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(54) **AIR OPERATED DIAPHRAGM PUMP WITH ELECTRIC GENERATOR**

LUFTBETRIEBENE MEMBRANPUMPE MIT EINEM GENERATOR

POMPE À MEMBRANE PNEUMATIQUE DOTÉE D'UN GÉNÉRATEUR ÉLECTRIQUE

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EP 2 430 308 B9

Description

[0001] This application claims priority to a provisional application having serial number 61/176,754 filed on May 8, 2009.

I. Background

A. Field of Invention

[0002] This invention pertains to the art of methods and apparatuses regarding air operated diaphragm pumps and more specifically to methods and apparatuses regarding integrated power sources for supplying electrical power to air operated diaphragm pumps as well as other apparatuses.

B. Description of the Related Art

[0003] Fluid-operated pumps, such as diaphragm pumps, are widely used particularly for pumping liquids, solutions, viscous materials, slurries, suspensions or flowable solids. Double diaphragm pumps are well known for their utility in pumping viscous or solids-laden liquids, as well as for pumping plain water or other liquids, and high or low viscosity solutions based on such liquids. Accordingly, such double diaphragm pumps have found extensive use in pumping out sumps, shafts, and pits, and generally in handling a great variety of slurries, sludges, and waste-laden liquids. Fluid driven diaphragm pumps offer certain further advantages in convenience, effectiveness, portability, and safety. Double diaphragm pumps are rugged and compact and, to gain maximum flexibility, are often served by a single intake line and deliver liquid through a short manifold to a single discharge line. One such double diaphragm pump that may be utilized in conjunction with the present invention is described in pending patent application 12/693,044 filed January 25, 2010 and owned by IDEX AODD, Inc..

[0004] Commonly, diaphragm pumps include various components requiring electrical power. For example, an electric shifting mechanism may be used to control the reciprocal flow of pressurized fluid within a diaphragm pump. EP 1 712 795 A1 is considered as the closest prior art, it discloses a control system for an air-operated diaphragm pump, wherein the pump comprises the features of the preamble of claim 1. Also, diaphragm pumps may include a control system that allows the operation of the pump to be monitored and/or controlled. Although known diaphragm pumps work well for their intended purpose, several disadvantages exist. Often, the location or environment in which the pump is utilized makes it impracticable to connect the pump to a power outlet or stationary power source via external electrical wiring. Not having access to an external source of power may render the pump or components thereof inoperable. What is needed then is an integrated power supply for supplying electrical power to a diaphragm pump.

II. Summary

[0005] The present invention provides a pump comprising a first diaphragm assembly, wherein the first diaphragm assembly is disposed in a first chamber and includes a first diaphragm forming a first pumping chamber and a first diaphragm chamber within the first chamber; a second diaphragm assembly, wherein the second diaphragm assembly is disposed in a second chamber and includes a second diaphragm forming a second pumping chamber and a second diaphragm chamber within the second chamber, wherein a connecting rod is operatively connected to the first and the second diaphragms and allows the first and the second diaphragm assemblies to reciprocate together between a first diaphragm position and a second diaphragm position; a center section, wherein the center section at least partially causes a compressed fluid to be alternately supplied to or exhausted from the first and the second diaphragm chambers, and; an integrated power supply, wherein the integrated power supply utilizes compressed air supplied to the pump to supply power to at least a first component of the pump, wherein the integrated power supply comprises an impeller; a gear reduction assembly; and, an alternator having a rotor and a stator, wherein at least a portion of the compressed air entering into the pump passes over the impeller and causes the impeller to rotate at a first velocity and generate a first torque, wherein the impeller is operatively connected to the gear reduction assembly, wherein the gear reduction assembly causes the rotor to rotate at a second velocity and generate a second torque.

[0006] Another aspect of the present invention refers to a pump wherein the integrated power supply generates an alternating current or a direct current.

[0007] Yet, another aspect of the present invention is to provide a pump wherein the integrated power supply further comprises a regulator, wherein the regulator regulates flow of compressed air across the impeller.

[0008] Another aspect of the present invention is to provide a pump wherein the integrated power supply further comprises a bridge rectifier.

[0009] Further yet, another aspect of the present invention is to provide a pump wherein the alternator comprises a plurality of magnets coupled to the stator, and a coil winding coupled to the rotor.

[0010] Further, another aspect of the present invention is to provide a method for supplying power to a pump, the method comprising the steps of:

> providing a first diaphragm assembly, wherein the first diaphragm assembly is disposed in a first chamber and includes a first diaphragm forming a first pumping chamber and a first diaphragm chamber within the first chamber; a second diaphragm assembly, wherein the second diaphragm assembly is disposed in a second chamber and includes a second diaphragm forming a second pumping chamber and

a second diaphragm chamber within the second chamber, wherein a connecting rod is operatively connected to the first and the second diaphragms and allows the first and the second diaphragm assemblies to reciprocate together between a first diaphragm position and a second diaphragm position; a center section, wherein the center section at least partially causes a compressed fluid to be alternately supplied to or exhausted from the first and the second diaphragm chambers, and; an integrated power supply;

generating electrical power, wherein the integrated power supply generates electrical power utilizing compressed air supplied to the pump, wherein the integrated power supply comprises: an impeller; a gear reduction assembly, the impeller operatively connected to the gear reduction assembly; and, an alternator, the method further comprising the steps of: passing air entering into the pump over the impeller rotating the impeller at a first velocity; generating a first torque, rotating a rotor at a second velocity via the gear reduction assembly; and generating a second torque.

[0011] Another aspect of the present invention is to provide a method for supplying power to a pump further comprising the step of:

generating alternating current or direct current to supply power to a pump component.

[0012] Further, another aspect of the present invention is to provide a method for supplying power to a pump wherein the integrated power supply further comprises a regulator, the method further comprising the step of:

regulating flow of compressed air across the impeller.

[0013] Still yet, another aspect of the present invention is to provide a method for supplying power to a pump wherein the integrated power supply further comprises:

a bridge rectifier.

[0014] One advantage of this invention is that the operation of the pump or other apparatuses to be powered is not limited by the location and accessibility of an external source of power.

[0015] Still other benefits and advantages of the invention will become apparent to those skilled in the art to which it pertains upon a reading and understanding of the following detailed specification.

III. Brief Description of the Drawings

[0016] The invention may take physical form in certain parts and arrangement of parts, a preferred embodiment of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIGURE 1 shows an illustrative view of an air operated double diaphragm pump comprising a power supply according to one embodiment of the invention;

FIGURE 2 shows a schematic illustration of an air operated double diaphragm pump, particularly illustrating the pump at the end of a pumping stroke in the left direction;

FIGURE 3 shows a schematic illustration of an air operated double diaphragm pump, particularly illustrating the pump at the end of a pumping stroke in the right direction;

FIGURE 4 shows a partial cut-away view of an air operated double diaphragm pump having a power supply according to one embodiment of the invention;

FIGURE 5 shows an assembly view of the power supply according to one embodiment of the invention;

FIGURE 6A shows an assembly view of the rotor assembly shown in FIGURE 5;

FIGURE 6B shows an assembly view of the case assembly shown in FIGURE 5;

FIGURE 6C shows an assembly view of the generator assembly shown in FIGURE 5;

FIGURE 7 shows a schematic illustration of an air operated diaphragm pump having a power supply for supplying electrical power independent of the operation of the pump according to one embodiment of the invention.

IV. Detailed Description

[0017] Referring now to the drawings wherein the showings are for purposes of illustrating embodiments of the invention only and not for purposes of limiting the same, FIGURES 1-5 illustrate the present invention. FIGURE 1 shows an air operated double diaphragm pump 10 comprising a power supply 1 according to one embodiment of the invention. The power supply 1 may comprise an integrated power supply and may increase the utility and portability of the pump 10 by eliminating the requirement to connect the pump 10 to an external power source via external electrical wiring. The power supply 1 may comprise a generator or an alternator. The power supply 1 may generate direct and/or alternating current.

Although the invention is described in terms of an air operated double diaphragm pump, the invention may be utilized with any type pump chosen with sound judgment by a person of ordinary skill in the art. The terms "compressed air," "compressed fluid," "air," and "fluid" may be used interchangeably and refer to a pressurized fluid suitable for operating a fluid powered diaphragm pump.

[0018] With reference now to FIGURES 1, 2, and 3, the pump 10 may now be generally described. The pump 10 may comprise a first diaphragm chamber 21 and a second diaphragm chamber 22. A connecting rod 30 may operatively connect a first diaphragm plate 24 to a second diaphragm plate 25. As the connecting rod 30 moves all the way to the left, as shown in FIGURE 2, the second diaphragm plate 25 may engage the end of an actuator pin 27 thereby causing a pilot valve spool 29 to be shifted to the left. Compressed air entering the pump 10 through a pump inlet 15 may be directed into a pilot valve assembly 28 through a pilot inlet port 31. With the pilot valve spool 29 moved to the left position as shown in FIGURE 2, the pilot valve assembly 28 may communicate compressed air to a first signal port 42 of the main fluid valve assembly 34, as illustrated by the line shown at 40. The communication of compressed air to the first signal port 42 may cause a main fluid valve spool 35 to be shifted from a leftmost position, shown in FIGURE 2, to a rightmost position, shown in FIGURE 3. In the leftmost position, shown in FIGURE 2, compressed air entering the pump 10 through the pump inlet 15 may be communicated through a first inlet port 37 of the main fluid valve 34 and may be transmitted to the first diaphragm chamber 21, as illustrated by the line 38. Compressed air may also be communicated to a second inlet port 39 of the main fluid valve 34 but may be blocked by the main fluid valve spool 35 as shown in FIGURE 2. As compressed air is directed into the first diaphragm chamber 21, compressed air may be vented or exhausted from the second diaphragm chamber 22 through an exhaust port 32 of the main fluid valve assembly 34, as illustrated by the line 45.

[0019] With continued reference now to FIGURES 1, 2, and 3, as indicated above, compressed air may be transmitted from the pilot valve 28 to the first signal port 42 of the main fluid valve 34. The transmission of compressed air to the first signal port 42 may cause the main fluid valve spool 35 to shift to the right and assume the rightmost position, shown in FIGURE 3, thereby blocking entry of compressed fluid through the first inlet port 37 and permitting compressed fluid to enter the valve 34 through the second inlet port 39. The movement of the main fluid valve spool 35 to the right may be initiated upon the second diaphragm chamber 22 becoming substantially full of compressed air thereby causing the first diaphragm plate 24 to be moved to the right and caused to engage the end of the actuator pin 27. The engagement of the end of the actuator pin 27 by the first diaphragm plate 24 may cause the pilot valve spool 29 to be moved to the right. The movement of the pilot valve spool 29 to the right may cause compressed air entering the pilot valve assembly 28 to be transmitted to a second signal port 43 of the main air valve 34, as illustrated by the line 47. The communication of compressed air to the second signal port 43 may cause the main fluid valve spool 35 to be shifted to the left and assume the position shown in FIGURE 2. However, with the main fluid valve spool 35 in the position as shown in FIGURE 3, the first inlet port 37 may be blocked and compressed air may flow through the second inlet port 39 and into the second diaphragm chamber 22, as illustrated by the line 44. Compressed air from the first diaphragm chamber 21 may be vented or exhausted through the exhaust port 32, as illustrated by the line 48.

[0020] With reference now to FIGURE 1, in one embodiment, the power supply 1 may utilize compressed air to supply electrical power to the pump 10. The power supply 1 may be used to supply electrical power to the pump 10, or components thereof, during operation of the pump 10 or, may supply electrical power to the pump 10 substantially continuously in conjunction with compressed air being supplied to the power supply 1. The power supply 1 may utilize compressed air entering the pump 10 through the pump inlet 15 or compressed air exhausted from the first and/or second diaphragm chambers 21, 22. In one embodiment, the power supply 1 may be used to recharge a battery, not shown, supplied to the pump 10, wherein the battery, not shown, is utilized to supply electrical power to the pump 10. The power supply 1 may be selectively coupled to the pump 10. The power supply 1 may comprise any type of structure or device for converting compressed air into electrical power chosen with sound judgment by a person of ordinary skill in the art. In one embodiment, the power supply 1 may comprise a power supply housing 2 that enables the power supply 1 to be selectively coupled to the pump housing 11. In another embodiment, the power supply 1 may comprise an integrated component that is substantially contained within the pump housing 11.

[0021] With reference now to FIGURES 1, 4, and 5, in one embodiment, the power supply 1 may generate an alternating current. The power supply 1 may comprise an impeller 71, a rotor shaft 72, a rotor 73, and a stator 74. The impeller 71 may comprise a plurality of blades 75 that at least partially extend into at least a portion of a fluid passage 76. At least a portion of the compressed air supplied to the pump 10 may be directed to flow through the fluid passage 76. The compressed air flowing through the fluid passage 76 may at least partially cause the rotation of the impeller 71 by exerting a force on at least a portion of the blades 75. In one embodiment, the compressed air flowing through the fluid passage 76 may cause the impeller 71 to rotate at about 2000 rotations per minute (rpm). In one embodiment, the compressed air may pass through a regulator 83 prior to entering the fluid passage 76. The regulator 83 may regulate the pressure of the compressed air entering the fluid passage 76 to at least partially ensure the uniform rotation of the impeller 71. In a more specific embodiment, the regulator 83 may regulate the pressure of compressed air entering the fluid passage 76 to 15 psi. In one embodiment, compressed air entering the fluid passage 76 may be supplied directly from a source of compressed air, not shown. In another embodiment, compressed air entering the fluid passage 76 may comprise at least a portion of the compressed air entering the pump 10 through the pump inlet 15. In a more specific embodiment, compressed air entering the fluid passage 76 may be supplied from the compressed air directed into the pilot valve assembly 28. In yet another embodiment, compressed air entering the fluid passage 76 may be supplied from compressed air being exhausted from the pump 10 through the exhaust port 32. Compressed air exiting the fluid passage 76 may be exhausted from the pump 10 into the ambient air or, may be directed back into the pump 10. In one embodiment, compressed air exiting the fluid passage 76 may be directed back into the pump 10 through the pump inlet 15. In another embodiment, compressed air exiting the fluid passage 76 may be directed to flow across a controller, not shown, or other electrical assembly for the purpose of cooling, lowering, or otherwise controlling the operating temperature of the controller or other electrical assembly.

[0022] With continuing reference to FIGURES 1, 4, and 5, the impeller 71 may be operationally connected to the rotor shaft 72 such that the rotation of the impeller 71 at least partially causes the rotation of the rotor shaft 72. In one embodiment, a gear assembly 77 may operationally connect the impeller 71 and the rotor shaft 72. The gear assembly 77 may allow the rotational properties of the impeller 71 to be altered when translated to the rotor shaft 72. The gear assembly 77 may allow a decreased or minimal amount of compressed air to be utilized for operating the power supply 1. In one embodiment, the gear assembly 77 may comprise a gear reduction assembly that at least partially causes the rotor shaft 72 to comprise a decreased rotational velocity and an increased torque with respect to the impeller 71. In a more specific embodiment, the gear assembly 77 may cause a gear reduction of 4:1. The rotor shaft 72 may be operationally connected to the rotor 73 such that the rotation of the rotor shaft 72 at least partially causes the rotation of the rotor 73. The stator 74 may be substantially encircle the rotor 73 such that the rotation of the rotor 73 causes at least a first magnet 78 to rotate relative to at least a first coil winding 79 thereby inducing an electric current to flow through the coil winding 79. In one embodiment, a plurality of magnets 78 may be coupled to the rotor 73 and a plurality of coil windings 79 may be coupled to the stator 74. The magnets 78 may have a staggered or alternating plurality such that the north and south poles of each magnet 78 alternate around the rotor 73. The stator 74 may comprise a first, second, and third coil winding 79. The first, second, and third coil windings 79 may be evenly spaced at intervals of about 120 degrees such that the rotation of the rotor 73 at least partially causes alternating magnetic fields to induce a subsequent three-phase alternating current in the stator 74. In one embodiment, the coil windings 79 may be wound around an iron ring 82 positioned adjacent to the magnets 78.

[0023] With continuing reference to FIGURES 1, 4, and 5, a plurality of wires or stator leads 80 may be utilized to direct the flow of current from the stator 74. In one embodiment, the current may be directed through a bridge rectifier 81 for supplying direct current to one or more components of the pump 10. Optionally, the power supply 1 may comprise a voltage regulator, not shown, for regulating the amount of voltage supplied to one or more components of the pump 10. The power supply 1 may be used to supply electrical power to any component of the pump 10 chosen with sound judgment by a person of ordinary skill in the art. In one embodiment, the power supply 1 may supply electrical power to a control device, not shown, for controlling the compressed air utilized in operating the pump 10. In another embodiment, the power supply 1 may supply power to a controller and/or solenoids for electronically controlling the movement of the main valve assembly 34. Examples of other devices or components of the pump 10 that may be supplied power by the power supply 1 include, but are not limited to, leak detectors, PH monitoring sensors, air flow meters, liquid flow meters, gas flow meters, pressure sensors, stroke sensors, wired communication devices, wireless communication devices, fluid sensing devices, liquid level sensors, liquid level controls, float switches, solenoids, valves, and pump control systems.

[0024] With continued reference now to FIGURES 1 and 4, in one embodiment, the power supply 1 may generate direct current. The power supply 1 may comprise the plurality of magnets 78 coupled to the stator 74 and the coil winding 79 coupled to the rotor 73. The rotation of the rotor 73 may cause the coil winding 79 to rotate with respect to the magnets 78 thereby inducing an electric current through the coil winding 79. The current induced in the coil winding 79 may comprise a direct current that is fed through a wire or rotor lead, not shown, to one or more components of the pump 10. The output supplied by the power supply 1 may be modified by varying one or more variables, such as, for example, the amount of compressed air directed through the fluid passage 76; the speed at which the compressed air flows through the fluid passage 76; the configuration of the impeller 71 (i.e., size and/or number of blades 75); the configuration of the gear assembly 77; the size and number of magnets 78; and, the size, material comprising the coil winding, number of windings per coil winding, and the total number of coil windings 79.

[0025] In another possible realization of a pump, the power supply 1 may comprise a piezo-power generation assembly. Instead of utilizing compressed air, the piezo-power generation assembly may utilize the vibration or movement of the pump 10 while operating to generate electrical power. The power supply 1 may comprise a piezoelectric material. The vibration of the pump 10 during operation of the pump 10 may both stress and strain the piezoelectric material. As is known in the art, when subjected to the stress/strain, the piezoelectric material produces electrical charge on its surface. The vibration of the pump 10 may cause the piezoelectric material to produce an AC current due to the piezoelectric material producing a charge traveling in one direction when the piezoelectric material is subjected to stress and a charge traveling in the opposite direction when the piezoelectric material is subjected to strain. In one embodiment, the alternating current generated by the power supply 1 may be transformed to direct current by the bridge rectifier 81 as is known in the art.

[0026] With reference now to FIGURE 7, the power supply 1 may be adapted to supply electrical power independently from the operation of the pump 10. In one embodiment, a valve 85 may be positioned in fluid communication with the compressed air entering the pump 10 through pump inlet 15. The valve 85 may allow for compressed air to be selectively supplied to the power supply 1 while preventing compressed air from being supplied to components of the pump 10 thereby preventing the operation of the pump 10 (i.e., the first and second diaphragm chambers 21, 22) while allowing the power supply 1 to provide electrical power. Additionally, the valve 85 may allow compressed air to be contemporaneously supplied to the pump 10 and the power supply 1 such that the power supply 1 can provide electrical power to one or more components of the pump 10 during operation of the pump 10. Further, the valve 85 may allow compressed air to be supplied to operate the pump 10 while preventing compressed air from being supplied to the power supply 1 thereby preventing the power supply 1 from providing electrical power during the operation of the pump 10. The valve 85 may comprise a valve that can be manually actuated by an operator and/or may comprise a valve that can be selectively actuated by a controller, not shown, in accordance with preprogrammed instructions contained in a memory portion, not shown, of the controller, as is well known in the art. The electrical power supplied by the power supply 1 may be used to power various electrical components of the pump 10 during periods in which the pump 10 is not currently operating. In one embodiment, the pump 10 may comprise a rechargeable battery, not shown, utilized to supply electrical power to one or more components of the pump 10 that is supplied electrical power by the power supply 1 to recharge the rechargeable battery, not shown. In a more specific embodiment, upon termination of operation of the pump 10, the controller, not shown, may control the valve 85 to supply compressed air to the power supply 1 while preventing compressed air from being supplied to operate the pump 10 to cause the power supply 1 to supply electrical power that is utilized to recharge the rechargeable battery, not shown. Upon determining that the rechargeable battery, not shown, is fully charged, the controller, not shown, may control the valve 85 to prevent compress air from being further supplied to the power supply 1. In another embodiment, the power supply 1 may supply electrical power that is utilized to power various diagnostic or ancillary components of the pump 10. In one embodiment, the power supply 1 may supply electrical power to devices that provide diagnostic information relating to the operation of the pump 10, such as, for example, a pump cycle counter, a failure detection device, a device for determining pump speed, or any other device for providing pump diagnostic information chosen with sound judgment by a person of ordinary skill in the art.

[0027] The embodiments have been described, hereinabove. It will be apparent to those skilled in the art that the above methods and apparatuses may incorporate changes and modifications. It is intended to include all such modifications and alterations in so far as they come within the scope of the appended claims.

Claims

1. A pump (10) comprising:

a first diaphragm assembly, wherein the first diaphragm assembly is disposed in a first chamber and includes a first diaphragm forming a first pumping chamber and a first diaphragm chamber (21) within the first chamber;
a second diaphragm assembly, wherein the second diaphragm assembly is disposed in a second chamber and includes a second diaphragm forming a second pumping chamber and a second diaphragm chamber (22) within the second chamber, wherein a connecting rod (30) is operatively connected to the first and the second diaphragms and allows the first and the second diaphragm assemblies to reciprocate together between a first diaphragm position and a second diaphragm position;
a center section, wherein the center section at least partially causes compressed air to be alternately supplied to or exhausted from the first and the second diaphragm chambers (21, 22), **characterized by**:
an integrated power supply (1), wherein the integrated power supply (1) utilizes compressed air supplied to the pump (10) to supply power to at least a first component of the pump (10), wherein
the integrated power supply (1) comprises:
an impeller (71);
a gear reduction assembly; and,
an alternator having a rotor (73) and a stator (74),
wherein at least a portion of the compressed air entering into the pump (10) passes over the impeller (71) and causes the impeller (71) to rotate at a first velocity and generate a first torque,

wherein the impeller (71) is operatively connected to the gear reduction assembly,
wherein the gear reduction assembly causes the rotor (73) to rotate at a second velocity and generate a second torque.

2. The pump (10) of claim 1, wherein the integrated power supply (1) generates an alternating current or a direct current.

3. The pump (10) of claim 1, wherein the integrated power supply (1) further comprises:

a regulator (83), wherein the regulator (83) regulates flow of compressed air across the impeller (71).

4. The pump (10) of claim 1, wherein the integrated power supply (1) further comprises:

a bridge rectifier (81).

5. The pump (10) of claim 1, wherein the alternator comprises:

a plurality of magnets (78) coupled to the stator (74); and
a coil winding coupled to the rotor (73).

6. A method for supplying power to a pump (10), the method comprising the steps of:

providing a first diaphragm assembly, wherein the first diaphragm assembly is disposed in a first chamber and includes a first diaphragm forming a first pumping chamber and a first diaphragm chamber (21) within the first chamber; a second diaphragm assembly, wherein the second diaphragm assembly is disposed in a second chamber and includes a second diaphragm forming a second pumping chamber and a second diaphragm chamber (22) within the second chamber, wherein a connecting rod (30) is operatively connected to the first and the second diaphragms and allows the first and the second diaphragm assemblies to reciprocate together between a first diaphragm position and a second diaphragm position; a center section, wherein the center section at least partially causes compressed air to be alternately supplied to or exhausted from the first and the second diaphragm chambers (21, 22), **characterized by** an integrated power supply (1); the method **characterized by**:

generating electrical power, wherein the integrated power supply (1) generates electrical power utilizing compressed air supplied to the pump (10), wherein the integrated power supply (1) comprises:

an impeller (71);
a gear reduction assembly, the impeller (71) operatively connected to the gear reduction assembly; and,

an alternator, the method further comprising the steps of:

passing air entering into the pump (10) over the impeller (71);
rotating the impeller (71) at a first velocity;
generating a first torque,
rotating a rotor (73) at a second velocity via the gear reduction assembly; and
generating a second torque.

7. The method of claim 6, further comprising the step of:

generating alternating current or direct current to supply power to a pump component.

8. The method of claim 6, wherein the integrated power supply (1) further comprises a regulator (83), the method further comprising the step of:

regulating flow of compressed air across the impeller (71).

9. The method of claim 6, wherein the integrated power supply (1) further comprises:

a bridge rectifier (81).

Patentansprüche

1. Pumpe (10), umfassend:

eine erste Membranbaugruppe, wobei die erste Membranbaugruppe in einer ersten Kammer angeordnet ist und eine erste Membran umfasst, die eine erste Pumpenkammer und eine erste Membrankammer (21) innerhalb der ersten Kammer bildet;
eine zweite Membranbaugruppe, wobei die zweite Membranbaugruppe in einer zweiten Kammer angeordnet ist und eine zweite Membran umfasst, die eine zweite Pumpenkammer und eine zweite Membrankammer (22) innerhalb der zweiten Kammer bildet, wobei eine Verbindungsstange (30) mit der ersten und der zweiten Membran funktional verbunden ist und ein gemeinsames Hin- und Herbewegen der ersten und der zweiten Membranbaugruppe

zwischen einer ersten Membranposition und einer zweiten Membranposition ermöglicht;
einen Mittelabschnitt, wobei der Mittelabschnitt wenigstens teilweise bewirkt, dass Druckluft der ersten und der zweiten Membrankammer (21, 22) abwechselnd zugeführt oder daraus abgelassen wird,

gekennzeichnet durch:

eine integrierte Energieversorgung (1), wobei die integrierte Energieversorgung (1) der Pumpe (10) zugeführte Druckluft verwendet, um wenigstens einer ersten Komponente der Pumpe (10) Energie zuzuführen,

wobei

die integrierte Energieversorgung (1) Folgendes umfasst:
ein Laufrad (71);
eine Untersetzungsbaugruppe und
einen Generator mit einem Rotor (73) und einem Stator (74),
wobei wenigstens ein Teil der in die Pumpe (10) gelangenden Druckluft über das Laufrad (71) gelangt und bewirkt, dass sich das Laufrad (71) mit einer ersten Drehzahl dreht und ein erstes Drehmoment erzeugt,
wobei das Laufrad (71) mit der Untersetzungsbaugruppe funktional verbunden ist,
wobei die Untersetzungsbaugruppe bewirkt, dass sich der Rotor (73) mit einer zweiten Drehzahl dreht und ein zweites Drehmoment erzeugt.

2. Pumpe (10) nach Anspruch 1, wobei die integrierte Energieversorgung (1) einen Wechselstrom oder einen Gleichstrom erzeugt.

3. Pumpe (10) nach Anspruch 1, wobei die integrierte Energieversorgung (1) weiterhin Folgendes umfasst:

einen Regler (83), wobei der Regler (83) den Druckluftfluss durch das Laufrad (71) steuert oder regelt.

4. Pumpe (10) nach Anspruch 1, wobei die integrierte Energieversorgung (1) weiterhin Folgendes umfasst:

einen Brückengleichrichter (81).

5. Pumpe (10) nach Anspruch 1, wobei der Generator Folgendes umfasst:

eine Mehrzahl von mit dem Stator (74) gekoppelten Magneten (78) und
eine mit dem Rotor (73) gekoppelte Spulenwicklung.

6. Verfahren zur Zuführung von Energie zu einer Pumpe (10), wobei das Verfahren die folgenden Schritte umfasst:

Bereitstellen einer ersten Membranbaugruppe, wobei die erste Membranbaugruppe in einer ersten Kammer angeordnet ist und eine erste Membran umfasst, die eine erste Pumpenkammer und eine erste Membrankammer (21) innerhalb der ersten Kammer bildet; Bereitstellen einer zweiten Membranbaugruppe, wobei die zweite Membranbaugruppe in einer zweiten Kammer angeordnet ist und eine zweite Membran umfasst, die eine zweite Pumpenkammer und eine zweite Membrankammer (22) innerhalb der zweiten Kammer bildet, wobei eine Verbindungsstange (30) mit der ersten und der zweiten Membran funktional verbunden ist und ein gemeinsames Hin- und Herbewegen der ersten und der zweiten Membranbaugruppe zwischen einer ersten Membranposition und einer zweiten Membranposition ermöglicht; Bereitstellen eines Mittelabschnitts, wobei der Mittelabschnitt wenigstens teilweise bewirkt, dass Druckluft der ersten und der zweiten Membrankammer (21, 22) abwechselnd zugeführt oder daraus abgelassen wird, **gekennzeichnet durch** eine integrierte Energieversorgung (1); wobei das Verfahren **gekennzeichnet ist durch**:

das Erzeugen von elektrischer Energie, wobei die integrierte Energieversorgung (1) elektrische Energie erzeugt, indem sie der Pumpe (10) zugeführte Druckluft verwendet, wobei die integrierte Energieversorgung (1) Folgendes umfasst:

ein Laufrad (71);
eine Untersetzungsbaugruppe, wobei das Laufrad (71) mit der Untersetzungsbaugruppe funktional verbunden ist; und

einen Generator, wobei das Verfahren weiterhin die folgenden Schritte umfasst:

Leiten von in die Pumpe (10) eindringender Luft über das Laufrad (71);
Drehen des Laufrades (71) mit einer ersten Drehzahl;
Erzeugen eines ersten Drehmoments,
Drehen eines Rotors (73) mit einer zweiten Drehzahl über die Unterset-

zungsbaugruppe und Erzeugen eines zweiten Drehmoments.

7. Verfahren nach Anspruch 6, weiterhin umfassend den Schritt des:

Erzeugens von Wechselstrom oder Gleichstrom, um einer Pumpenkomponente Energie zuzuführen.

8. Verfahren nach Anspruch 6, wobei die integrierte Energieversorgung (1) weiterhin einen Regler (83) umfasst, wobei das Verfahren weiterhin den Schritt des:

Regelns des Druckluftflusses über das Laufrad (71)
umfasst.

9. Verfahren nach Anspruch 6, wobei die integrierte Energieversorgung (1) weiterhin Folgendes umfasst:

einen Brückengleichrichter (81).

Revendications

1. Pompe (10) comprenant :

un premier assemblage de diaphragme, le premier assemblage de diaphragme étant disposé dans une première chambre et incluant un premier diaphragme formant une première chambre de pompage et une première chambre de diaphragme (21) dans la première chambre ;
un second assemblage de diaphragme, le second assemblage de diaphragme étant disposé dans une seconde chambre et incluant un second diaphragme formant une seconde chambre de pompage et une seconde chambre de diaphragme (22) dans la seconde chambre, une tige de liaison (30) étant reliée fonctionnellement aux premier et second diaphragmes et permettant aux premier et second assemblages de diaphragme d'avoir ensemble un mouvement de va-et-vient entre une première position de diaphragme et une seconde position de diaphragme ;
une partie centrale, la partie centrale provoquant au moins partiellement alternativement la fourniture d'air comprimé aux première et seconde chambres de diaphragme (21, 22) et l'évacuation d'air comprimé des première et seconde chambres de diaphragme (21, 22),

caractérisée par :

une alimentation électrique intégrée (1), l'alimentation électrique intégrée (1) utilisant de l'air comprimé fourni à la pompe (10) pour alimenter au moins un premier composant de la pompe (10),
l'alimentation électrique intégrée (1) comprenant :

une roue à aubes (71) ;
un assemblage de réduction de vitesse ; et
un alternateur ayant un rotor (73) et un stator (74),
au moins une partie de l'air comprimé entrant dans la pompe (10) étant envoyée contre la roue à aubes (71) et amenant la roue à aubes (71) à tourner à une première vitesse et à produire un premier couple,
la roue à aubes (71) étant reliée fonctionnellement à l'assemblage de réduction de vitesse,
l'assemblage de réduction de vitesse amenant le rotor (73) à tourner à une seconde vitesse et à produire un second couple.

2. Pompe (10) selon la revendication 1, dans laquelle l'alimentation électrique intégrée (1) produit un courant alternatif ou un courant continu.

3. Pompe (10) selon la revendication 1, dans laquelle l'alimentation électrique intégrée (1) comprend en outre :

un régulateur (83), le régulateur (83) régulant le flux d'air comprimé à travers la roue à aubes (71).

4. Pompe (10) selon la revendication 1, dans laquelle l'alimentation électrique intégrée (1) comprend en outre :

un pont redresseur (81).

5. Pompe (10) selon la revendication 1, dans laquelle l'alternateur comprend :

une pluralité d'aimants (78) couplés au stator (74) ; et
une bobine couplée au rotor (73).

6. Procédé pour alimenter une pompe (10), le procédé comprenant les étapes suivantes :

prévoir un premier assemblage de diaphragme, le premier assemblage de diaphragme étant disposé dans une première chambre et incluant un premier diaphragme formant une première chambre de pompage et une première chambre de diaphragme (21) dans la première chambre ;
un second assemblage de diaphragme, le second assemblage de diaphragme étant disposé

dans une seconde chambre et incluant un second diaphragme formant une seconde chambre de pompage et une seconde chambre de diaphragme (22) dans la seconde chambre, une tige de liaison (30) étant reliée fonctionnellement aux premier et second diaphragmes et permettant aux premier et second assemblages de diaphragme d'avoir ensemble un mouvement de va-et-vient entre une première position de diaphragme et une seconde position de diaphragme ; une partie centrale, la partie centrale provoquant au moins partiellement alternativement la fourniture d'air comprimé aux première et seconde chambres de diaphragme (21, 22) et l'évacuation d'air comprimé des première et seconde chambres de diaphragme (21, 22), **caractérisé par** une alimentation électrique intégrée (1), le procédé étant **caractérisé par** :
le fait de produire de l'énergie électrique, l'alimentation électrique intégrée (1) produisant de l'énergie électrique en utilisant de l'air comprimé fourni à la pompe (10), l'alimentation électrique intégrée (1) comprenant :

une roue à aubes (71) ;
un assemblage de réduction de vitesse, la roue à aubes (71) étant fonctionnellement reliée à l'assemblage de réduction de vitesse ; et
un alternateur, le procédé comprenant en outre les étapes suivantes :

envoyer de l'air entrant dans la pompe (10) contre la roue à aubes (71) ;
faire tourner la roue à aubes (71) à une première vitesse ;
produire un premier couple,
faire tourner un rotor (73) à une seconde vitesse via l'assemblage de réduction de vitesse ; et produire un second couple.

7. Procédé selon la revendication 6, comprenant en outre l'étape suivante :

produire du courant alternatif ou du courant continu pour alimenter un composant de la pompe.

8. Procédé selon la revendication 6, dans lequel l'alimentation électrique intégrée (1) comprend en outre un régulateur (83), le procédé comprenant en outre l'étape suivante :

réguler le flux d'air comprimé à travers la roue à aubes (71).

9. Procédé selon la revendication 6, dans lequel l'alimentation électrique intégrée (1) comprend en outre :

un pont redresseur (81).

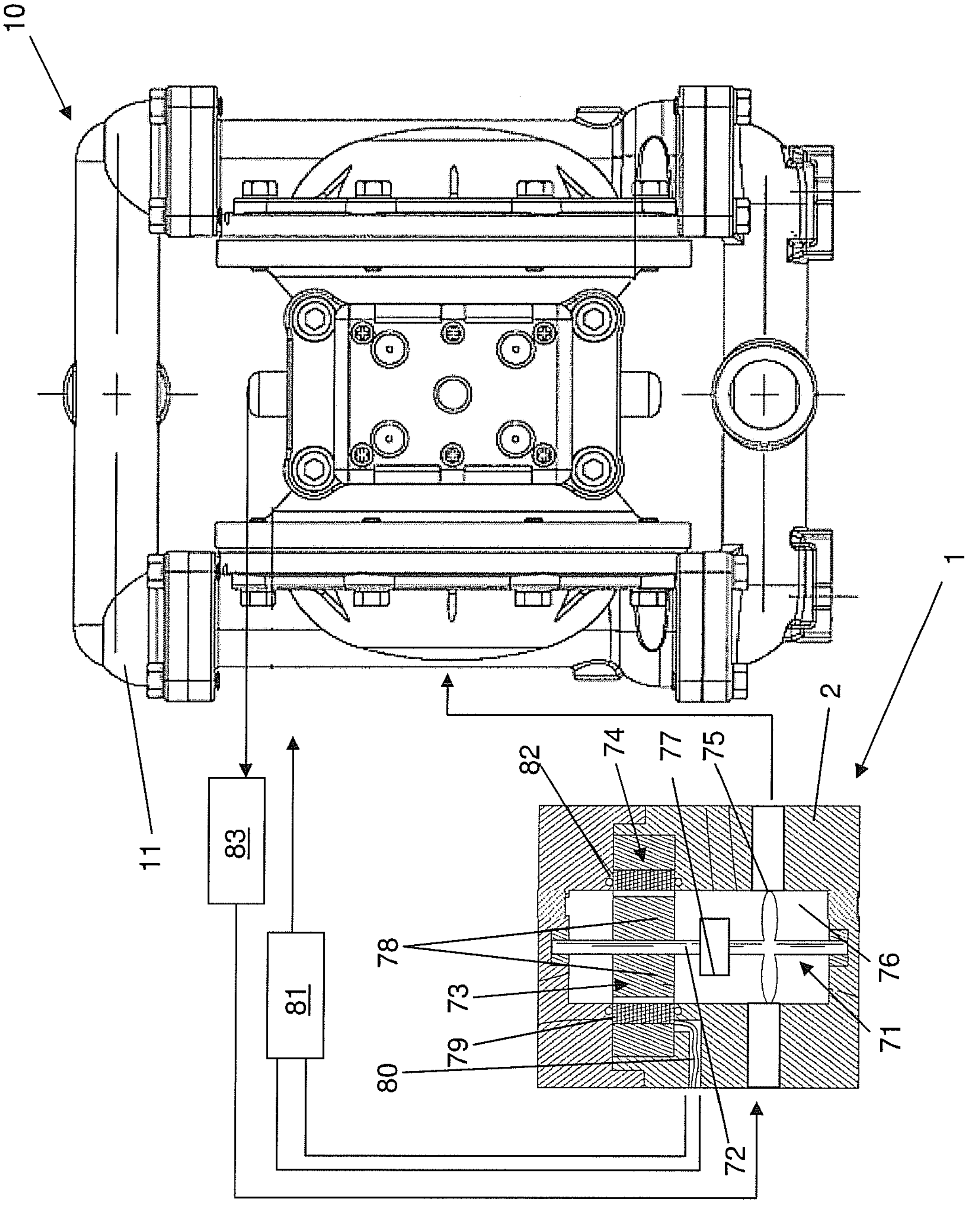

Fig. – 1

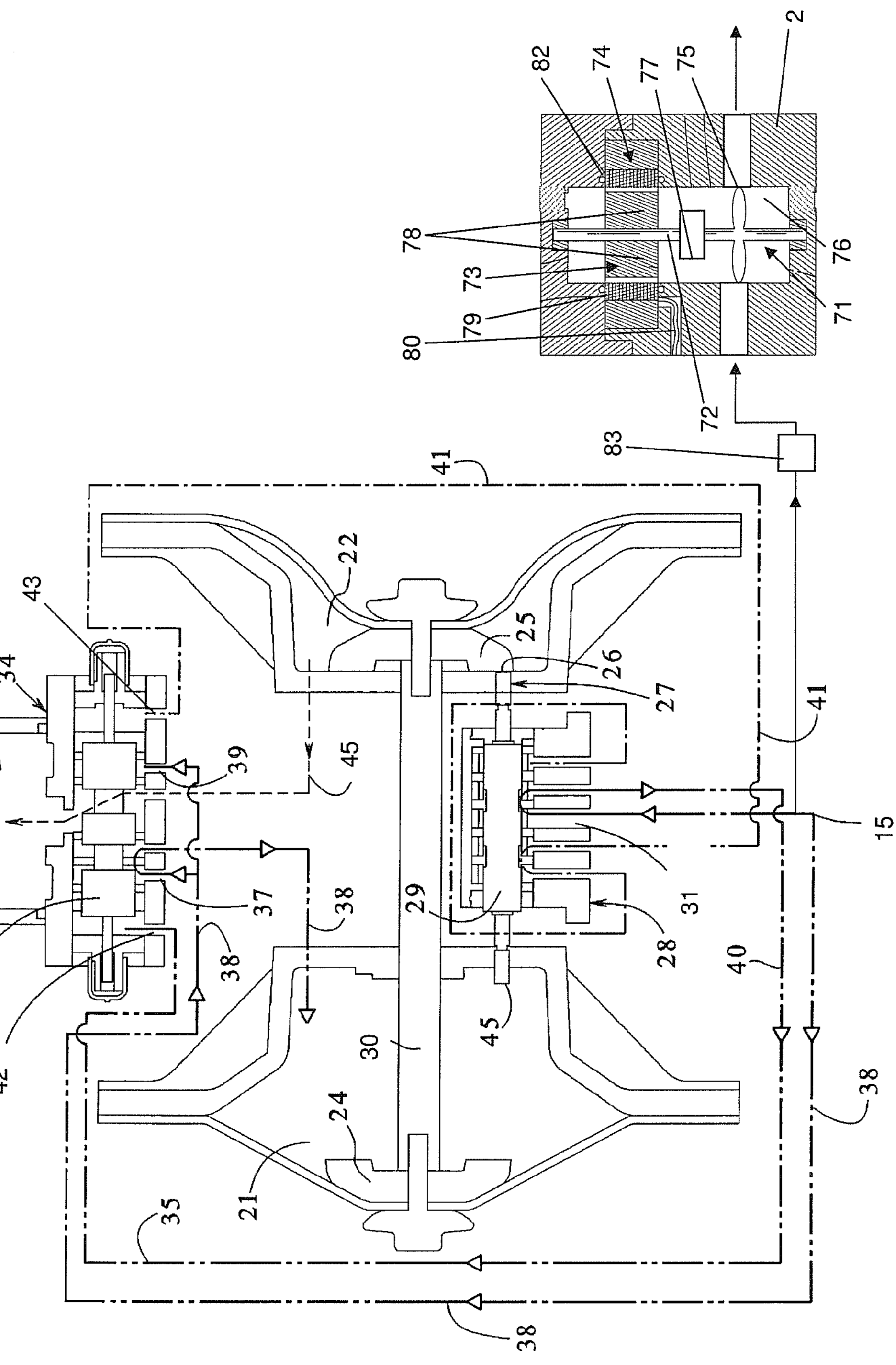
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Fig. – 2

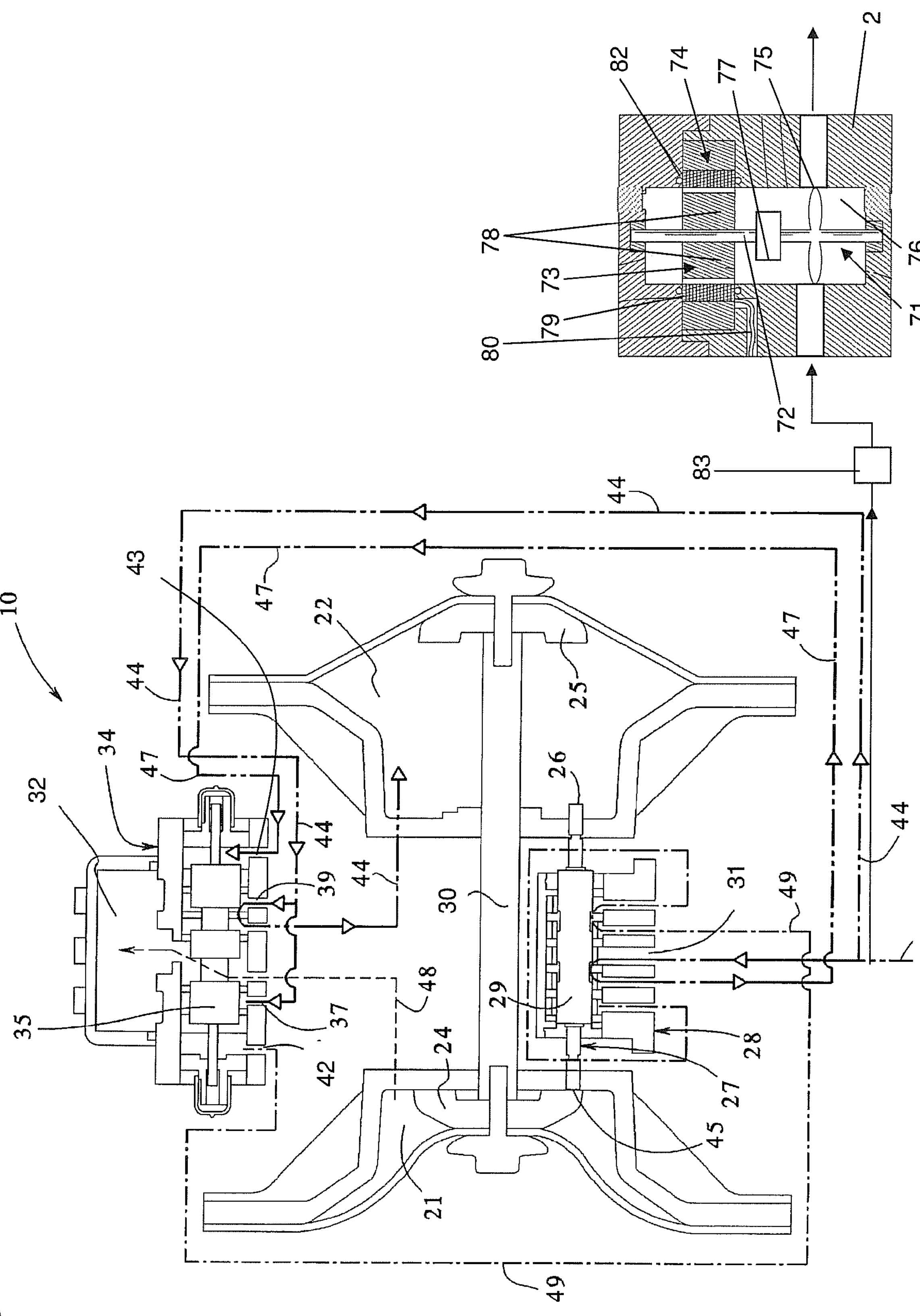
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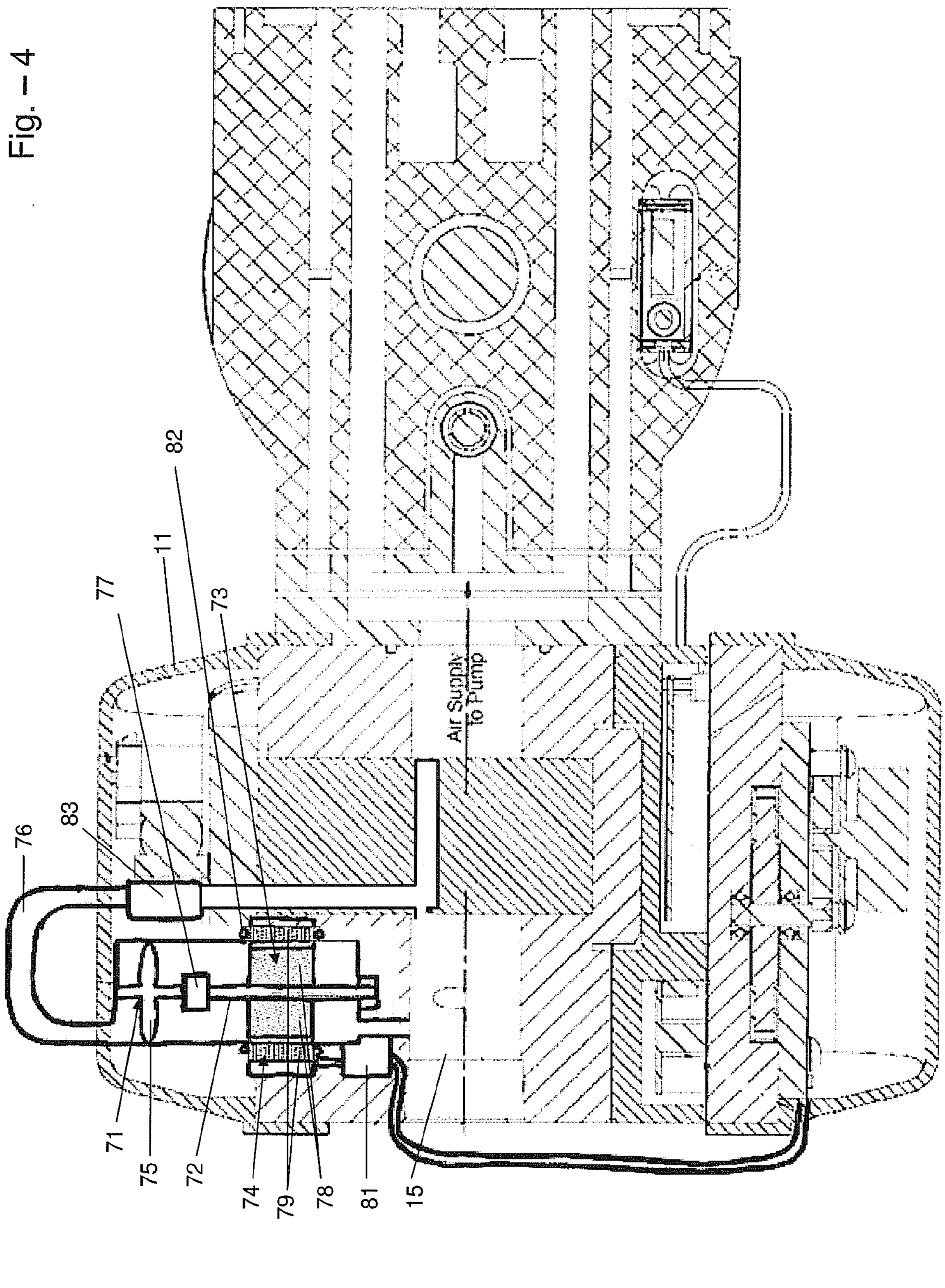
Fig. – 3

Fig. – 4



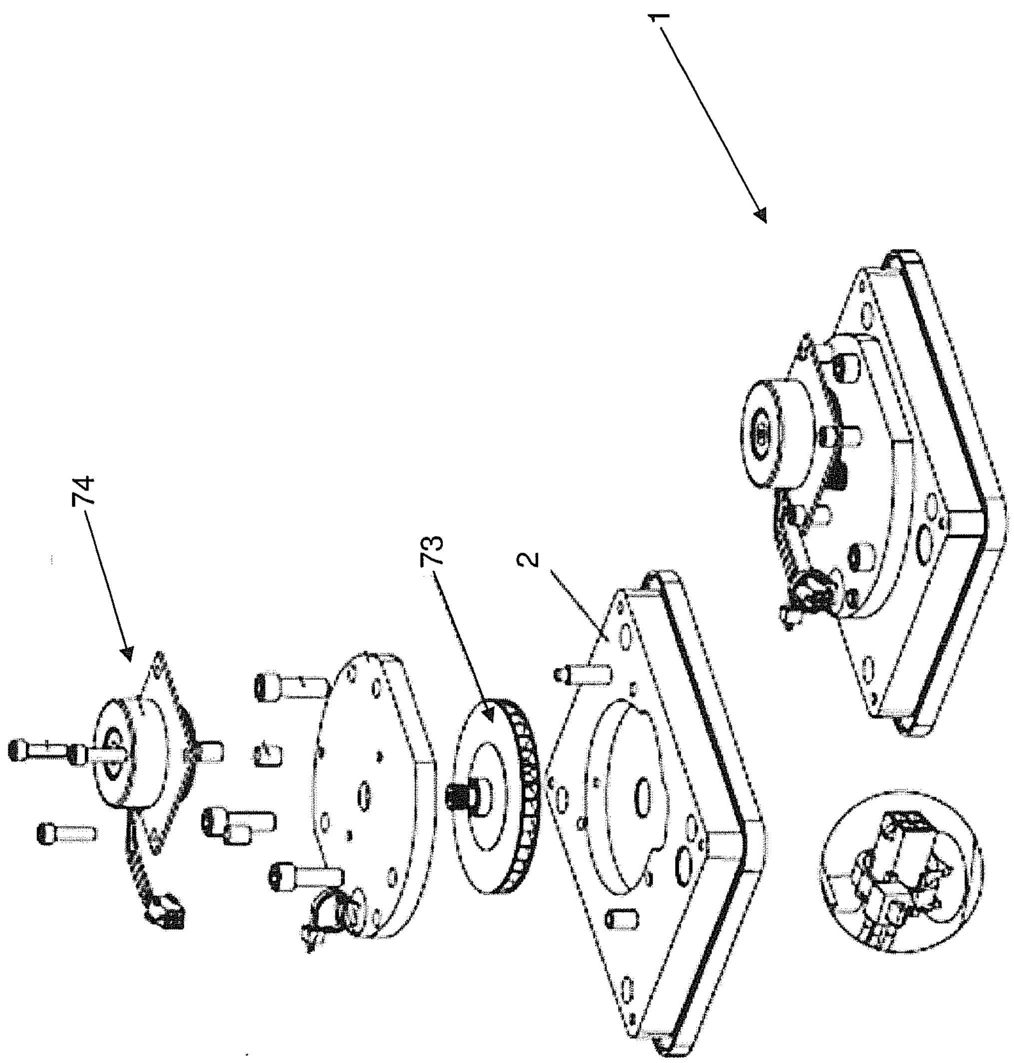


Fig. – 5

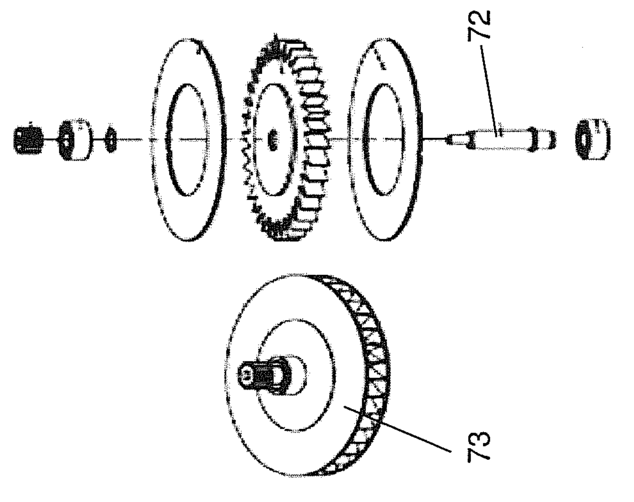


Fig. – 6A

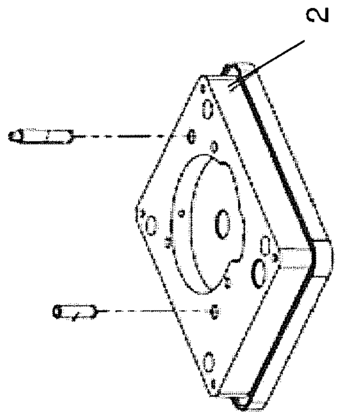


Fig. – 6B

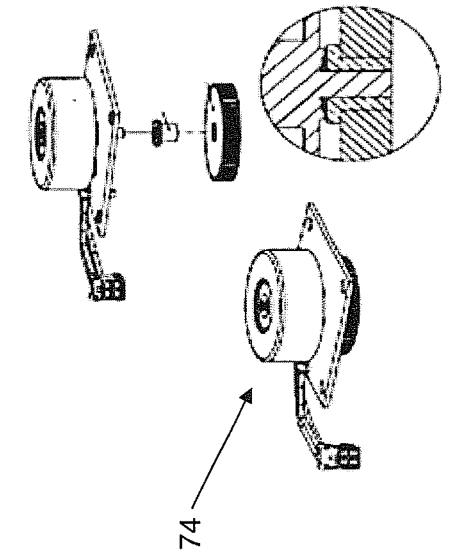


Fig. – 6C

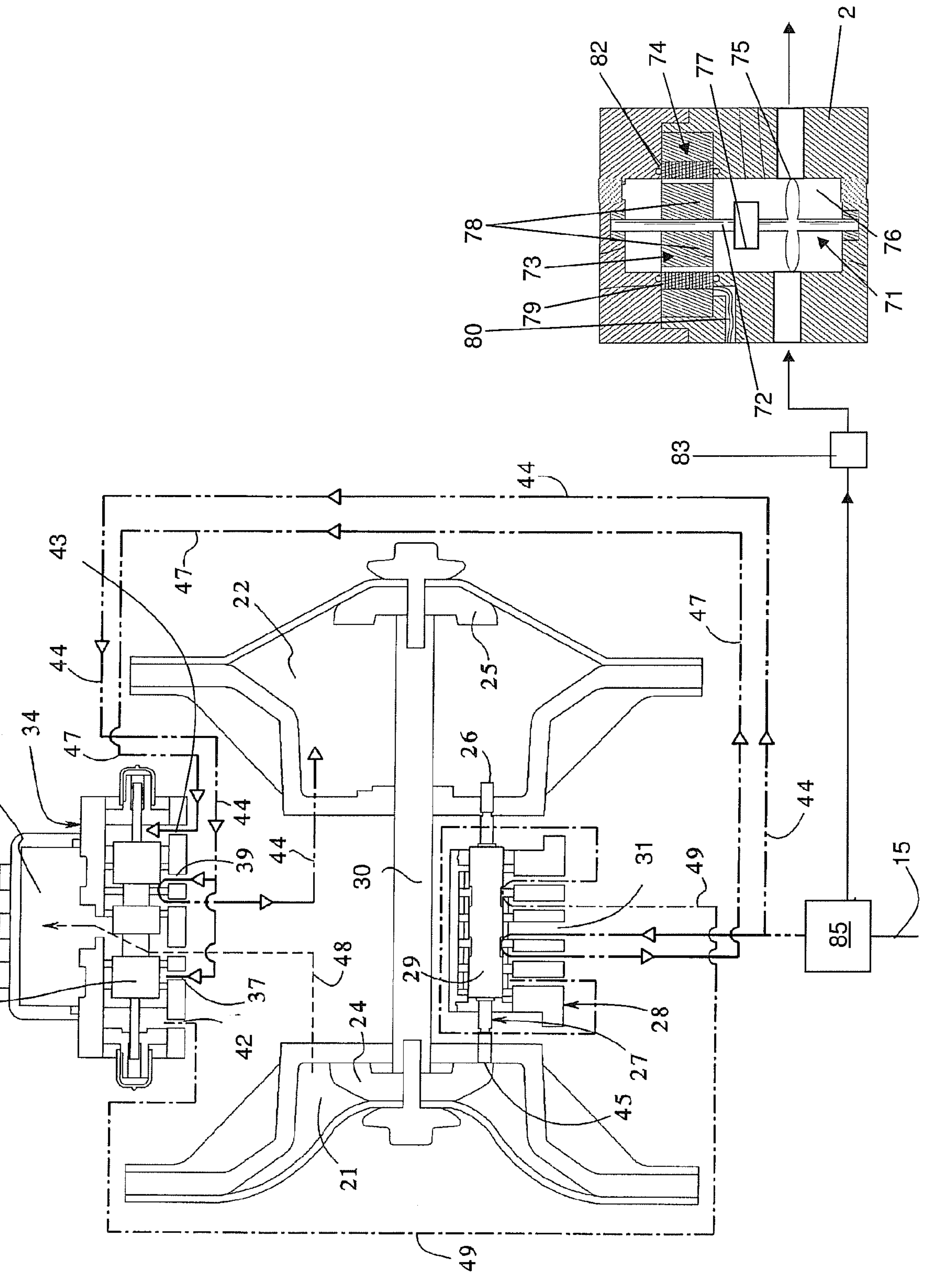

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Fig. – 7

REFERENCES CITED IN THE DESCRIPTION

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