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(54) **Vibration pump**

(57) A vibration pump, comprising a coil (7) of a known type that is provided with a rectilinear solenoid winding and first and second valve means (3, 5) for controlling the flow of the passing fluid respectively in a suction duct (2b) and in a delivery duct (11a). Inside the coil (7) and coaxially thereto, a moving core (9) made of ferromagnetic material is provided, which can perform an axial translational motion with respect to the coil. The pump according to the present invention is characterized in that it comprises a fixed core (11), also made of ferromagnetic material and is adapted to increase the magnetic induction of the circuit and capable of acting as a magnetic attraction pole for the moving core (9). The pump is also characterized in that the second valve means (5) are arranged inside the moving core (9).

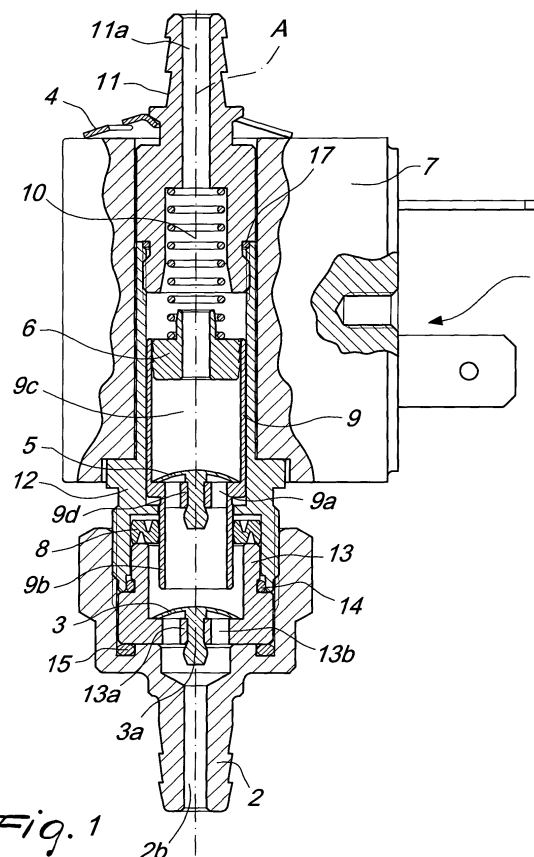


Fig. 1

Description

[0001] The present invention relates to a vibration pump adapted to increase the pressure of a liquid in a duct.

[0002] Among the various known devices suitable for the purpose of increasing the pressure of a liquid in a duct, vibration pumps are very inexpensive and compact as well as simple in their operating principle and therefore in their manufacture, and this makes them reliable. However, they are not able to generate high pressures and therefore are generally characterized by relatively modest heads.

[0003] It is known that the operating principle on which these devices are based is the use of the action of an alternating magnetic field generated by the electric current that flows through a circuit.

[0004] The most suitable circuit, and therefore the one most widely used to generate a magnetic field H , is the circuit constituted by a solenoid with a number N of turns, i.e., a conductor in which the electric current i that flows through it makes a number N of complete turns in the same direction. The magnetomotive force f_{mm} is the product $N \cdot i$ and indicates that the force associated with the magnetic field is proportional both to the intensity of the current i and to the number N of turns of the solenoid winding.

[0005] If the solenoid has the classic rectilinear shape, the magnetomotive force f_{mm} generated by the current that flows through it acts in the internal axial region of the rectilinear solenoid. In this region, in practice, a magnetic field is generated which is similar to the one generated by the presence of a pair of magnetic poles N-S, whose orientation depends, in a known manner, on the direction in which the current i flows through the solenoid.

[0006] The conventional devices that constitute the background art of vibration pumps provide for the presence of a so-called moving core, i.e., an element made of ferromagnetic material, which is arranged inside a rectilinear solenoid as described above and is crossed by a current i .

[0007] Said moving core, conveniently arranged inside a guiding element, which can be for example sleeve-shaped, is induced to move in accordance with said f_{mm} . Clearly, since the magnetomotive force f_{mm} is a vector quantity and so is the current i that generates it, if the current i is a direct current, the magnetomotive force f_{mm} is unidirectional, whereas if the current i is a sinusoidal alternating current, the magnetomotive force f_{mm} that it generates is likewise of the sinusoidal alternating type.

[0008] The presence of an alternating magnetomotive force f_{mm} inside the solenoid winding causes the moving core to perform an alternating translational motion inside said solenoid.

[0009] In practice, therefore, an alternating current produces a back-and-forth motion of the moving core,

and this motion can be conveniently utilized to provide the suction-pressure effect of a vibration pump in which the moving core assumes the function of a suction and delivery piston.

5 [0010] As mentioned initially, known devices that use this operating principle are not devoid of drawbacks, particularly as regards the low values of the delivery pressure and of the head. To obtain higher values of the delivery pressure, it is necessary to increase the magnetomotive force f_{mm} , thus by acting with an increase in the power supply current of the solenoid and/or by increasing the number of turns thereof. This entails the drawback of ultimately having devices with very large and bulky solenoids due to the large number of turns N and of having to keep the value of the electric resistance low even with high currents i in the solenoid.

10 [0011] In order to obviate these drawbacks, it is possible to increase the value of the magnetic induction B without increasing the power and the weight of the windings of the solenoid (or coil). In order to achieve this goal, it is sufficient to remember that the value of the magnetic induction B , i.e., the effect of the magnetic field H , is given by

$$25 \quad B = \mu_r \cdot \mu_0 \cdot H$$

where H is the value of the magnetic field
 μ_0 is the value of the magnetic permeability of vacuum
 30 ($\mu_0 = 4 \cdot 10^{-7}$)

μ_r is the value of the relative magnetic permeability of the medium in which the magnetic induction is generated.

35 [0012] Ferromagnetic materials have values of μ_r that can reach into the tens of thousands, and therefore the presence of an appropriately selected ferromagnetic material arranged inside the magnetic field H generated by a solenoid increases the value of said induction.

40 [0013] One solution adopted in known devices to further increase the effectiveness of the magnetic induction B consists in placing cylindrical bushes of ferromagnetic material proximate to the ends of the solenoid and coaxially to said solenoid. Said magnetic bushes increase the N-S polarization effect of the magnetic field, increasing the traction force that acts on the moving core that can slide inside the solenoid and inside said magnetic bushes. This increases the suction-pressure effect of the pump.

45 [0014] Conventional solutions for oscillating piston pumps have fluid flow control means, i.e., flow control or on-off valves that alternately control or cut off the intake and the outlet and are arranged respectively near the suction and delivery ducts or are both arranged near just one of the ducts, either the suction duct or the delivery duct, and are also arranged outside the solenoid of the coil.

50 [0015] The fluid flow control valves are usually kept in the sealing position by springs that have an appropri-

ately selected rigidity.

[0016] Other drawbacks affect also the devices of the background art that use the solutions described above. Among these drawbacks, it is certainly possible to include constructive complexity, since the two ferromagnetic bushes must be arranged at the ends of the solenoid and must be separated each other by a third annular element, termed spacer, which is fitted coaxially to the two bushes and is made of diamagnetic material, for example plastics. Moreover, an evident need is felt to create appropriately provided coils that are specific for the application, i.e., capable of accommodating the ferromagnetic bushes, the cylindrical sleeve of the pump and the moving core, while the motion of the flow control valves is determined exclusively by the compression/decompression cycles of the fluid without utilizing the inertia forces generated by the reciprocating motion of the oscillating component.

[0017] Another drawback that affects the background art is the presence of the springs required to keep or return the fluid flow control valves in the sealing position, both at the intake and at the delivery.

[0018] The need to provide said springs increases the complexity of the design of known types of oscillating piston pumps and also requires the appropriate sizing of these components and the provision of suitable seats to accommodate them.

[0019] Another drawback of the use of sealing springs is that it is necessary to maintain the coaxial arrangement of said spring with respect to the corresponding gasket associated therewith, which can be for example mushroom-shaped. The need to have a correct alignment of the spring with the corresponding gasket increases the complexity of the steps for the assembly of the device.

[0020] Another drawback of vibration pumps that use valve assemblies constituted by a spring and a gasket is constituted by the seal of said valves when the pump is off. The springs of the sealing valves must in fact be deformable enough to allow said valve to open simply by way of the interplay of pressures. This functional requirement leads to the fact that said springs cannot have a very high elastic constant and therefore a very high rigidity. This entails that when the pump is off, and therefore the pressure of the fluid does not assist the closing action performed by the spring, seepage or dripping can occur.

[0021] Some conventional devices use, as intake and delivery valves, mushroom-shaped gaskets mounted on the sealing springs described above. These mushroom gaskets have a hemispherical cross-section, which abuts in order to close the intake or delivery duct, respectively, on a surface that is appropriately step-shaped or otherwise provided with a sharp edge. The need to shape the intake and delivery channels, respectively, with sharp edges introduces a further complication in the design of said device. In addition to increasing the complexity of the design of the device, the fact of

having to provide a hemispherical gasket that abuts against a sharp-edged sealing surface further entails the additional disadvantage of making said gasket more exposed to damage; for example, the gaskets can retain the impression of the metallic sealing seat, and if said impression no longer mates exactly with the corresponding seat, for example due to axial misalignments of said gasket, sealing problems can arise.

[0022] The aim of the present invention is to provide a vibration pump that is capable of eliminating or reducing the drawbacks mentioned above.

[0023] Within this aim, an object of the present invention is to provide a vibration pump that has no ferromagnetic bushes, at the same time achieving the same function performed by said bushes in increasing magnetic induction.

[0024] Another object of the present invention is to provide a vibration pump device that is based on the operating principle of electric valves, so that it is possible to provide synergies and economies of scale that can be utilized in industrial production.

[0025] This aim and these and other objects that will become better apparent hereinafter are achieved by a vibration pump that comprises a coil of a known type that is provided with a rectilinear solenoid winding of N turns with a longitudinal axis, a suction duct that is coaxial to said longitudinal axis, a delivery duct that is also coaxial to said longitudinal axis, first and second valve means adapted to control the flow of the passing fluid respectively in the suction duct and in the delivery duct, further comprising, inside the coil and coaxially thereto, a moving core made of ferromagnetic material, which comprises a duct of the moving core that is closed at its upper end by an insert provided with an axial duct. The moving core is supported by a sleeve that is made of a non-ferromagnetic material and is also coaxial to the coil, and the core is free to move axially inside the sleeve. The vibration pump according to the present invention is characterized in that it further comprises a fixed core, which is also made of ferromagnetic material and is arranged at one of the ends of the solenoid of the coil and is adapted to increase the magnetic induction of the circuit when the coil is crossed by an electric current i , the fixed core being further capable of acting as a magnetic attraction pole for the moving core, and is further characterized in that the second valve means are arranged inside the moving core.

[0026] Further characteristics and advantages of the invention will become better apparent from the following description of a preferred but not exclusive embodiment of the vibration pump according to the invention, illustrated by way of non-limiting example with reference to the accompanying drawings, wherein:

Figure 1 is a partially sectional front view of the vibration pump according to the invention, with the moving core in the valve closure position;

Figure 1a is a transverse sectional view of the first

umbrella-shaped gasket or suction valve according to the invention;

Figure 1b is a transverse sectional view of the second umbrella-shaped gasket or suction valve according to the invention;

Figure 2 is an identical partially sectional front view of the vibration pump according to the invention in the step for suction and simultaneous delivery, with the suction valve open and the delivery valve closed;

Figure 2a is an enlarged-scale view of a detail of Figure 2, illustrating the suction valve in the open position;

Figure 3 is an identical partially sectional front view of the vibration pump according to the invention, during the transfer of the fluid inside the pump, with the delivery valve open and the suction valve closed;

Figure 3a is an enlarged-scale view of a detail of Figure 3, illustrating the delivery valve in the open position;

Figure 4 is an identical partially sectional front view of an electric valve of a known type.

[0027] With reference to Figure 1, the vibration pump 1 according to the invention comprises a coil 7, which is constituted by the winding of N turns, which is supplied with a current i , generating a magnetic field H.

[0028] The coil 7 is preferably constituted by a copper winding, by an armature generally made of galvanized steel, and by insulating parts usually made of plastics, as is known to the person skilled in the art. The coil 7 is preferably keyed or splined and retained by the elastic ring 4 on the sleeve 12, which is made of non-ferromagnetic material, for example brass or plastics, and is screwed onto the suction coupling 2, also made of non-ferromagnetic material.

[0029] With reference to Figure 1, it is possible to identify an axis of symmetry A for the coil 7, which is the longitudinal axis of symmetry of the solenoid winding of N turns. The vibration pump according to the invention has an axial symmetry with respect to the axis of symmetry A of the solenoid, and in particular the flow of liquid occurs in ducts that are coaxial to said axis A.

[0030] A fixed spacer 13, typically made of brass or plastics, is interposed between the sleeve 12 and the suction coupling 2 and forms a seal both on the sleeve 12 and on the suction coupling 2 thanks to the gaskets 14 and 15 of the O-ring type made of elastomer.

[0031] To ensure the flow of the fluid, the spacer 13 is provided axially with a central supporting hole 13a and with a plurality of fluid passage holes 13b, which are arranged around the central hole 13a.

[0032] First valve means are interposed between the suction duct 2b and the spacer 13 inside said spacer 13 and more specifically at the central supporting hole 13a, and are constituted, in the embodiment of Figure 1, by a first gasket 3, preferably made of elastomer, which is

umbrella-shaped, with a stem 3a provided with a bulge 3b at its free end. Said stem 3a is inserted in the central supporting hole 13a until it blocks the first gasket 3 in the correct position, which remains set by the interlocking of the bulge 3b. The upper flap 3c of the umbrella-shaped gasket 3 rests on the internal surface of the spacer 13, so as to cover the fluid passage holes 13b. With this umbrella-shaped configuration of the gasket 3, when the upper flap 3c rests on the fluid passage holes 13b, passage of the fluid from below above said gasket 3 is prevented. In order to allow passage of the fluid, the upper flap 3c must rise, leaving open the fluid passage holes 13b.

[0033] The moving core 9 made of ferromagnetic stainless steel is instead arranged inside the sleeve 12. The moving core 9 is substantially shaped like a hollow cylinder and is provided internally with a chamber or duct 9c. On the bottom of said chamber or duct 9c there is a central supporting hole 9d and there is a plurality of fluid passage holes 9a arranged around the central supporting hole 9d. In order to close said supporting hole 9d, second valve means are provided, which are arranged inside said moving core 9 and are constituted, in the illustrated embodiment, by a second gasket 5, which is fully similar to the first gasket 3. Like the first gasket 3, said second gasket is umbrella-shaped, with a stem 5a that ends with a bulge 5b and an upper flap 5c. Said stem 5a is inserted in the supporting hole 9d until it locks the second gasket 5 in the correct closure position, which is defined by the interlocking of the bulge 5b. The upper flap 5c of the umbrella-shaped gasket 5 rests on the inner surface of the moving core 9 so as to cover the fluid passage holes 9a. With this umbrella-like shape of the second gasket 5, when the upper flap 5c rests on the fluid passage holes 9a, passage of the fluid from below above said gasket 5 is prevented. In order to allow the passage of the fluid, the upper flap 5c must rise, leaving the fluid passage holes 9a open.

[0034] An insert 6, made of ferromagnetic stainless steel in the described embodiment, is provided at the top of the moving core 9 and is stably rigidly coupled inside said moving core 9. The insert 6 is crossed internally by an axial duct 6a, and in addition to closing in an upward region the moving core 9, acts as a support for a spring 10 preferably made of stainless steel.

[0035] In its upper part, the sleeve 12 is closed by the fixed core 11, which also acts as a delivery duct, since it is axially provided with the delivery duct 11a. Said spring 10 acts between the insert 6 rigidly coupled to the moving core 9 and the fixed core 11.

[0036] The seal between the sleeve 12 and the fixed core 11 is ensured by an annular gasket 17, preferably made of PTFE.

[0037] The operating principle of the vibration pump 1 according to the invention is now described with particular reference to the embodiment of Figure 2 and 3.

[0038] The coil 7 is of a known type and is fully similar to the coils used for electric valves. When the coil 7 is

supplied with AC voltage, it generates a magnetic field that moves, likewise with an alternating motion, the moving core 9. The fixed core 11, which also acts as a delivery duct, attracts the moving core 9 due to the magnetic force. Since the current i that flows through the coil 7 is of the alternating type, when the magnetic force generated in the internal region of the solenoid reverses direction, the moving core 9 moves away from the fixed core 11.

[0039] In order to amplify the attraction-repulsion effect, it is possible to use diode means to rectify the supply voltage. In this case, the spring 10, preferably made of stainless steel, is interposed between the moving core 9 and the fixed core 11 and acts along the common axis A of the two cores, contrasting their mutual approach. In this manner, the number of times the moving core 9 is attracted by the fixed core 11 during an operating cycle is doubled, and the spring 10 interposed between the two cores is used to apply the force that mutually spaces said cores. When the spring 10, by compressing due to the approach of the moving core 9 to the fixed core 11, reaches a load that exceeds the traction force applied by the magnetic field, it repels the moving core 9, moving it away from the fixed core 11.

[0040] As is evident from the structure described so far, and as shown in Figure 2, when the moving core 9 approaches the fixed core 11, a partial vacuum is generated above the first gasket 3 arranged inside the spacer 13; in particular, a partial vacuum is generated in the region of the stem 9b of the moving core 9, and a compression is generated in the region above the second gasket 5 accommodated in the moving core 9. The effect of the partial vacuum generated above the first gasket 3 is to aspirate the liquid into the pump through the suction duct 2b, since the approach of the moving core 9 to the fixed core 11 allows the lifting of the upper flap 3c of the first gasket 3, with consequent opening of the fluid passage holes 13b.

[0041] The compression in the region above the second gasket 5 instead pushes the liquid toward the delivery duct 11a, since the second gasket 5 still closes the holes 9a by way of the inertia and of the pressure that acts on the upper flap 5c of the umbrella.

[0042] In the subsequent step, shown in Figure 3, in which the spring 10 moves the moving core 9 away from the fixed core 11, a compression is instead produced in the region above the first gasket 3 and a partial vacuum is generated in the region above the second gasket 5. The effect of the compression is to press the first gasket 3 against its sealing seat, thus closing the fluid passage holes 13b and preventing the reverse flow of water out of the pump through the suction duct 2b. The effect of the partial vacuum in the region above the second gasket 5 is instead to draw water from the volume comprised between the first gasket 3 and the second gasket 5. The inertia and the partial vacuum in fact allow to lift the upper flap 5c of the second gasket 5, consequently opening the fluid passage holes 9a.

[0043] The operating principle as described above, therefore, entails that at every half cycle a transfer of water occurs above the second gasket 5 and in the next half cycle water is transferred or overflowed from this region outside the pump.

[0044] A double-lip elastomer gasket 8, preferably of the self-lubricated type, is further provided above the spacer 13 and ensures the seal between the stem 9b of the moving core 9 and the chamber 12a that is formed in the part below the sleeve 12, and inside which the spacer 13 is keyed. The double-lip gasket 8 is free to perform a translational motion within the portion of the chamber 12a that is comprised between the stem 9b of the moving core 9 and the spacer 13. The shape, position and mobility described for the double-lip gasket 8 optimize the interplay of pressures that leads to the aspiration of the water in the suction duct 2b and to its compression in the delivery duct 11a.

[0045] In particular, during the aspiration of the liquid, the double-lip gasket 8 prevents the liquid located above the second gasket 5 from flowing back downwardly, flowing in the gap between the moving core 9 and the sleeve 12, while during delivery, when the liquid is transferred from the duct 9c above the second gasket 5, it prevents said liquid from being propelled upwardly, passing outside the moving core 9.

[0046] It has been found that the vibration pump thus described allows to eliminate the drawbacks of known kinds of device that are currently in use.

[0047] In particular, the vibration pump described above allows to amplify the effect of the magnetic field generated by the solenoid crossed by current without having to resort to bushes that are coaxial with the sleeve 12. In this manner, the device is smaller, lighter and compact.

[0048] Another advantage of the present invention is that the fixed core 11 is used both as an element for amplifying the magnetic field and as a delivery duct, again achieving an optimization of weights and dimensions, to the benefit of structural simplicity.

[0049] Another advantage consists in that umbrella-shaped gaskets are used as valve means and act according to their deformability and shape, which is studied and sized according to the pressure forces involved.

This, as mentioned, allows to avoid all the drawbacks noted above and associated with the use of valve means supported by elastic springs, above all the size and sealing problems associated with the choice of the rigidity of the springs and the complication of the design of the regions of the pump against which the gasket abuts, with a consequent simplification of the constructive design of said pump and of its assembly.

[0050] Another advantage obtained by means of the vibration pump according to the invention is the fact that it uses coils of the type normally used for similar devices, in particular to provide electric valves, and therefore it is possible to associate the production of the device according to the invention with the production of known

types of device, providing advantageous economies of scale.

[0051] The person skilled in the art can easily appreciate that the vibration pump described above is susceptible of numerous modifications and variations, all of which are within the scope of the inventive concept described above. 5

[0052] Accordingly, the protective scope of the claims must not be limited by the illustrations or by the preferred embodiment presented in the description by way of example, but rather the claims must comprise all the characteristics of patentable novelty that reside within the present invention, including all the characteristics that would be treated as equivalent by the person skilled in the art. 10

[0053] All the details may further be replaced with other technically equivalent elements, and the materials and dimensions may be various according to requirements, provided that they are suitable for the operation of the device as described. 15

[0054] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs. 20 25

Claims 30

1. A vibration pump, comprising a coil (7) of a known type that is provided with a rectilinear solenoid N turn winding with a longitudinal axis (A), a suction duct (2b) that is coaxial to said longitudinal axis (A), a delivery duct (11a) that is also coaxial to said longitudinal axis (A), first and second valve means (3, 5) adapted to control the flow of the passing fluid respectively in the suction duct (2b) and in the delivery duct (11a), further comprising, inside said coil (7) and coaxially thereto, a moving core (9) made of ferromagnetic material, which comprises a duct (9c) of the moving core (9) that is closed at its upper end by an insert (6) provided with an axial duct (6a), said moving core (9) being supported by a sleeve (12) that is made of a non-ferromagnetic material and is also coaxial to said coil (7), said moving core (9) being free to move axially inside said sleeve (12), **characterized in that** it further comprises a fixed core (11), which is also made of ferromagnetic material, is arranged at one of the ends of the solenoid of said coil (7) and is adapted to increase the magnetic induction of the circuit when said coil is crossed by an electric current (i), said fixed core (11) being capable of acting as a magnetic attraction pole for said moving core (9), and **in that** said second valve means (5) are arranged inside said moving core (9). 35 40 45 50 55

2. The vibration pump according to claim 1, **characterized in that** said first valve means (3) and said second valve means (5) are constituted by gaskets, that are preferably made of elastomer and are umbrella-shaped, with a stem (3a, 5a) and an upper flap (3c, 5c).

3. The vibration pump according to claim 2, **characterized in that** each one of said first and second umbrella-shaped gaskets (3, 5) is adapted to enter, with said stem (3a, 5a), a supporting hole (13a, 9d) provided specifically respectively in the region above said suction duct (2b) and in the lower region of said duct (9c) of said moving core (9), each one of said umbrella-shaped gaskets (3, 5) being capable, with said upper flap (3c, 5c) thereof, of closing one or more fluid passage holes (13b, 9a) respectively of the first and second gaskets arranged proximate to said supporting hole (13a, 9d).

4. The vibration pump according to claim 2 or 3, **characterized in that** each one of said first and second umbrella-shaped gaskets (3, 5) further comprises, at the end of said stem (3a, 5a), a bulge (3b, 5b) that is adapted to couple said stem (3a, 5a) in said supporting hole (13a, 9d), so that said upper flap (3c, 5c) closes said fluid passage holes (13b, 9a) when said gasket is in the closed position.

5. The vibration pump according to any one of the preceding claims, wherein said sleeve (12) is closed in an upward region by said fixed core (11), where the seal between said sleeve (12) and said fixed core (11) is ensured by a gasket (17).

6. The vibration pump according to any one of the preceding claims, **characterized in that** said sleeve (12) is stably connected to a suction coupling (2), within which said suction duct (2b) passes, a fixed spacer (13) being further provided between said suction duct (2) and said sleeve (12), said spacer being preferably made of plastics or brass and provided axially with said supporting hole (13a).

7. The vibration pump according to claim 6, **characterized in that** it comprises a gasket (8), which is arranged inside a chamber (12a) provided in the lower part of said sleeve (12) and delimited by said spacer (13), said gasket (8) being adapted to form a seal between said stem (9b) of said moving core (9) and said chamber (12a).

8. The vibration pump according to claim 6, wherein an O-ring gasket (14) is provided between said spacer (13) and said sleeve (12).

9. The vibration pump according to claim 6, wherein an O-ring gasket (15) is provided between said

spacer (13) and said suction coupling (2).

10. The vibration pump according to claim 6, **characterized in that** said spacer is connected to said first gasket (3) by way of a first spring (4).

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11. The vibration pump according to any one of the preceding claims, **characterized in that** said delivery duct (11a) is arranged inside said fixed core (11).

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14. The vibration pump according to any one of the preceding claims, **characterized in that** it comprises a spring (10), which is arranged between said fixed core (11) and said insert (6) of said moving core (9).

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15. The vibration pump according to claim 14, **characterized in that** it comprises, on said coil (7), a diode element that is adapted to rectify the current (i) that supplies said coil (7).

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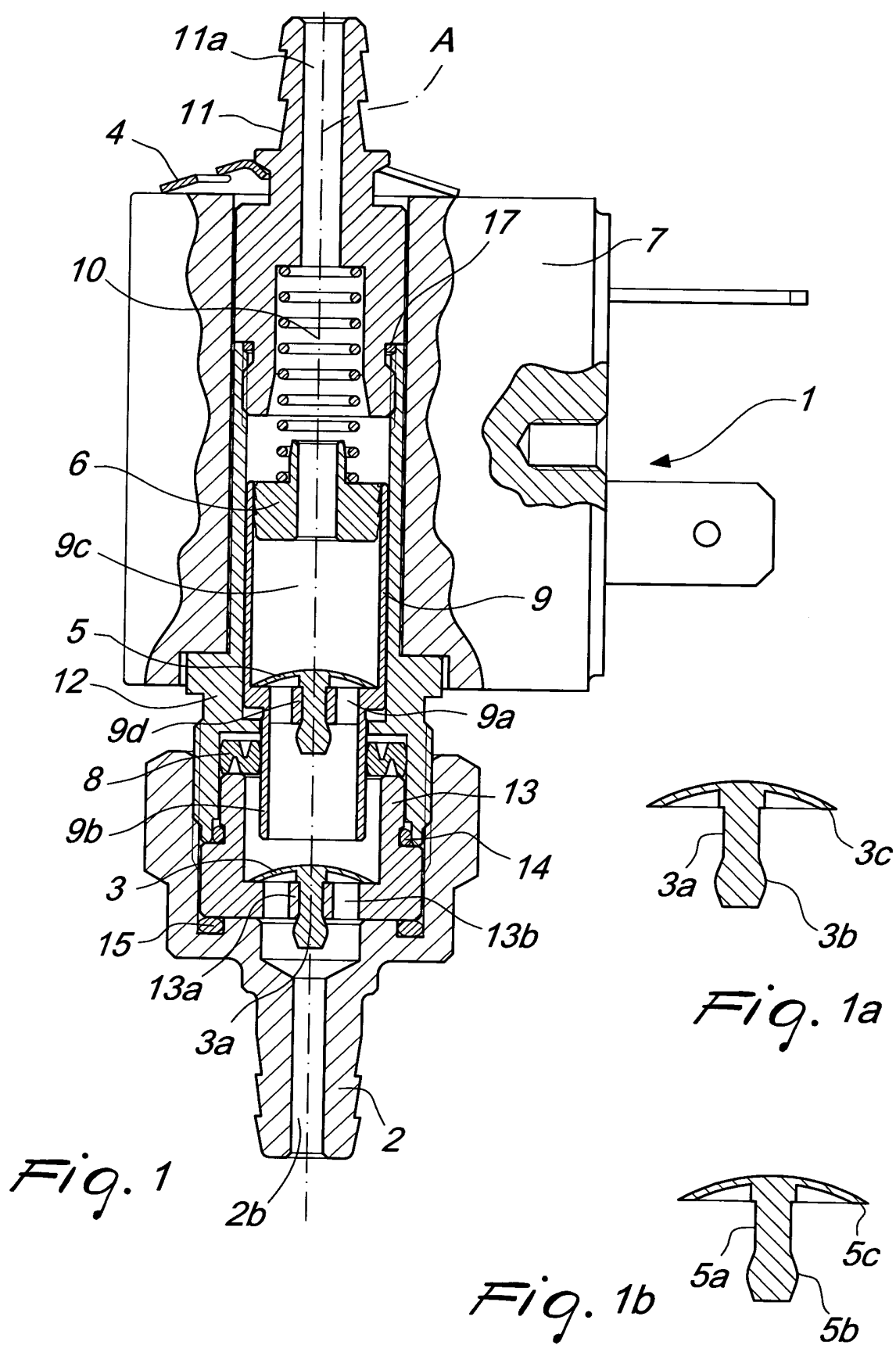
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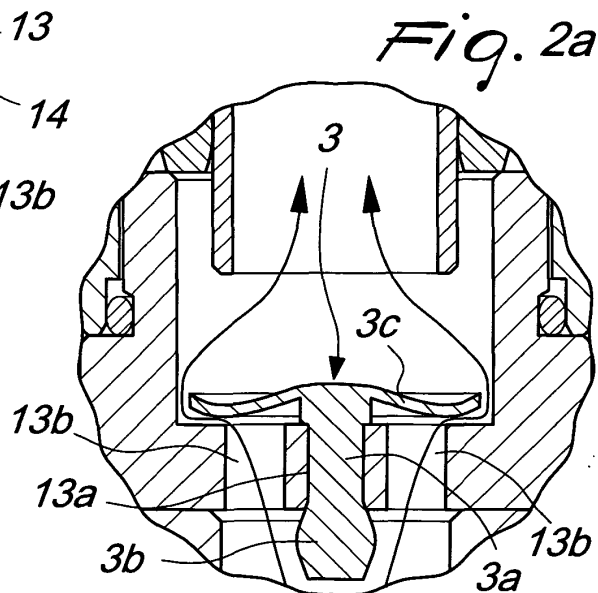
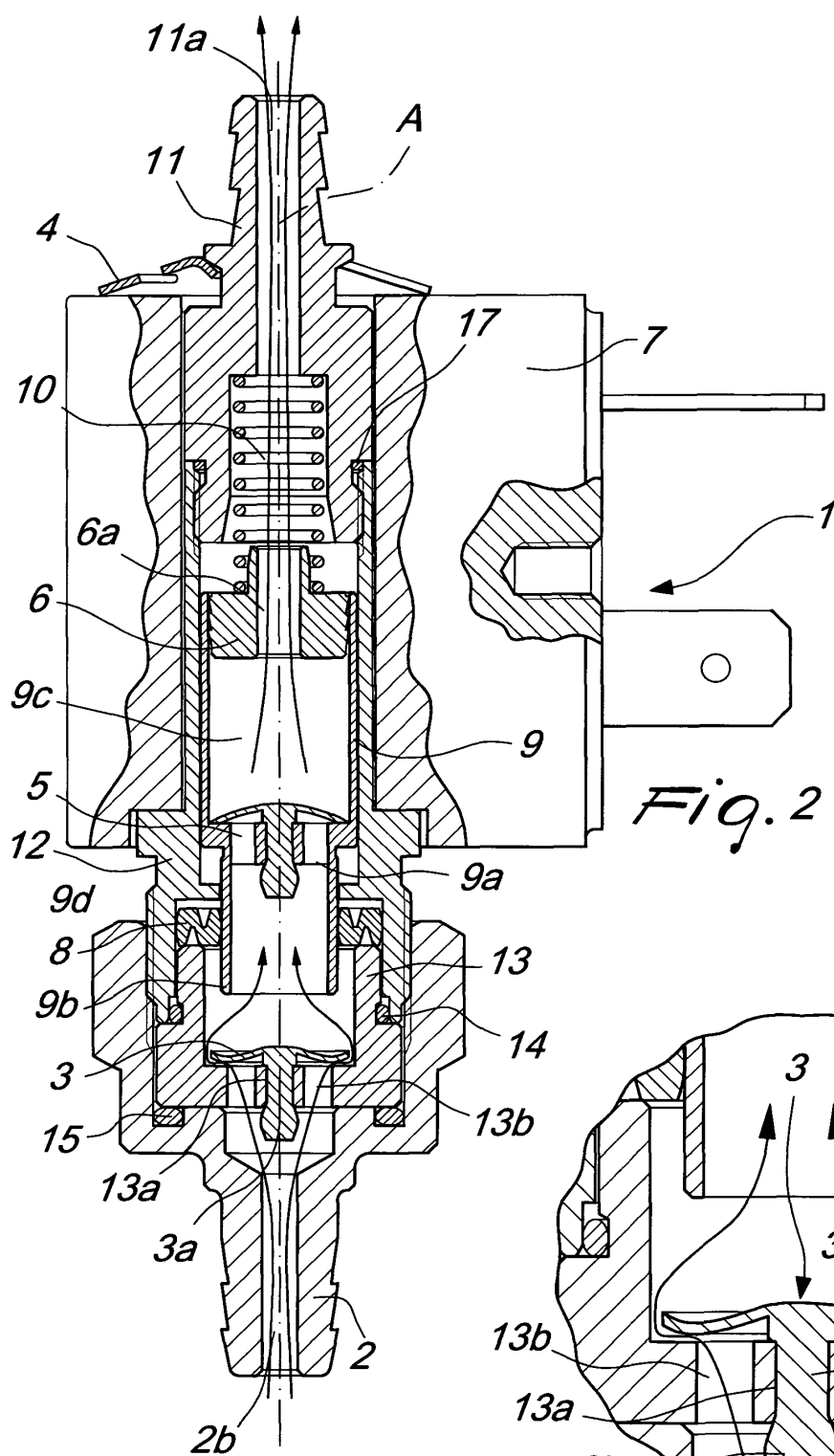
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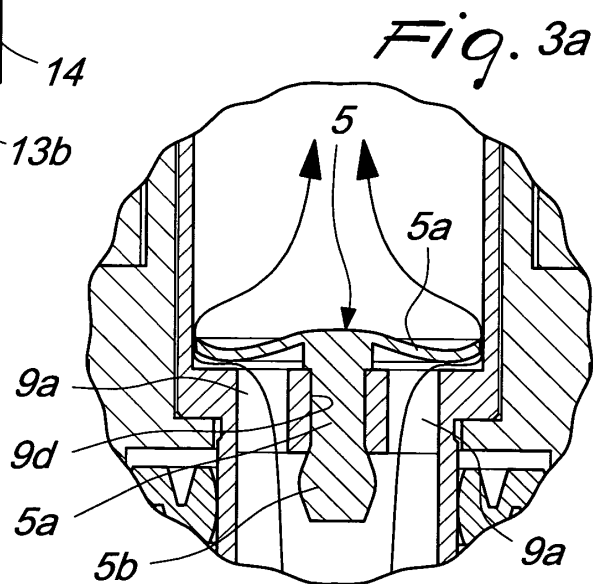
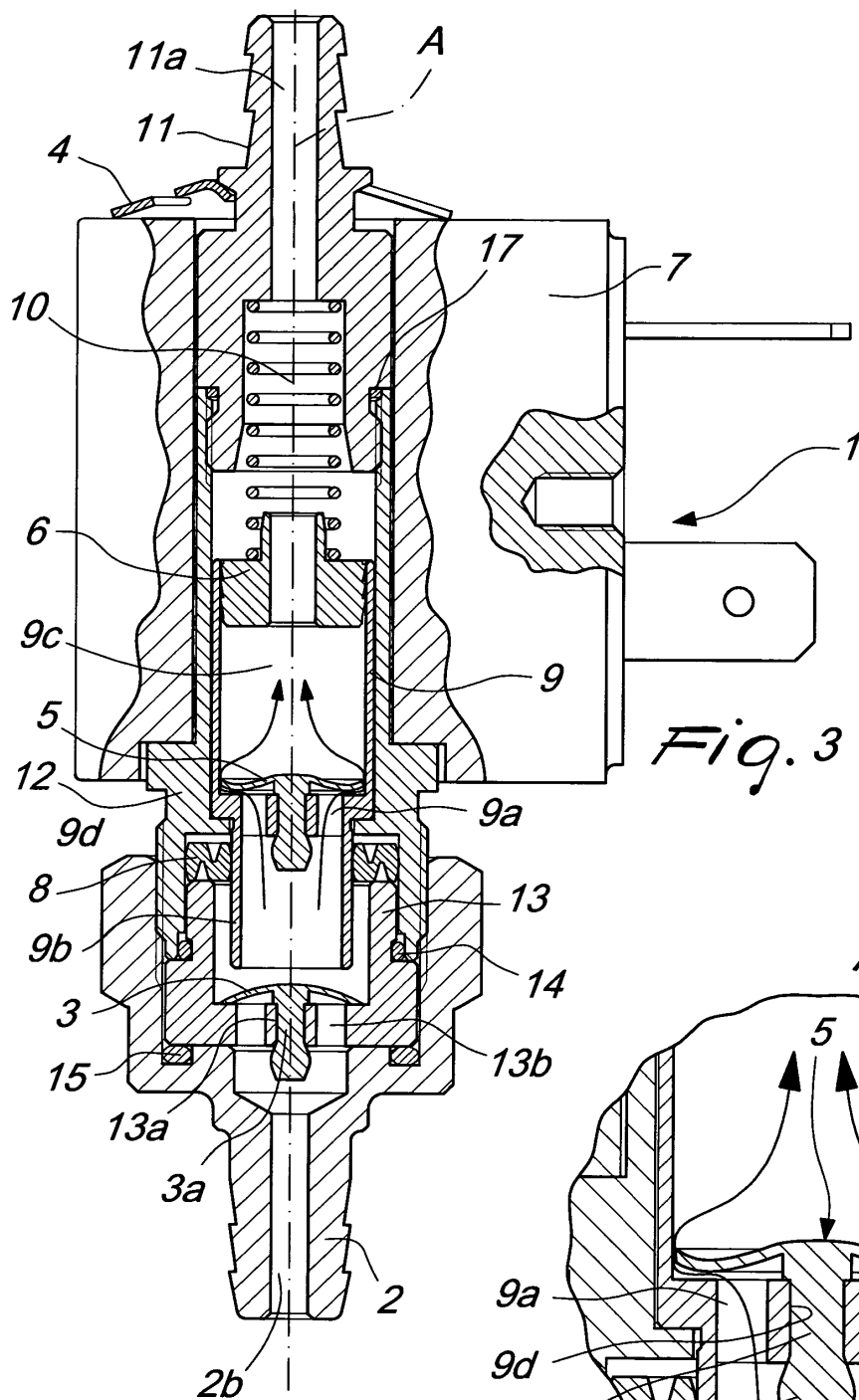
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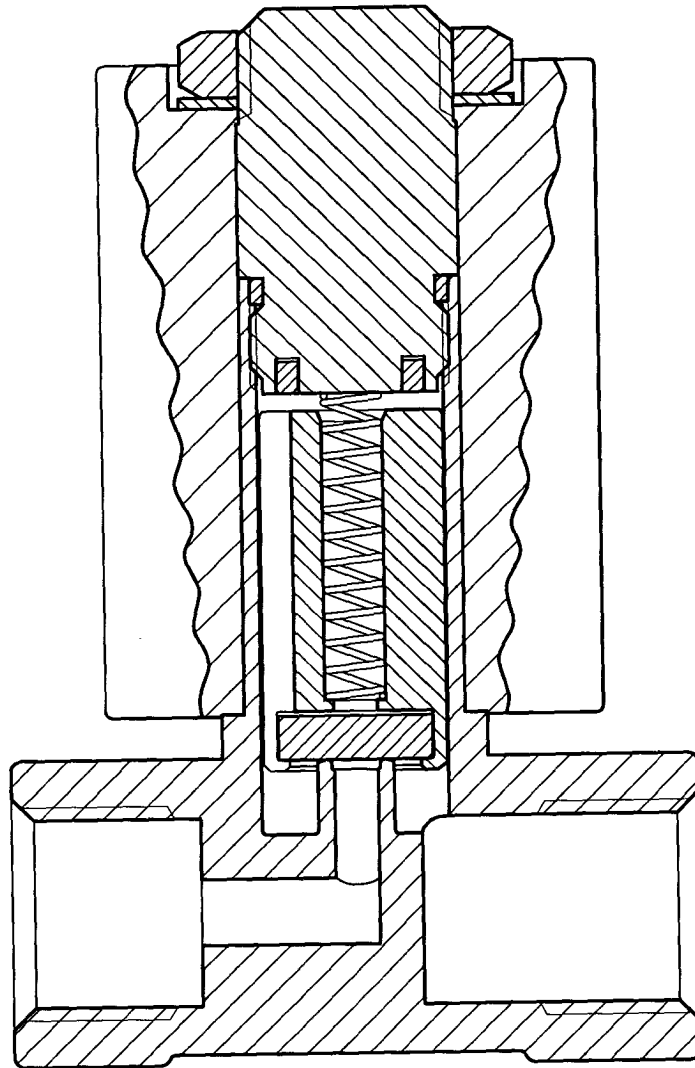


Fig. 4
PRIOR ART



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 42 5429

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	US 6 554 588 B1 (DIBENEDETTO CALOGERO) 29 April 2003 (2003-04-29) * abstract *	1-13	F04B17/04
A	----- EP 1 319 832 A (DELLORTO SPA) 18 June 2003 (2003-06-18) * abstract *	1	
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A	----- GB 1 502 880 A (LUCIFER SA) 8 March 1978 (1978-03-08) * page 1, left-hand column, line 9 - line 45 *	1	

			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			F04B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 January 2005	Examiner Fistas, N
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03-02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 04 42 5429

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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04-01-2005

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