94 may have any suitable undulations or fins 106 that increase the total surface area of the underside surface 94 that is exposed to the interior 56 of the housing 28. These undulations or fins 106 can be of any suitable configuration. For example, fins 106 may be transverse or longitudinal ridges, zig-zag ridges, etc. or die undulations may be dimples or raised mounds in the surface, etc.

[0051] Figure 8 is a view of the pathway side of an exemplary bearing jacket manifold 82, and the arrows show the direction of the flow of the cooling fluid 70 through an exemplary tortuous pathway 76. Circumscribing the tortuous pathway 76 is a sealing trough 122 into which an elastomeric seal 120 is positioned so that the pathway side of the bearing jacket manifold 82 can sealingly engage the corresponding bearing cover 35. The tortuous pathway 76 directs the flow of the cooling fluid 70 through the bearing jacket manifold 72 from the pressure inlet 86 at the bearing inlet end 88 eventually to the return outlet 90 at the bearing outlet end 92. Since the tortuous pathway 76 is on the pathway side of the bearing jacket manifold 94 which is sealed to the bearing cover 35, there is no danger that the cooling fluid 70 will enter the interior 56 of the housing 28 and contaminate the lubricant 42.

[0052] Figure 9 depicts an exemplary elastomeric seal

120 for sealing the connection between the pathway side of an exemplary bearing jacket manifold 82 to a bearing cover 35. Such elastomeric seals 120 can be high-pressure water cut to the desired shape that will fit the sealing trough 122. Similarly, an elastomeric seal can be made to seal the connection of the plate manifold 94 to the top plate 30.

[0053] The bearing-side surface 84 of the exemplar} bearing jacket manifold 82 is shown in Figure 10. This exemplar} bearing jacket manifold 82 has a relatively smooth bearing-side surface 84. However, it should be understood that undulations or fins (similar to those on the underside surface of the plate manifold 94), could be used on the bearing-side surface 84 so long as they do not interfere with the bearings 44 or the rotation of the eccentrics 36. Such undulations or fins would increase the surface area of the bearing-side surface that is exposed to the interior 56 of the housing 28 and the splash of lubricant 42 during use of the exciter 24. As heat is generated during the use of the exciter 24, particularly by the bearings 44, the lubricant 42 heats up and is splashed against the bearing-side surface 84. Because the bearing jacket manifold 82 is made of a material with better thermal conductivity than the housing 28, heat transfers from the lubricant 42 to the bearing jacket manifold 82. During the circulation of the cooling fluid 70 within the closed loop conduit it will pass through each bearing jacket manifold 82 and heat is transferred from each bearing jacket manifold 82 to the cooling fluid 70. The cooling fluid 70 eventually exits the bearing jacket manifold 82 and the plate manifold 94 to be cooled at the heat removal portion 80 of the bearing cooling system 68.

[0054] Figure 11 is a perspective view of the exterior side of an exemplary bearing cover 35 and an exemplary connector 108. The bearing cover 35 depicted is designed to cooperate with the connector 108 to transport cooling fluid 70 from the plate manifold 94 to a corresponding bearing jacket manifold 82 and back to the plate manifold 94 after circulating the cooling fluid 70 through the tortuous path 76 of the bearing jacket manifold 82. The connector 108 has a first flow conduit 110 that conveys the cooling fluid 70 from the plate manifold 94 to an inlet bore 124 in the bearing cover 35 and then to the pressure inlet 86. The connector 108 has a second flow conduit 112 that receives cooling fluid 70 from the return outlet 90 of the bearing jacket manifold 82 via an outlet bore 126 in the bearing cover 35 and delivers it to the plate manifold 94.

[0055] Although Figure 11 shows a connector 108 that connects to the bearing cover 35, it should be understood that the connector 108 could have any suitable shape and could connect directly to the bearing jacket manifold 82 so long as it conveys the cooling fluid 70 into and out of the bearing jacket manifold 82.

[0056] Figure 12 is a perspective view of the interior side 128 of the bearing cover 35 of Figure 11, and shows the inlet bore 124 and outlet bore 126 in phantom lines. The interior side 128 scalably engages the pathway side

of the bearing jacket manifold 82 and the elastomeric seal 120.

[0057] Figure 13 is a perspective view of an alternative embodiment of a bearing jacket manifold 82 wherein an inlet fitting 130, inlet hose 132, outlet fitting 134, and outlet hose 136 connect directly to the bearing cover 35. With this alternative embodiment, no plate manifold 94 is used. The inlet fitting 130, inlet hose 132, outlet fitting 134, and outlet hose 136 are part of the closed loop conduit that circulates the cooling fluid 70. The inlet fitting 130 and the outlet fitting 134 connect to the pressure inlet 86 and return outlet 90, respectively.

[0058] Of course, it should be understood that the configuration of the plate manifold(s) 94 would be determined by the size and shape of the housing 28.

Claims

1. A vibratory assembly (20) configured to contain lubricant (42) and comprising:

an exciter (24) having a housing (22) with an interior having a reservoir portion configured to receive the lubricant (42) in a lubricant reservoir (50) and internal components, the internal components comprising bearings (44) and at least a first eccentric weight (36) rotatable in a clockwise direction and a second eccentric weight (36) rotatable in a counter-clockwise direction, rotation of the first eccentric weight (36) and the second eccentric weight (36) causing vibration of the housing (24), the housing (24) further comprising at least one bearing opening (33) and a bearing cover (35) for each bearing opening (33): and

a cooling system (68) comprising a heat exchanging assembly (72), a fluid, a fluid pump, the heat exchanging assembly (72) having at least one surface being exposed to the interior of the housing (24) and the lubricant (42) contained within the interior of the housing (24), and a tortuous pathway (76) not exposed to the interior of the housing (24), the tortuous pathway (76) being a portion of a closed loop conduit through which the fluid flows under the force of the fluid pump, wherein the heat exchanging assembly (72) comprises

at least one bearing jacket manifold (82) having a bearing-side surface; and wherein the tortuous pathway (76) for the bearing jacket manifold is provided within the at least one bearing jacket manifold (82); and wherein the at least one bearing jacket manifold (82) further comprises a pressure inlet disposed at a bearing inlet end of the tortuous pathway (76) portion of the closed loop conduit and a re-

- turn outlet at a bearing outlet end of the tortuous pathway (76) portion of the closed loop conduit, the at least one bearing jacket manifold (82) being disposed between the at least one bearing opening (33) and the bearing cover (35) such that the bearing-side surface is exposed to the interior of the housing (24) near the bearing, and the fluid flows under the force of the fluid pump through the pressure inlet into the tortuous pathway (76) and exits through the return outlet.
2. A vibratory assembly (20) as set forth in claim 1, wherein the bearing jacket manifold (82) is made of a metal having thermal conductivity at least 10% greater than the thermal conductivity of whatever metal the housing (24) is made.
3. A vibratory assembly (20) as set forth in claim 2, wherein the metal of which the bearing jacket manifold (82) is made is selected from the group consisting of aluminum, copper, iron, nickel, silver, zinc, and alloys thereof.
4. A vibratory assembly (20) as set forth in claim 1, wherein:
- the housing (24) further comprises a top plate (30) and side walls (32); and the heat exchanging assembly further comprises:
- a plate manifold (94); and
a tortuous pathway portion (76) of the closed loop conduit provided within the plate manifold (94),
- wherein the plate manifold (94) has an underside surface, a plate pressure inlet disposed at a plate inlet end of the tortuous pathway portion (76) provided within the plate manifold (94) and a plate return outlet at a plate outlet end of the tortuous pathway portion (76) provided within the plate manifold (94), the plate manifold (94) being disposed subtending the top plate (30) between the top plate (30) and the side walls (32) such that the underside surface is exposed to the interior of the housing (24) and the fluid flows under the force of the fluid pump through the plate pressure inlet into the tortuous pathway portion (76) provided within the plate manifold (94) and exits through the plate return outlet.
5. A vibratory assembly (20) as set forth in claim 4, wherein the plate manifold (94) is made of a metal having thermal conductivity at least 10% greater than the thermal conductivity of whatever metal the housing (24) is made.
6. A vibratory assembly (20) as set forth in claim 5, wherein the metal of which the plate manifold (94) is made is selected from the group consisting of aluminum, copper, iron, nickel, silver, zinc, and alloys thereof.
7. A vibratory assembly (20) as set forth in claim 4, wherein the underside surface of the plate manifold (94) has fins.
8. A vibratory assembly (20) as set forth in claim 4, further comprising:
- at least one connector that connects the plate manifold (94) to the at least one bearing jacket manifold (82) such that the fluid flowing through the closed loop conduit passes through the plate manifold (94) and the at least one bearing jacket manifold (82), at least one connector having a first flow conduit and a second flow conduit, the first flow conduit configured to transport fluid from the tortuous pathway (76) portion of the closed loop conduit within the plate manifold (94) to the pressure inlet of the separate tortuous pathway (76) portion within the at least one bearing jacket manifold (82), the second flow conduit configured to transport fluid from the return outlet of the separate tortuous pathway (76) portion of the closed loop conduit within the bearing jacket manifold (82) to the separate tortuous pathway (76) portion within the plate manifold (94); and
wherein the at least one bearing jacket manifold (82) is disposed between the at least one bearing opening (33) and the bearing cover (35) such that the bearing-side surface is exposed to the interior of the housing (24) near the bearing, the fluid flows under the force of the fluid pump through the plate pressure inlet into the tortuous pathway (76) portion of the plate manifold (94), through the first flow conduit of the at least one connector, into the separate tortuous pathway (76) portion within the at least one bearing jacket manifold (82), through the second flow conduit of the at least one connector, into the separate tortuous pathway (76) portion within the plate manifold (94), exits through the plate return outlet, and returns to the fluid pump.
9. A vibratory assembly (20) as set forth in claim 1, wherein the fluid is selected from a group consisting of water, antifreeze, and combinations thereof.
10. A vibratory assembly (20) as set forth in claim 1, wherein the cooling system (68) further comprises at least one of a fluid storage unit, cooling fans, and an in-line heat exchanger.

11. A vibratory assembly (20) as set forth in claim 4, comprising:

an exciter (24) having a housing (24) with a top plate (30), side walls (32), a plurality of bearing openings (33), and a bearing cover (35) for each bearing opening (33); and
a cooling system (68) comprising a heat exchanging assembly (72), the heat exchanging assembly (72) comprises:

a plurality of bearing jacket manifolds (82), one for each bearing, each having a bearing-side surface; and

a plurality of connectors, one for each bearing jacket manifold (82), that connects the plate manifold (94) to each of the plurality of bearing jacket manifolds (82) such that the fluid flowing through the closed loop conduit passes through the plate manifold (94) and each of the bearing jacket manifolds (82), each of the plurality of connectors having a first flow conduit and a second flow conduit, the first flow conduit configured to transport fluid from the tortuous pathway (76) portion of the closed loop conduit within the plate manifold (94) to the pressure inlet of the separate tortuous pathway (76) portion within the one of the plurality of bearing jacket manifolds (82), the second flow conduit configured to transport fluid from the return outlet of the separate tortuous pathway (76) portion of the closed loop conduit within each of the plurality of bearing jacket manifolds (82) to the separate tortuous pathway (76) portion within the plate manifold (94); and

wherein the plate manifold (94) is disposed subtending the top plate (30) between the top plate (30) and the side walls (32) such that the underside surface is exposed the lubricant (42) within the interior of the housing (24), and each of the plurality of bearing jacket manifolds (82) is disposed between one of the plurality of bearing openings (33) and one of the bearing covers (35) such that the bearing-side surface is exposed to the interior of the housing (24) near one of the bearings, the fluid flows under the force of the fluid pump through the plate pressure inlet into the tortuous pathway (76) portion of the plate manifold (94), through the first flow conduit of one of the plurality of connectors, into the separate tortuous pathway (76) portion within one of the bearing jacket manifolds (82), through the second flow conduit of the connector, into the separate tortuous pathway (76) portion within the

plate manifold (94), exits through the plate return outlet, and returns to the fluid pump.

12. A vibratory assembly (20) as set forth in claim 11, wherein the plate manifold (94) is made of a metal having thermal conductivity at least 10% greater than the thermal conductivity of whatever metal the housing (24) is made.

13. A vibratory assembly (20) as set forth in claim 12, wherein the metal of which the plate manifold (94) is made is selected from the group consisting of aluminum, copper, iron, nickel, silver, zinc, and alloys thereof.

14. A vibratory assembly (20) as set forth in claim 11, wherein the underside surface of the plate manifold (94) has fins.

15. A vibratory assembly (20) as set forth in claim 11, wherein the fluid is selected from a group consisting of water, antifreeze, and combinations thereof.

16. A vibratory assembly (20) as set forth in claim 11, wherein the cooling system further comprises at least one of a fluid storage unit, cooling fans, and an in-line heat exchanger.

17. A method for cooling a vibratory assembly (20) during the operation of the vibratory assembly (20), the vibratory assembly (20) comprising an exciter (24) having a housing (24) with a top plate (30), side walls (32), at least one bearing opening (33) and a bearing cover (35) for each bearing opening (33), and an interior having a reservoir portion for receiving lubricant (42) in a lubricant reservoir (50) and internal components, the internal components comprising at least one bearing, at least a first eccentric weight (36) rotatable in a clockwise direction and a second eccentric weight (36) rotatable in a counterclockwise direction, rotation of the first eccentric weight (36) and the second eccentric weight (36) causing vibration of the housing (24), the cooling method comprising the steps of:

providing a heat exchanging assembly (72), a fluid, a fluid pump, wherein the heat exchanging assembly (72) comprises at least one surface being exposed to the interior of the housing (24) and the lubricant (42) contained within the interior of the housing (24), and a tortuous pathway (76) not exposed to the interior of the housing (24),

wherein the heat exchanging assembly (72) comprises at least one bearing jacket manifold (82), the bearing jacket manifold (82) having a bearing-side surface; and

wherein the tortuous pathway (76) for the bearing jacket manifold is provided within the at least one bearing jacket manifold; and wherein the at least one bearing jacket manifold (82) further comprises a pressure inlet disposed at a bearing inlet end of the tortuous pathway (76) portion of the closed loop conduit and a return outlet at a bearing outlet end of the tortuous pathway (76) portion of the closed loop conduit, the at least one bearing jacket manifold (82) being disposed between the at least one bearing opening (33) and the bearing cover (35) such that the bearing-side surface is exposed to the interior of the housing (24) near the bearing;

actuating the fluid pump to pump fluid through a closed loop conduit that includes the tortuous pathway (76);

passing the fluid under the force of the fluid pump through the pressure inlet into the tortuous pathway (76) so that the fluid exits through the return outlet;

drawing heat from the interior of the housing (24) by thermal conductivity through the at least one bearing jacket manifold (82);

heating the fluid as the fluid passes through the tortuous pathway (76) portion of the closed loop conduit within the at least one bearing jacket manifold (82); and

dissipating at least a portion of the heat carried by the fluid remote from the housing (24).

Patentansprüche

1. Vibrationsanordnung (20), die dazu ausgelegt ist, Schmiermittel (42) zu enthalten und Folgendes umfasst:

einen Erreger (24), der ein Gehäuse (22) mit einem Inneren, das einen Speicherabschnitt aufweist, der dazu ausgelegt ist, das Schmiermittel (42) in einem Schmiermittelspeicher (50) aufzunehmen, und Innenkomponenten aufweist, wobei die Innenkomponenten Lager (44) und mindestens ein erstes exzentrisches Gewicht (36), das im Uhrzeigersinn drehbar ist, und ein zweites exzentrisches Gewicht (36), das gegen den Uhrzeigersinn drehbar ist, umfassen, wobei das Drehen des ersten exzentrischen Gewichts (36) und des zweiten exzentrischen Gewichts (36) eine Vibration des Gehäuses (24) bewirkt, wobei das Gehäuse (24) ferner mindestens eine Lageröffnung (33) und eine Lagerabdeckung (35) für jede Lageröffnung (33) umfasst; und ein Kühlsystem (68), das eine Wärmetauscha-

nordnung (72), ein Fluid, eine Fluidpumpe umfasst, wobei mindestens eine Fläche der Wärmetauschanordnung (72) dem Inneren des Gehäuses (24) und dem im Inneren des Gehäuses (24) enthaltenen Schmiermittel (42) ausgesetzt ist,

und einen gewundenen Kanal (76), der dem Inneren des Gehäuses (24) nicht ausgesetzt ist, wobei der gewundene Kanal (76) ein Teil eines geschlossenen Kreislaufs ist, durch den das Fluid unter Krafteinwirkung der Fluidpumpe strömt,

wobei die Wärmetauschanordnung (72) mindestens einen Lagerbuchsenverteiler (82) umfasst, der eine lagerseitige Fläche aufweist; und wobei der gewundene Kanal (76) für den Lagerbuchsenverteiler im mindestens einen Lagerbuchsenverteiler (82) bereitgestellt ist; und

wobei der mindestens eine Lagerbuchsenverteiler (82) ferner einen Druckeinlass, der an einem Lagereinlassende des gewundenen Kanalabschnitts (76) des geschlossenen Kreislaufs angeordnet ist, und einen Rückführungsauslass am Lagerauslassende des gewundenen Kanalabschnitts (76) des geschlossenen Kreislaufs umfasst, wobei der mindestens eine Lagerbuchsenverteiler (82) zwischen der mindestens einen Lageröffnung (33) und der Lagerabdeckung (35) angeordnet ist, sodass die lagerseitige Fläche dem Inneren des Gehäuses (24) in der Nähe des Lagers ausgesetzt ist, und

wobei das Fluid unter Krafteinwirkung der Fluidpumpe durch den Druckeinlass in den gewundenen Kanal (76) strömt und durch den Rückführungsauslass austritt.

2. Vibrationsanordnung (20) nach Anspruch 1, wobei der Lagerbuchsenverteiler (82) aus einem Metall gefertigt ist, das eine Wärmeleitfähigkeit aufweist, die mindestens 10 % höher ist als die Wärmeleitfähigkeit des Metalls, aus dem das Gehäuse (24) gefertigt ist.

3. Vibrationsanordnung (20) nach Anspruch 2, wobei das Metall, aus dem der Lagerbuchsenverteiler (82) gefertigt ist, aus der Gruppe bestehend aus Aluminium, Kupfer, Eisen, Nickel, Silber, Zink und Legierungen davon ausgewählt ist.

4. Vibrationsanordnung (20) nach Anspruch 1, wobei:
 - das Gehäuse (24) ferner eine Deckplatte (30) und Seitenwände (32) umfasst; und
 - die Wärmetauschanordnung ferner Folgendes umfasst:

einen Plattenverteiler (94) und einen gewundenen Kanalabschnitt (76) des geschlossenen Kreislaufs, der im Platten-

verteiler (94) bereitgestellt ist, wobei der Plattenverteiler (94) eine Unterseitenfläche, einen Plattendruckeinlass, der an einem Platteneinlassende des gewundenen Kanalabschnitts (76), der im Plattenverteiler (94) bereitgestellt ist, angeordnet ist, und einen Plattenrückführungsauslass an einem Plattenauslassende des gewundenen Kanalabschnitts (76), der im Plattenverteiler (94) bereitgestellt ist, aufweist, wobei der Plattenverteiler (94) der Deckplatte (30) gegenüber, zwischen der Deckplatte (30) und den Seitenwänden (32) angeordnet ist, sodass die Unterseitenfläche dem Inneren des Gehäuses (24) ausgesetzt ist und das Fluid unter Krafterwirkung der Fluidpumpe durch den Plattendruckeinlass in den gewundenen Kanalabschnitt (76), der im Plattenverteiler (94) bereitgestellt ist, strömt und durch den Plattenrückführungsauslass austritt.

5. Vibrationsanordnung (20) nach Anspruch 4, wobei der Plattenverteiler (94) aus einem Metall gefertigt ist, das eine Wärmeleitfähigkeit aufweist, die mindestens 10 % höher ist als die Wärmeleitfähigkeit des Metalls, aus dem das Gehäuse (24) gefertigt ist.

6. Vibrationsanordnung (20) nach Anspruch 5, wobei das Metall, aus dem der Plattenverteiler (94) gefertigt ist, aus der Gruppe bestehend aus Aluminium, Kupfer, Eisen, Nickel, Silber, Zink und Legierungen davon ausgewählt ist.

7. Vibrationsanordnung (20) nach Anspruch 4, wobei die Unterseitenfläche des Plattenverteilers (94) Lamellen aufweist.

8. Vibrationsanordnung (20) nach Anspruch 4, ferner Folgendes umfassend:

mindestens ein Verbindungselement, das den Plattenverteiler (94) mit dem mindestens einen Lagerbuchsenverteiler (82) verbindet, sodass das durch den geschlossenen Kreislauf strömende Fluid durch den Plattenverteiler (94) und den mindestens einen Lagerbuchsenverteiler (82) strömt, wobei mindestens ein Verbindungselement eine erste Strömungsleitung und eine zweite Strömungsleitung aufweist, wobei die erste Strömungsleitung dazu ausgelegt ist, Fluid vom gewundenen Kanalabschnitt (76) des geschlossenen Kreislaufs innerhalb des Plattenverteilers (94) zum Druckeinlass des getrennten gewundenen Kanalabschnitts (76) innerhalb des mindestens einen Lagerbuchsenverteilers (82) zu transportieren, wobei die zweite Strömungsleitung dazu ausgelegt ist, Fluid vom

Rückführungsauslass des getrennten, gewundenen Kanalabschnitts (76) des geschlossenen Kreislaufs innerhalb des Lagerbuchsenverteilers (82) zum getrennten, gewundenen Kanalabschnitt (76) innerhalb des Plattenverteilers (94) zu transportieren; und wobei der mindestens einen Lagerbuchsenverteiler (82) zwischen der mindestens einen Lageröffnung (33) und der Lagerabdeckung (35) angeordnet ist, sodass die lagerseitige Fläche dem Inneren des Gehäuses (24) in der Nähe des Lagers ausgesetzt ist, wobei das Fluid unter Krafterwirkung der Pumpe durch den Plattendruckeinlass in den gewundenen Kanalabschnitt (76) des Plattenverteilers (94), durch die erste Strömungsleitung des mindestens einen Verbindungselements, in den getrennten gewundenen Kanalabschnitt (76) innerhalb des mindestens einen Lagerbuchsenverteilers (82), durch die zweite Strömungsleitung des mindestens einen Verbindungselements, in den getrennten, gewundenen Kanalabschnitt (76) innerhalb des Plattenverteilers (94) strömt, durch den Plattenrückführungsauslass austritt und zur Fluidpumpe zurückströmt.

9. Vibrationsanordnung (20) nach Anspruch 1, wobei das Fluid aus einer Gruppe bestehend aus Wasser, Frostschutzmittel und Kombinationen davon ausgewählt ist.

10. Vibrationsanordnung (20) nach Anspruch 1, wobei das Kühlsystem (68) ferner eine Fluidspeichereinheit und/oder Kühlgebläse und/oder einen Reihewärmetauscher umfasst.

11. Vibrationsanordnung (20) nach Anspruch 4, Folgendes umfassend:

einen Erreger (24), der ein Gehäuse (24) mit einer Deckplatte (30), Seitenwänden (32), mehreren Lageröffnungen (33) und einer Lagerabdeckung (35) für jede Lageröffnung (33) aufweist; und ein Kühlsystem (68), das eine Wärmetauschanordnung (72) umfasst, wobei die Wärmetauschanordnung (72) Folgendes umfasst:

mehrere Lagerbuchsenverteiler (82), einen pro Lager, wobei jeder eine lagerseitige Fläche aufweist; und

mehrere Verbindungselemente, eins pro Lagerbuchsenverteiler (82), die den Plattenverteiler (94) mit jedem der mehreren Lagerbuchsenverteiler (82) verbinden, sodass das durch den geschlossenen Kreislauf strömende Fluid durch den Plattenverteiler (94) und jeden der Lagerbuchsenver-

teiler (82) strömt, wobei jedes der mehreren Verbindungselemente eine erste Strömungsleitung und eine zweite Strömungsleitung aufweist, wobei die erste Strömungsleitung dazu ausgelegt ist, Fluid vom gewundenen Kanalabschnitt (76) des geschlossenen Kreislaufs innerhalb des Plattenverteilers (94) zum Druckeinlass des getrennten, gewundenen Kanalabschnitts (76) innerhalb des einen der mehreren Lagerbuchsenverteiler (82) zu transportieren, wobei die zweite Strömungsleitung dazu ausgelegt ist, Fluid vom Rückführungsauslass des getrennten, gewundenen Kanalabschnitts (76) des geschlossenen Kreislaufs innerhalb jedes der mehreren Lagerbuchsenverteiler (82) zum getrennten, gewundenen Kanalabschnitt (76) innerhalb des Plattenverteilers (94) zu transportieren; und wobei der Plattenverteiler (94) der Deckplatte (30) gegenüber, zwischen der Deckplatte (30) und den Seitenwänden (32) angeordnet ist, sodass die Unterseitenfläche dem Schmiermittel (42) im Inneren des Gehäuses (24) ausgesetzt ist, und jeder der mehreren Lagerbuchsenverteiler (82) zwischen einer der mehreren Lageröffnungen (33) und einer der Lagerabdeckungen (35) angeordnet ist, sodass die lagerseitige Fläche dem Inneren des Gehäuses (24) in der Nähe der Lager ausgesetzt ist, wobei das Fluid unter Krafterwirkung der Fluidpumpe durch den Plattendruckeinlass in den gewundenen Kanalabschnitt (76) des Plattenverteilers (94), durch den ersten Strömungskanal eines der mehreren Verbindungselemente, in den getrennten, gewundenen Kanalabschnitt (76) innerhalb eines der Lagerbuchsenverteiler (82), durch den zweiten Strömungseinlass des Verbindungselements, in den getrennten, gewundenen Kanalabschnitt (76) innerhalb des Plattenverteilers (94) strömt, durch den Plattenrückführungsauslass austritt und zur Fluidpumpe zurückströmt.

12. Vibrationsanordnung (20) nach Anspruch 11, wobei der Plattenverteiler (94) aus einem Metall gefertigt ist, das eine Wärmeleitfähigkeit aufweist, die mindestens 10 % höher ist als die Wärmeleitfähigkeit des Metalls, aus dem das Gehäuse (24) gefertigt ist.
13. Vibrationsanordnung (20) nach Anspruch 12, wobei das Metall, aus dem der Plattenverteiler (94) gefertigt ist, aus der Gruppe bestehend aus Aluminium, Kupfer, Eisen, Nickel, Silber, Zink und Legierungen davon ausgewählt ist.

14. Vibrationsanordnung (20) nach Anspruch 11, wobei die Unterseitenfläche des Plattenverteilers (94) Lamellen aufweist.

15. Vibrationsanordnung (20) nach Anspruch 11, wobei das Fluid aus einer Gruppe bestehend aus Wasser, Frostschutzmittel und Kombinationen davon ausgewählt ist.

16. Vibrationsanordnung (20) nach Anspruch 11, wobei das Kühlsystem ferner eine Fluidspeichereinheit und/oder Kühlgebläse und/oder einen Reihenwärmetauscher umfasst.

17. Verfahren zum Kühlen einer Vibrationsanordnung (20) während des Betriebs der Vibrationsanordnung (20), wobei die Vibrationsanordnung (20) einen Erreger (24) umfasst, der ein Gehäuse (24) mit einer Deckplatte (30), Seitenwänden (32), mindestens einer Lageröffnung (33) und einer Lagerabdeckung (35) für jede Lageröffnung (33) und ein Inneres mit einem Speicherabschnitt zur Aufnahme von Schmiermittel (42) in einem Schmiermittelspeicher (50) und Innenkomponenten aufweist, wobei die Innenkomponenten mindestens ein Lager, mindestens ein erstes exzentrisches Gewicht (36), das im Uhrzeigersinn drehbar ist, und ein zweites exzentrisches Gewicht (36), das gegen den Uhrzeigersinn drehbar ist, umfassen, wobei das Drehen des ersten exzentrischen Gewichts (36) und des zweiten exzentrischen Gewichts (36) eine Vibration des Gehäuses (24) bewirkt, wobei das Kühlverfahren ferner die folgenden Schritte umfasst:

Bereitstellen einer Wärmetauschanordnung (72), eines Fluids, einer Fluidpumpe, wobei die Wärmetauschanordnung (72) mindestens eine Fläche, die dem Inneren des Gehäuses (24) und dem im Inneren des Gehäuses (24) enthaltenen Schmiermittel (42) ausgesetzt ist, und einen gewundenen Kanal (76), der dem Inneren des Gehäuses (24) nicht ausgesetzt ist, umfasst, wobei die Wärmetauschanordnung (72) mindestens einen Lagerbuchsenverteiler (82) umfasst, wobei der Lagerbuchsenverteiler (82) eine lagerseitige Fläche aufweist; und wobei der gewundene Kanal (76) für den Lagerbuchsenverteiler innerhalb des mindestens einen Lagerbuchsenverteilers bereitgestellt ist; und wobei der mindestens eine Lagerbuchsenverteiler (82) ferner einen Druckeinlass, der an einem Lagereinlassende des gewundenen Kanalabschnitts (76) des geschlossenen Kreislaufs angeordnet ist, und einen Rückführungsauslass an einem Lagerauslass des gewundenen Kanalabschnitts (76) des geschlossenen Kreislaufs umfasst, wobei der mindestens eine La-

gerbuchsenverteiler (82) zwischen der mindestens einen Lageröffnung (33) und der mindestens einen Lagerabdeckung (35) angeordnet ist, sodass die lagerseitige Fläche dem Inneren des Gehäuses (24) in der Nähe des Lagers ausgesetzt ist; 5

Betätigen der Fluidpumpe, um Fluid durch einen geschlossenen Kreislauf, der den gewundenen Kanal (76) beinhaltet, zu pumpen;

Strömen des Fluids unter Kraftereinwirkung der Fluidpumpe durch den Druckeinlass in den gewundenen Kanal (76), sodass das Fluid aus dem Rückführungsauslass austritt; 10

Ableiten von Wärme aus dem Inneren des Gehäuses (24) durch Wärmeleitfähigkeit durch den mindestens einen Lagerbuchsenverteiler (82); 15

Erwärmen des Fluids, während das Fluid durch den gewundenen Kanalabschnitt (76) des geschlossenen Kreislaufs innerhalb des mindestens einen Lagerbuchsenvertellers (82) strömt; 20

und

Abführen mindestens eines Teils der vom Fluid getragenen Wärme vom Gehäuse (24) weg.

au moins un collecteur à chemise de palier (82) ayant une surface côté palier ; et la voie tortueuse (76) pour le collecteur à chemise de palier étant prévue dans l'au moins un collecteur à chemise de palier (82) ; et

l'au moins un collecteur à chemise de palier (82) comprenant en outre une entrée de pression disposée à une extrémité d'entrée de palier de la partie de voie tortueuse (76) du conduit en boucle fermée et une sortie de retour à une extrémité de sortie de palier de la partie de voie tortueuse (76) du conduit en boucle fermée, l'au moins un collecteur à chemise de palier (82) étant disposé entre l'au moins une ouverture de palier (33) et le couvercle de palier (35) de sorte que la surface côté palier soit exposée à l'intérieur du carter (24) près du palier, et le fluide s'écoulant sous la force de la pompe à fluide à travers l'entrée de pression dans la voie tortueuse (76) et sortant par la sortie de retour.

Revendications

1. Ensemble vibratoire (20) configuré pour contenir un lubrifiant (42) et comprenant :

un exciteur (24) comportant un carter (22) avec un intérieur ayant une partie de réservoir configurée pour recevoir le lubrifiant (42) dans un réservoir de lubrifiant (50) et des composants internes, les composants internes comprenant des paliers (44) et au moins un premier poids excentrique (36) pouvant tourner dans le sens horaire et un second poids excentrique (36) pouvant tourner dans le sens antihoraire, la rotation du premier poids excentrique (36) et du second poids excentrique (36) provoquant une vibration du carter (24), le carter (24) comprenant en outre au moins une ouverture de palier (33) et un couvercle de palier (35) pour chaque ouverture de palier (33) ; et 45

un système de refroidissement (68) comprenant un ensemble d'échange de chaleur (72), un fluide, une pompe à fluide, l'ensemble d'échange de chaleur (72) comprenant au moins une surface exposée à l'intérieur du carter (24) et au lubrifiant (42) contenu à l'intérieur du carter (24), et une voie tortueuse (76) non exposée à l'intérieur du carter (24), la voie tortueuse (76) étant une partie d'un conduit en boucle fermée par laquelle le fluide circule sous la force de la pompe à fluide, 50

dans lequel l'ensemble d'échange de chaleur (72) comprend :

- 25 2. Ensemble vibratoire (20) selon la revendication 1, dans lequel le collecteur à chemise de palier (82) est constitué d'un métal ayant une conductivité thermique supérieure d'au moins 10 % à la conductivité thermique de tout métal dans lequel le carter (24) est fabriqué. 30

3. Ensemble vibratoire (20) selon la revendication 2, dans lequel le métal à partir duquel est fabriqué le collecteur à chemise de palier (82) est choisi dans le groupe constitué par l'aluminium, le cuivre, le fer, le nickel, l'argent, le zinc et des alliages de ceux-ci. 35

4. Ensemble vibratoire (20) selon la revendication 1, dans lequel :

le carter (24) comprend en outre une plaque supérieure (30) et des parois latérales (32) ; et l'ensemble d'échange de chaleur comprend en outre :

un collecteur à plaques (94) ; et une partie de voie tortueuse (76) du conduit en boucle fermée prévue à l'intérieur du collecteur à plaques (94), dans lequel le collecteur à plaques (94) a une surface inférieure, une entrée de pression de plaque disposée à une extrémité d'entrée de plaque de la partie de voie tortueuse (76) prévue dans le collecteur à plaques (94) et une sortie de retour de plaque disposée à une extrémité de sortie de plaque de la partie de voie tortueuse (76) prévue dans le collecteur à plaques (94), le collecteur à pla-

ques (94) étant disposé sous-tendant la plaque supérieure (30) entre la plaque supérieure (30) et les parois latérales (32) de sorte que la surface inférieure est exposée à l'intérieur du carter (24) et le fluide s'écoule sous la force de la pompe à fluide à travers l'entrée de pression de plaque dans la partie de voie tortueuse (76) prévue dans le collecteur à plaques (94) et sort par la sortie de retour de plaque.

5. Ensemble vibratoire (20) selon la revendication 4, dans lequel le collecteur à plaques (94) est constitué d'un métal ayant une conductivité thermique supérieure d'au moins 10 % à la conductivité thermique de tout métal dans lequel le carter (24) est fabriqué.

6. Ensemble vibratoire (20) selon la revendication 5, dans lequel le métal à partir duquel est fabriqué le collecteur à plaques (94) est choisi dans le groupe constitué par l'aluminium, le cuivre, le fer, le nickel, l'argent, le zinc et des alliages de ceux-ci.

7. Ensemble vibratoire (20) selon la revendication 4, dans lequel la surface inférieure du collecteur à plaques (94) présente des ailettes.

8. Ensemble vibratoire (20) selon la revendication 4, comprenant en outre :

au moins un connecteur qui relie le collecteur à plaques (94) à l'au moins un collecteur à chemise de palier (82) de telle sorte que le fluide circulant à travers le conduit en boucle fermée traverse le collecteur à plaques (94) et l'au moins un collecteur à chemise de palier (82), au moins un connecteur ayant un premier conduit d'écoulement et un second conduit d'écoulement, le premier conduit d'écoulement étant configuré pour transporter du fluide depuis la partie de voie tortueuse (76) du conduit en boucle fermée dans le collecteur à plaques (94) vers l'entrée de pression de la partie de voie tortueuse (76) séparée dans l'au moins un collecteur à chemise de palier (82), le second conduit d'écoulement étant configuré pour transporter du fluide depuis la sortie de retour de la partie de voie tortueuse (76) séparée du conduit en boucle fermée dans le collecteur à chemise de palier (82) vers la partie de voie tortueuse (76) séparée dans le collecteur à plaques (94) ; et dans lequel l'au moins un collecteur à chemise de palier (82) est disposé entre l'au moins une ouverture de palier (33) et le couvercle de palier (35) de telle sorte que la surface côté palier est exposée à l'intérieur du carter (24) près du palier, le fluide s'écoule sous la force de la pompe à fluide à travers l'entrée de pression de plaque

dans la partie de voie tortueuse (76) du collecteur à plaques (94), s'écoule à travers le premier conduit d'écoulement de l'au moins un connecteur, dans la partie de voie tortueuse (76) séparée à l'intérieur de l'au moins un collecteur à chemise de palier (82), s'écoule à travers le second conduit d'écoulement de l'au moins un connecteur, dans la partie de voie tortueuse séparée (76) à l'intérieur du collecteur à plaques (94), sort par la sortie de retour de plaque et retourne à la pompe à fluide.

9. Ensemble vibratoire (20) selon la revendication 1, dans lequel le fluide est choisi dans un groupe constitué par l'eau, un antigel et des combinaisons de ceux-ci.

10. Ensemble vibratoire (20) selon la revendication 1, dans lequel le système de refroidissement (68) comprend en outre au moins un élément parmi une unité de stockage de fluide, des ventilateurs de refroidissement et un échangeur de chaleur en ligne.

11. Ensemble vibratoire (20) selon la revendication 4, comprenant :

un excitateur (24) ayant un carter (24) avec une plaque supérieure (30), des parois latérales (32), une pluralité d'ouvertures de palier (33), et un couvercle de palier (35) pour chaque ouverture de palier (33) ; et un système de refroidissement (68) comprenant un ensemble d'échange de chaleur (72), l'ensemble d'échange de chaleur (72) comprenant :

une pluralité de collecteurs à chemise de palier (82), un pour chaque palier, chacun ayant une surface côté palier ; et une pluralité de connecteurs, un pour chaque collecteur à chemise de palier (82), qui relie le collecteur à plaques (94) à chacun de la pluralité de collecteurs à chemise de palier (82) de sorte que le fluide circulant à travers le conduit en boucle fermée traverse le collecteur à plaques (94) et chacun des collecteurs à chemise de palier (82), chacun de la pluralité de connecteurs ayant un premier conduit d'écoulement et un second conduit d'écoulement, le premier conduit d'écoulement étant configuré pour transporter du fluide depuis la partie de voie tortueuse (76) du conduit en boucle fermée dans le collecteur à plaques (94) vers l'entrée de pression de la partie de voie tortueuse (76) séparée dans l'un de la pluralité de collecteurs à chemise de palier (82), le second conduit d'écoulement configuré pour transporter du fluide depuis la sortie de re-

tour de la partie de voie tortueuse (76) séparée du conduit à boucle fermée dans chacun de la pluralité de collecteurs à chemise de palier (82) vers la partie de voie tortueuse (76) séparée dans le collecteur à plaques (94) ; et

5 dans lequel le collecteur à plaques (94) est disposé sous-tendant la plaque supérieure (30) entre la plaque supérieure (30) et les parois latérales (32) de telle sorte que la surface inférieure est exposée au lubrifiant (42) à l'intérieur du carter (24), et chacun de la pluralité de collecteurs à chemise de palier (82) est disposé entre une ouverture de la pluralité d'ouvertures de palier (33) et l'un des couvercles de palier (35), de sorte que la surface côté palier soit exposée à l'intérieur du carter (24), près d'un des paliers, le fluide s'écoule sous la force de la pompe à fluide à travers l'entrée de pression de plaque dans la partie de voie tortueuse (76) du collecteur à plaques (94), à travers le premier conduit d'écoulement de l'un de la pluralité de connecteurs, dans la partie de voie tortueuse (76) séparée dans l'un des collecteurs à chemise de palier (82), s'écoule à travers le second conduit d'écoulement du connecteur, dans la partie de voie tortueuse (76) séparée dans le collecteur à plaques (94), sort par la sortie de retour de plaque et retourne à la pompe à fluide.

12. Ensemble vibratoire (20) selon la revendication 11, dans lequel le collecteur à plaques (94) est constitué d'un métal ayant une conductivité thermique supérieure d'au moins 10 % à la conductivité thermique de tout métal dans lequel le carter (24) est fabriqué.
13. Ensemble vibratoire (20) selon la revendication 12, dans lequel le métal à partir duquel est fabriqué le collecteur à plaques (94) est choisi dans le groupe constitué par l'aluminium, le cuivre, le fer, le nickel, l'argent, le zinc et des alliages de ceux-ci.
14. Ensemble vibratoire (20) selon la revendication 11, dans lequel la surface inférieure du collecteur à plaques (94) présente des ailettes.
15. Ensemble vibratoire (20) selon la revendication 11, dans lequel le fluide est choisi dans un groupe constitué par l'eau, un antigel et des combinaisons de ceux-ci.
16. Ensemble vibratoire (20) selon la revendication 11, dans lequel le système de refroidissement comprend en outre au moins un élément parmi une unité de stockage de fluide, des ventilateurs de refroidissement et un échangeur de chaleur en ligne.

17. Procédé de refroidissement d'un ensemble vibratoire (20) pendant le fonctionnement de l'ensemble vibratoire (20), l'ensemble vibratoire (20) comprenant un excitateur (24) ayant un carter (24) avec une plaque supérieure (30), des parois latérales (32), au moins une ouverture de palier (33) et un couvercle de palier (35) pour chaque ouverture de palier (33), et un intérieur ayant une partie de réservoir pour recevoir un lubrifiant (42) dans un réservoir de lubrifiant (50) et des composants internes, les composants internes comprenant au moins un palier, au moins un premier poids excentrique (36) pouvant tourner dans le sens horaire et un second poids excentrique (36) pouvant tourner dans le sens antihoraire, la rotation du premier poids excentrique (36) et du second poids excentrique (36) provoquant une vibration du carter (24), le procédé de refroidissement comprenant les étapes consistant à :

fournir un ensemble d'échange de chaleur (72), un fluide, une pompe à fluide, dans lequel l'ensemble d'échange de chaleur (72) comprend au moins une surface exposée à l'intérieur du carter (24) et au lubrifiant (42) contenu à l'intérieur du carter (24), et une voie tortueuse (76) non exposée à l'intérieur du carter (24), dans lequel l'ensemble d'échange de chaleur (72) comprend au moins un collecteur à chemise de palier (82), le collecteur à chemise de palier (82) ayant une surface côté palier ; et dans lequel la voie tortueuse (76) pour le collecteur à chemise de palier est prévue dans l'au moins un collecteur à chemise de palier ; et dans lequel l'au moins un collecteur à chemise de palier (82) comprend en outre une entrée de pression disposée à une extrémité d'entrée de palier de la partie d'entrée de la voie tortueuse (76) du conduit en boucle fermée et une sortie de retour à une extrémité de sortie de palier de la partie de voie tortueuse (76) du conduit en boucle fermée, l'au moins un collecteur à chemise de palier (82) étant disposé entre l'au moins une ouverture de palier (33) et le couvercle de palier (35), de sorte que la surface côté palier soit exposée à l'intérieur du carter (24) près du palier ; actionner la pompe à fluide pour pomper le fluide à travers un conduit en boucle fermée qui comprend la voie tortueuse (76) ; faire passer le fluide sous la force de la pompe à fluide à travers l'entrée de pression dans la voie tortueuse (76) de sorte que le fluide sorte par la sortie de retour ; aspirer de la chaleur de l'intérieur du carter (24) par conductivité thermique à travers au moins un collecteur à chemise de palier (82) ; chauffer le fluide au fur et à mesure que le fluide traverse la partie de voie tortueuse (76) du con-

duit en boucle fermée à l'intérieur d'au moins un collecteur à chemise de palier (82) ; et dissiper au moins une partie de la chaleur transportée par le fluide à distance du carter (24).

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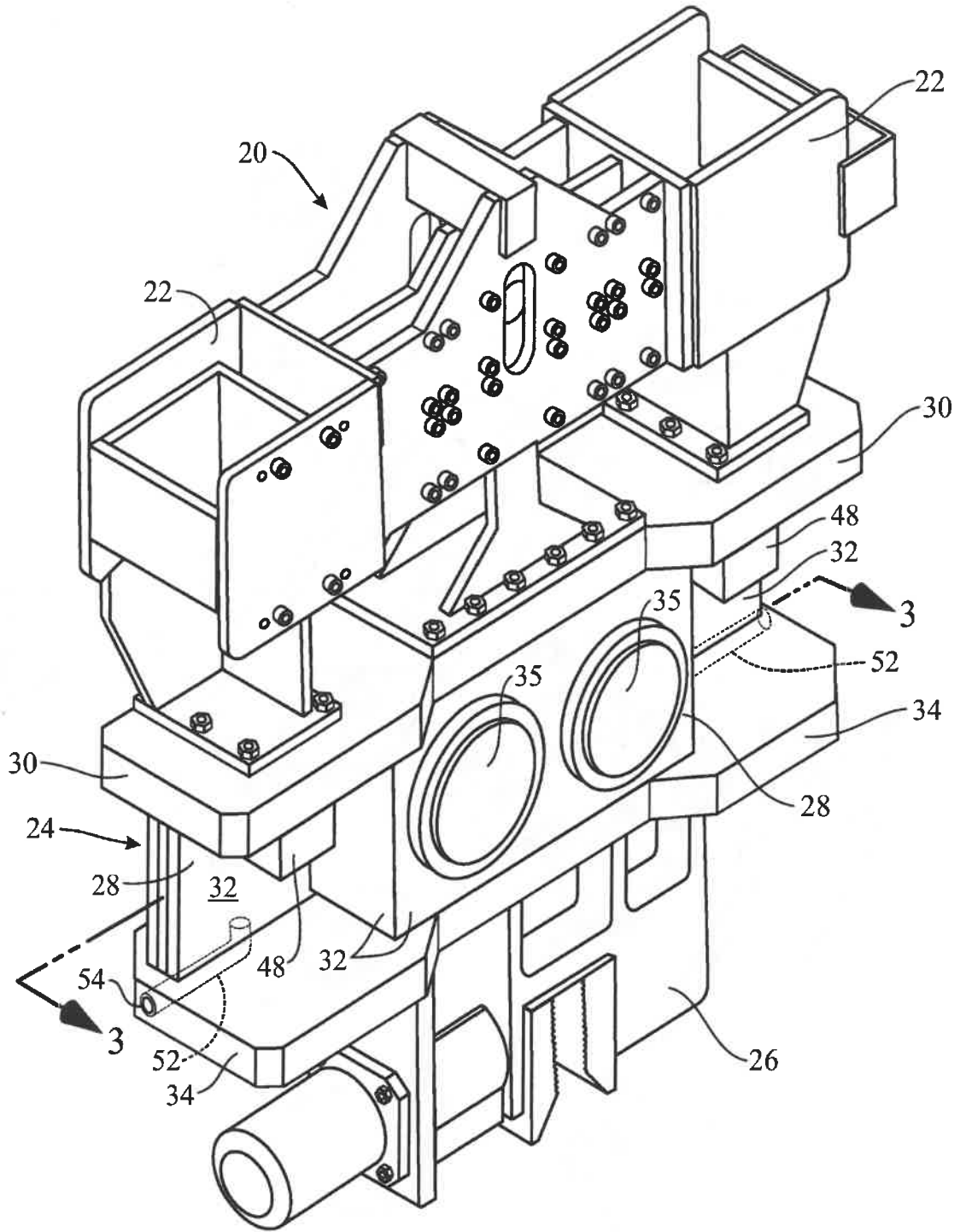


FIG. 1
PRIOR ART

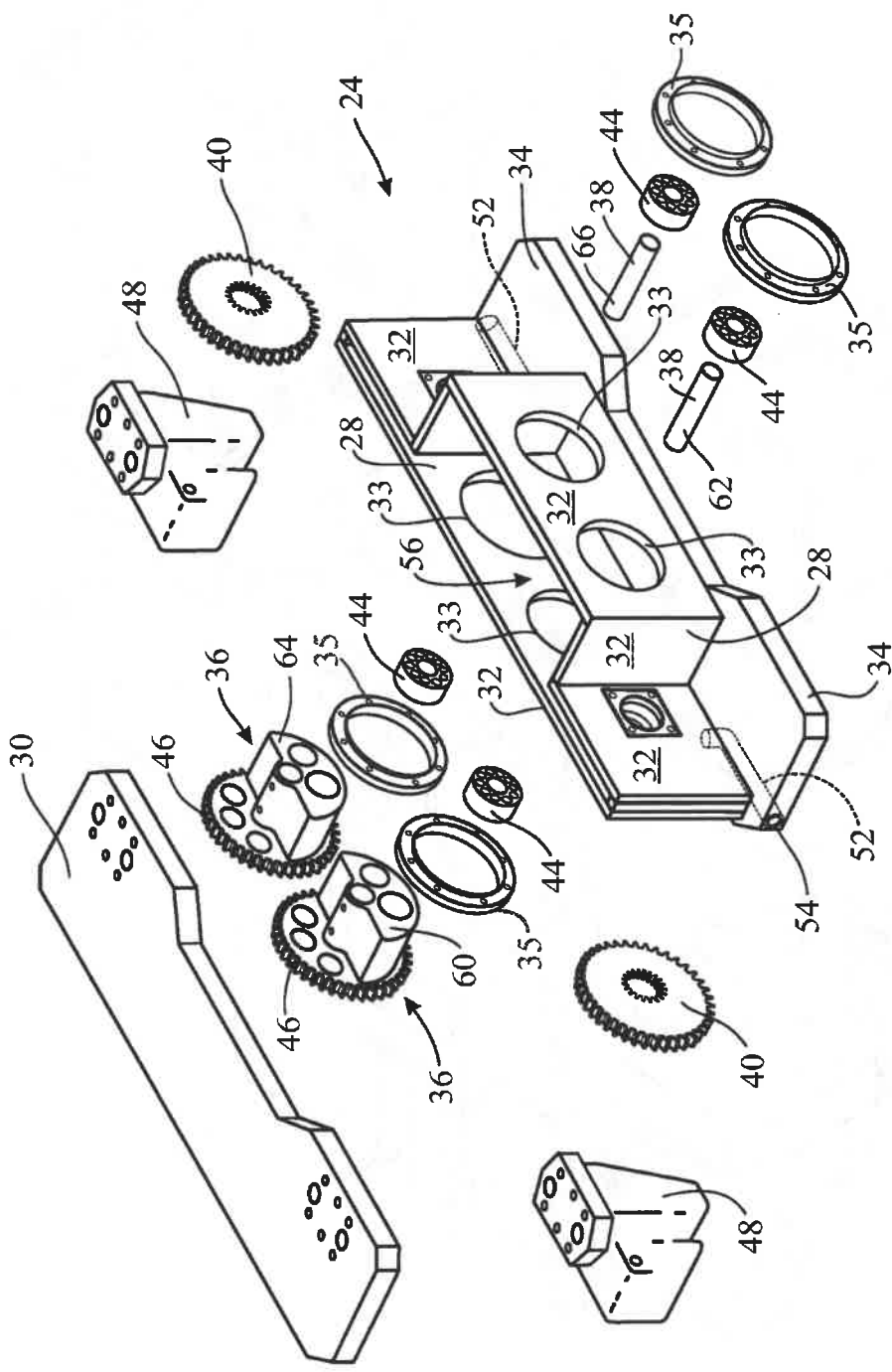


FIG. 2
PRIOR ART

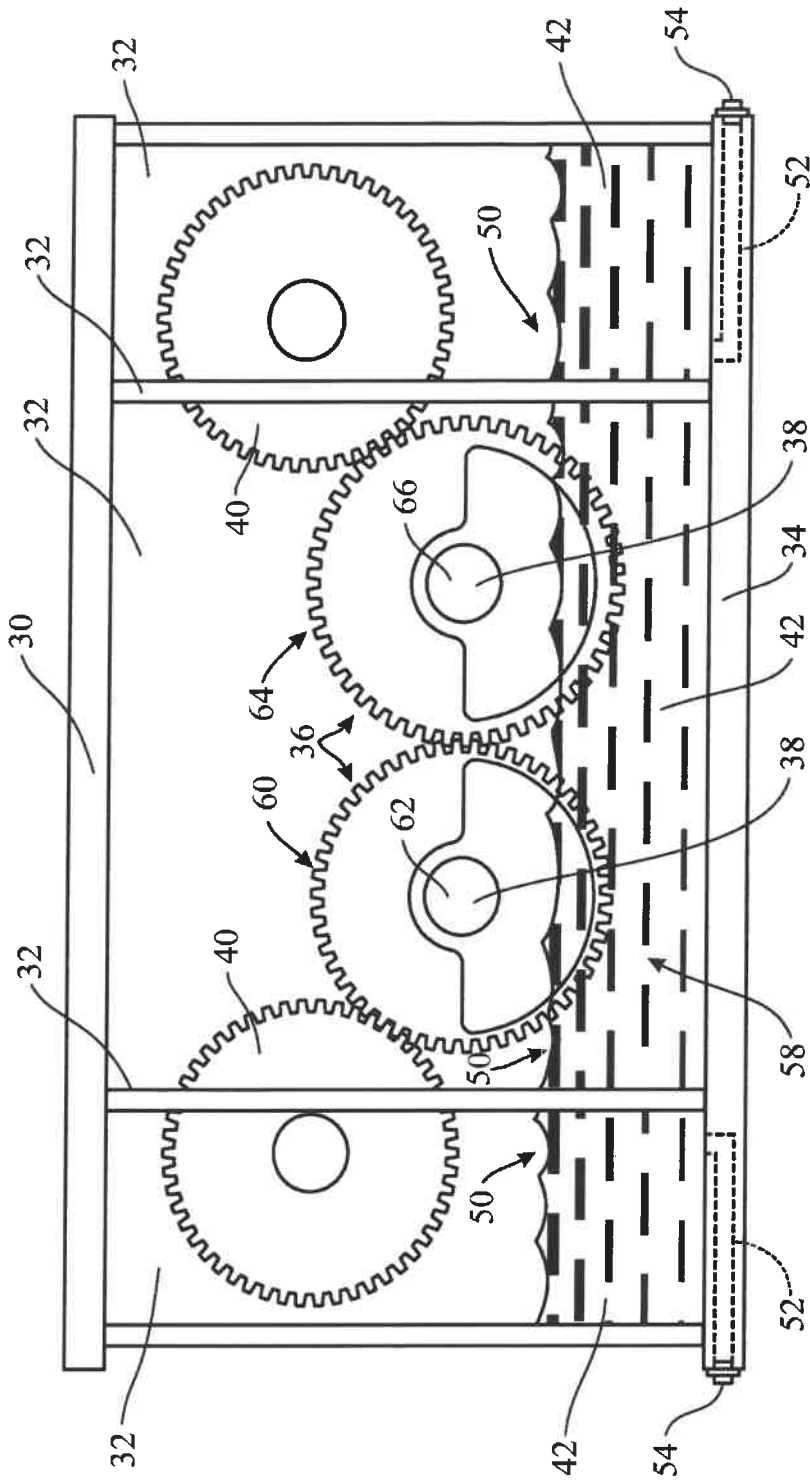


FIG. 3
PRIOR ART

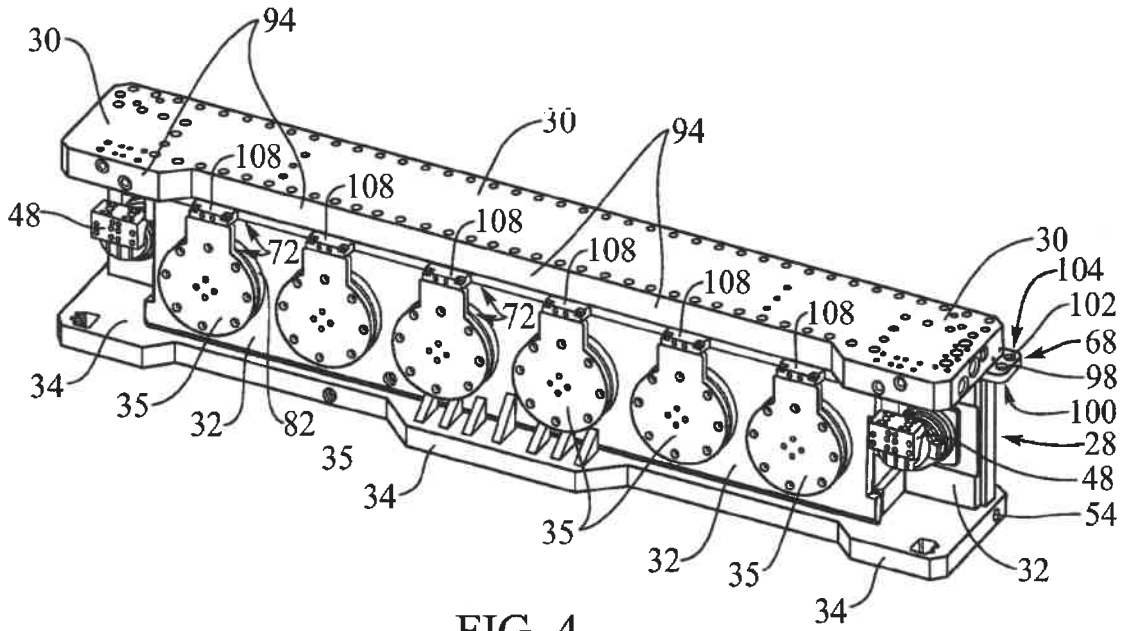


FIG. 4

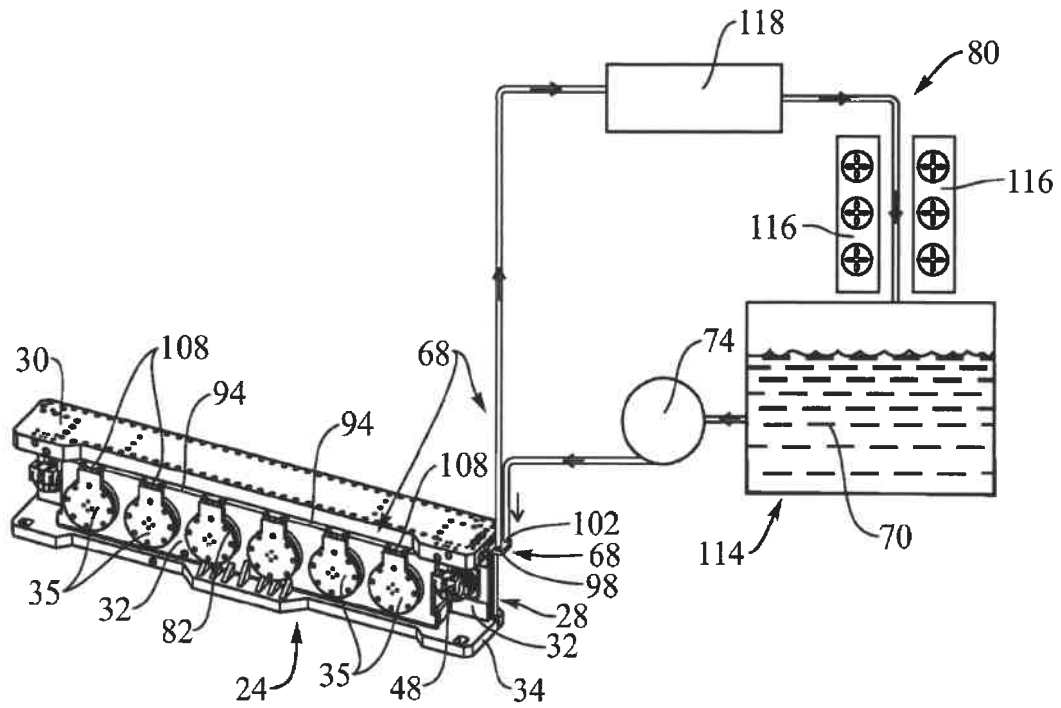


FIG. 5

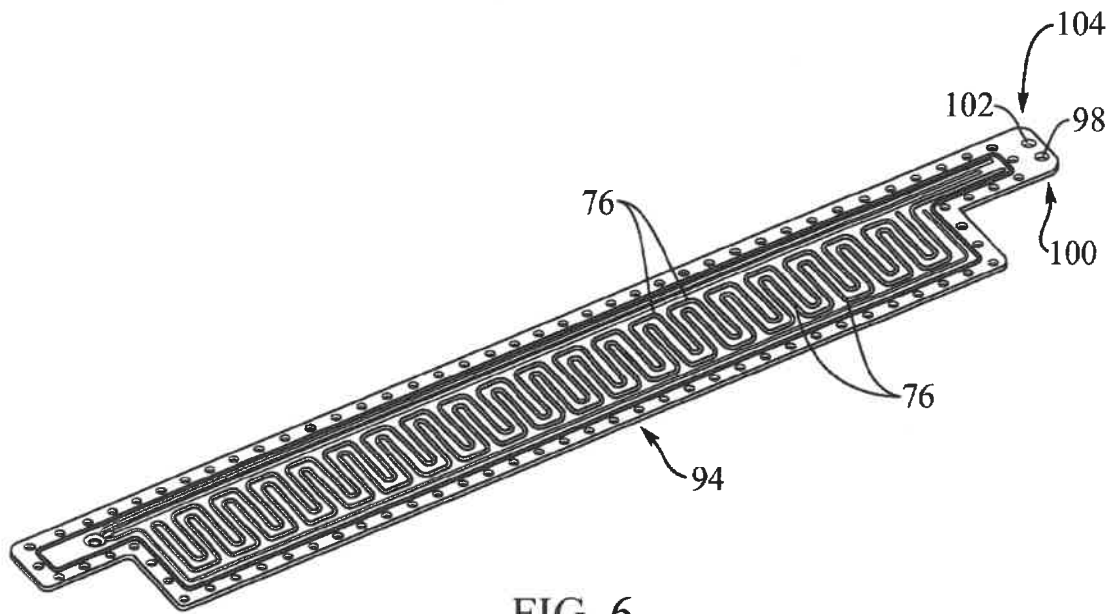


FIG. 6

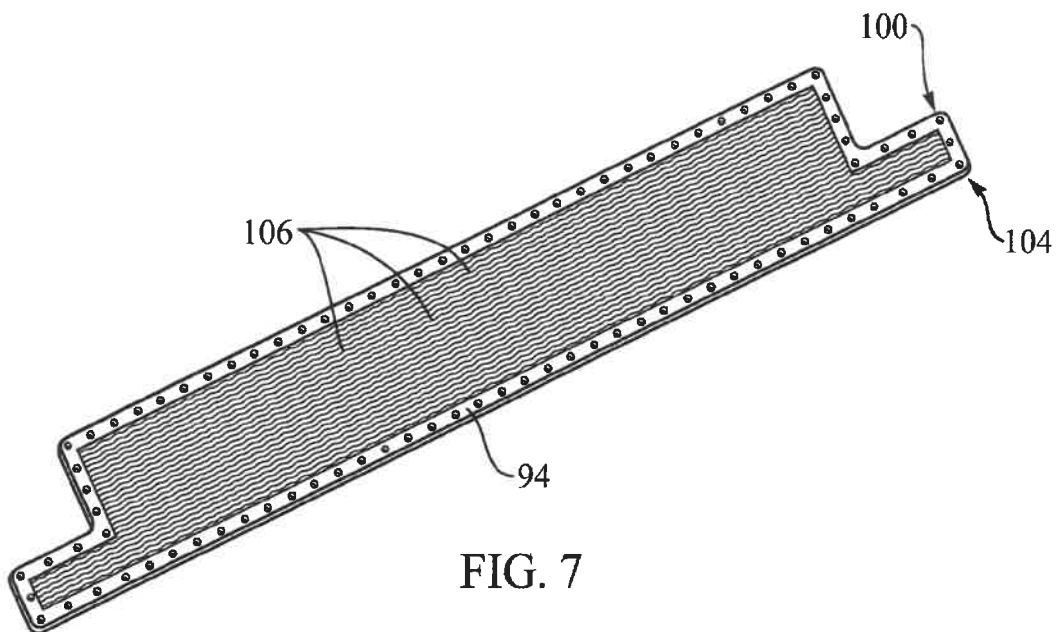


FIG. 7

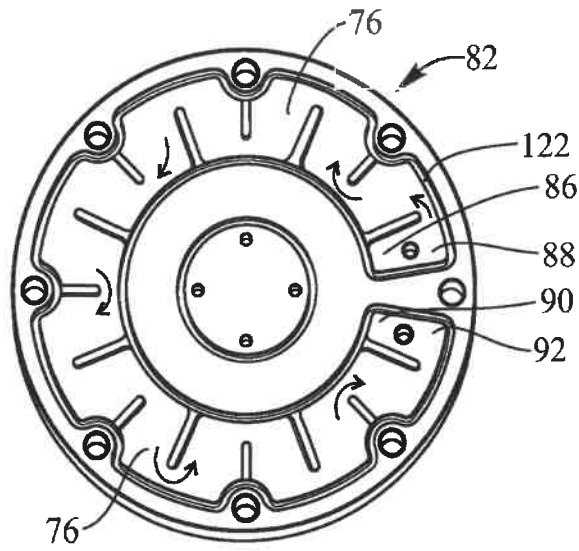


FIG. 8

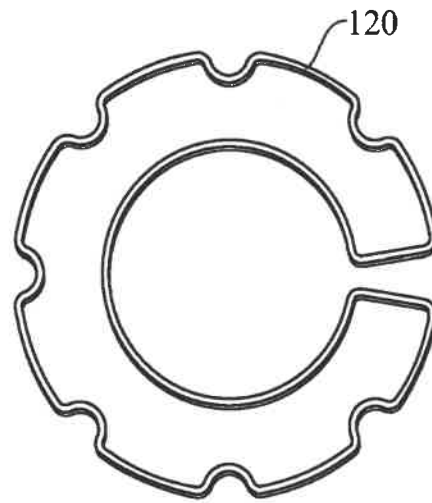


FIG. 9

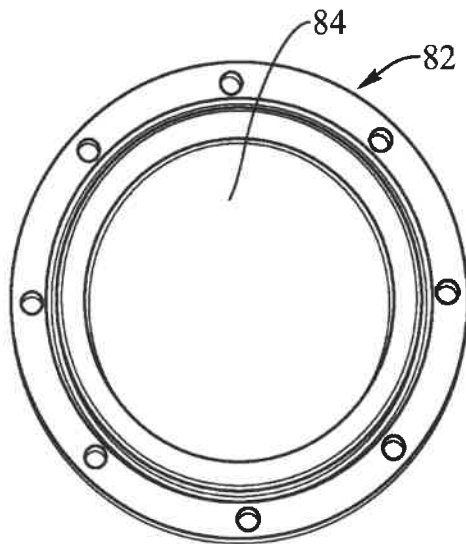


FIG. 10

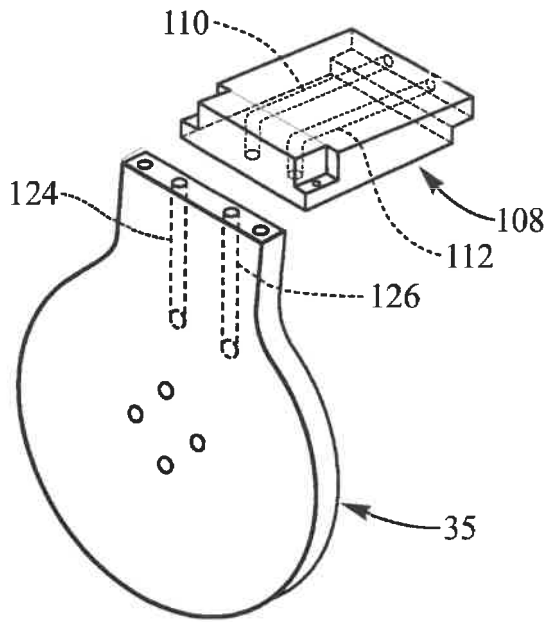


FIG. 11

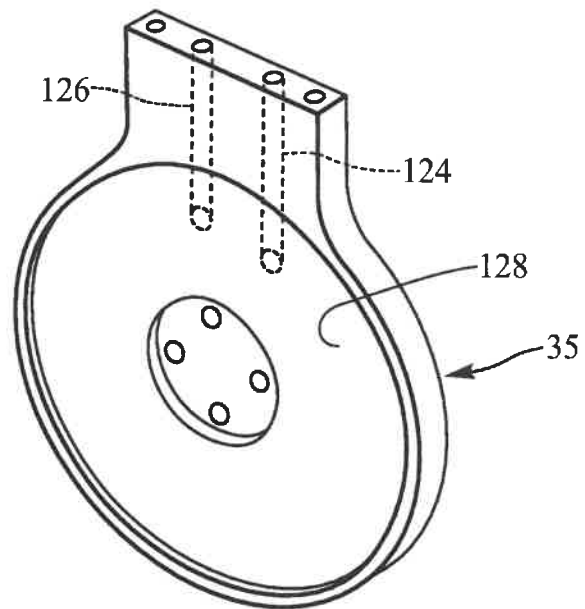


FIG. 12

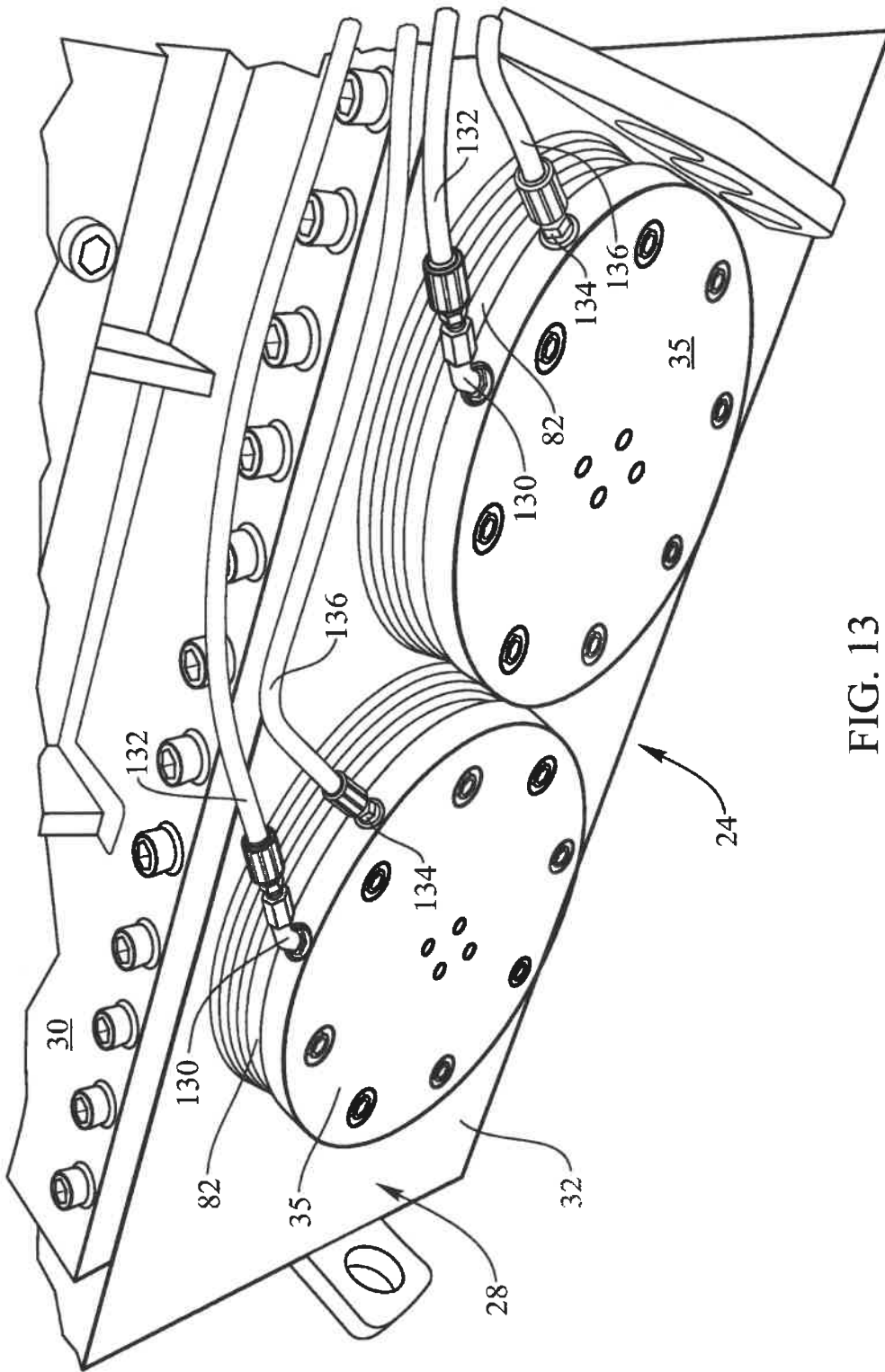


FIG. 13

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REFERENCES CITED IN THE DESCRIPTION

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