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(54) **MAGNETIC SYSTEM FOR VIBRATING PISTON PUMPS**

MAGNETISCHE VORRICHTUNG FÜR SCHWINGKOLBENPUMPEN

SYSTEME MAGNÉTIQUE POUR POMPES À PISTON OSCILLANT ÉLECTROMAGNÉTIQUE

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EP 2 993 346 B1

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Description

Subject of the invention

[0001] This invention concerns an improved electro-magnetic system for vibrating piston pump with an isolated compression chamber suitable for moving liquids; consisting of an electromagnetic system which drive in alternative sense a magnetic core extended into a plunger acting as the compression mean that impels the liquid in a compression chamber towards an outlet. The vibrating pump, which is the subject of this invention, has features intended to increase the efficiency of the electro-magnetic driver system due to a specific metallic structure, an axially flexible plunger comprising two or more different materials and the assembly of the compression chamber by clipping methods, allowing it to obtain similar performances of current vibrating piston pumps with less cooper, iron and lower assembly costs while consuming less electricity during operation.

State of the art.

[0002] Different types of pressure pumps used for moving liquids from one point to another are currently known. Gear pumps, centrifuge pumps, vane pumps, vibrating pumps and others might be mentioned.

[0003] The choice of the type of pump basically depends on the requirements it must meet, such as: dimensions/weight, maximum pressure, maximum flow, flow at working pressure, power consumed, characteristics of the fluid to be moved (oils, acids, food, etc.), price or noise level.

[0004] Vibrating piston pumps, which are of the type referred to in this invention, work by alternatively moving a magnetic core using a tubular electro-magnet around the said magnetic core. The use of AC to power the electro-magnet generate magnetic pulses that go from zero to maximum at the pace of the AC. These magnetic pulses attract the magnetic core from an upstream position to a downstream position. A spring placed downstream of the magnetic core is compressed and push said magnetic core back to its upstream position when the magnetic pulse is zero producing the alternative movement thereof.

[0005] The electromagnetic systems currently used in vibrating pumps as described in DE 20 2007 019 534 U1 or DE 10 2012 107 983 A1 has a low efficiency due to fact that the magnetic force responsible for moving the plunger from its upstream to the downstream position is created by the use of two separated bushings.

[0006] The vibrating piston pumps of DE 20 2007 019 534 U1, DE 10 2012 107 983 A1 and the one of this invention work accumulating energy in a spring, this is known as spring-mass system. The vibrating piston pumps as those described in the US Patent 4,021,152 work under a different principle which consist on using the magnetic flow to pump the fluid instead of storing

energy in a spring, which is later transmitted to the fluid. This last configuration, as well as the described in DE 20 2007 019 534 U1 and DE 10 2012 107 983 A1, as also low efficiency because only two separated bushings are responsible for displacing the plunger via the magnetic flow.

[0007] It also exists vibrating pumps like those described in JP S56 88971 A which rely on the full sinusoid of the AC power to generate alternative north / south magnetic pulses to drive a compression means. In this case, the technical solution retained consist on repelling and attracting a permanent magnet and it is not a spring-mass system as used by the pump subject of this invention. Other than using a different technology, these pumps have very low flow/pressure performances compared with piston pumps and are not an alternative to the pump subject of this invention.

[0008] Another key component on the efficiency of the magnetic system of vibrating solenoid pumps is the plunger. Due to the design, manufacturing specifications and materials currently used there is room to improve its efficiency and costs. To manufacture pistons, three processes are the most commonly used nowadays: full machining starting from a larger piece of stainless steel, press-bonding the ferritic stainless-steel core and the stainless-steel plunger or by plastic moulding a plunger over the ferritic stainless-steel core. All the existing plungers are rigid and without axial flexibility between the core and the piston.

[0009] Finally, but still significant to the efficiency of the production is the way on which the compression chamber is assembled to the magnetic system. Currently it is linked by screwing as shown in DE 20 2007 019 534 U1 and DE 10 2012 107 983 A1 or by a press-bonding process, and to ensure tightness several O-rings are used, resulting in assembly time and costs that can be improved.

[0010] In view of the foregoing problems, an object of the present invention is to provide a vibrating piston pump with improved magnetic efficiency, lower noise and easier assembly enabling to obtain the performances of current piston pumps with less raw material, mainly cooper, and manufacturing costs.

Description of the invention.

[0011] The vibrating piston pump for liquids, subject of this invention, comprising: an electromagnet constituted by a metallic structure and a coil, being said electromagnet the driver force that move longitudinally and in alternate direction a pumping means inside a driver chamber. The pumping mean is composed of a magnetic core, two springs, one at each side of that core and a plunger attached to said magnetic core. By powering the coil with AC, a pulsating magnetic flow is produced and the magnetic core is called to displace from its rest position at each magnetic pulse. The springs are responsible first to keep the magnetic core in a rest position and second

to accumulate the energy produced by the displacement of the magnetic core. When the magnetic flow come to zero the energy accumulated in the springs bring the magnetic core back to its rest position. This process repeats at the AC frequency and the pump works under the principle of a spring-mass system.

[0012] The free side of the plunger enter into a compression chamber provided with a liquid inlet and a liquid outlet and the alternative movement of the plunger impel the liquid by displacement from the inlet to the outlet. The said compression chamber is axially aligned with the driver chamber on which the pumping mean work and attached to the last by a fork shaped clip, resulting in a complete device that presents characteristics according to claim 1 that solve the problem explained above and provide a number of advantages both of use and manufacture.

[0013] According to the invention, the first feature of the vibrating piston pump is that the metallic structure of the electromagnet integrates a stud. The said stud is disposed behind the bottom of the magnetic core and axially aligned therewith, improving the electromagnetic efficiency of the pump, which in turn results in a reduction of the amount of copper and iron required to manufacture the pump, as well as the assembly costs and overall size.

[0014] A second feature of the vibrating pump of this invention is the axial flexibility of the plunger relative to the magnetic core. The plunger is solidly assembled to a magnetic core but with freedom of axial movement between both parts. This axial flexibility lowers the noise level of the pump.

[0015] According to the invention, the magnetic core is simple to manufacture and with few machining operations, thus reducing machining costs and waste of raw materials in the form of shavings. The plunger assembled to said magnetic core is a separate piece that can be made of any material compatible with the characteristics of the fluid to pump. The axial flexibility is given by the patella shape end of the plunger and the semi-housings that link the plunger to the magnetic core. The semi-housings can be obtained from plastic or rubber injection and improve the useful life of the pumping means which is exposed to high vibration frequencies.

[0016] Another advantage of having a pumping means built-up of separated components instead of a single metal piece mechanized is the simplicity of industrialization. Given that the diameter of the plunger is the variable used to change the hydraulic performances of vibrating piston pumps, in the pump of this invention, only the plunger must be specific and the magnetic core is standard for the entire family of pumps. Additionally as the magnetic core and the plunger are linked by a simple assembly operation, each part could be manufactured in the most suitable location and put together at the same time and location of the entire pump.

[0017] The third feature of the vibrating pump of this invention is the use of a fork shaped clip to join the compression chamber with the electromagnetic driver result-

ing in a compact and easy to assembly vibratory pump.

[0018] These and other features of the invention can be understood more easily by looking at the example version shown in the attached diagrams.

Description of the diagrams.

[0019] To complement the description made and in order to make it easier to understand the features of the invention, this report is accompanied by a set of drawings, which are merely illustrative and not restrictive, representing the following:

- Figure 1 shows a schematic drawing of an example of the vibrating piston pump in accordance with the invention, sectioned by a vertical plane; and
- Figure 2 shows a schematic drawing of an embodiment of the core-plunger assembly according to the invention, sectioned along a vertical plane.

Preferred version of the invention.

[0020] In the example version shown in Figure 1 the vibrating piston pump includes an electromagnetic system comprising a coil (1) and a metallic structure composed by a "U" shaped piece (2), two bushings (7.1, 7.2), a lower plate closure (3) and a screw stud (4).

[0021] The "U" shaped piece (2) is placed around the coil (1), the two bushings (7.1, 7.2) are placed inside the said coil (1) and the lower plate (3) is placed below, on the open side of the "U" shaped piece (2), closing the magnetic circuit with the screw stud (4). The lower plate (3) is fixed by the screw stud (4) to a driver chamber (5) which is positioned inside the coil (1) and the two bushings (7.1, 7.2).

[0022] Inside the driver chamber (5) there is a pumping mean moving axially and in alternative direction composed by a magnetic core (6) and a plunger (9) linked to the top of said magnetic core (6) by a semi-housings set (11).

[0023] The movement of the pumping mean is produced by a spring-mass system and the energy exchange system is composed by a compression spring (19) positioned below the bottom of the magnetic core (6) and a return spring (8) positioned above the top of the magnetic core (6).

[0024] The fluid to impel is displaced in a compression chamber (12) with an inlet (17) and an outlet (18) which is assembled to the driver chamber (5) and fixed by the fork shape clip (13).

[0025] According to the invention and as shown in Figure 1 the screw stud (4) is axially aligned and positioned below the bottom of the magnetic core (6) so that this screw stud (4) made part of the metallic structure (2, 3, 4, 7.1, 7.2).

[0026] In the example version shown in Figure 2 the plunger (9) is attached to a magnetic core (6) by a semi-

housing set (11) and has axial flexibility relative to the magnetic core (6) due to the patella design of the plunger's end linked to said magnetic core (6).

[0027] In the embodiment shown in Figure 1 the compression chamber (12) is housed in the upper side of the driver chamber (5) and fixed by the fork shape clip (13) that holds the compression chamber (12) assembled and free to rotate 360°. A sealing means (14) and a washer (15) prevents the fluid to leak from the compression chamber (12) to the driver chamber (5) and the seal (16) keeps the compression chamber (12) and the driver chamber (5) under tension to prevent vibration noise

[0028] Having described the nature of the invention sufficiently, as well as a preferred version, it is stated for the appropriate purposes that the materials, shape, size and arrangement of the elements described can be changed, provided this does not involve an alteration of the essential features of the invention claimed below.

Claims

1. Vibrating piston pump for liquids applicable in the displacement of fluids, including an electromagnetic system comprising a coil (1) and a metallic structure composed by a "U" shaped piece (2) placed around the said coil (1), two bushings (7.1, 7.2) placed inside the said coil (1), a lower plate closure (3) placed below on the open side of the "U" shaped piece (2) and a stud (4) completing the metallic structure; a driver chamber (5) which is positioned inside the coil (1) and the two bushings (7.1, 7.2); a pumping means capable of moving axially and in alternating directions inside the driver chamber (5) composed by a magnetic core (6) and a plunger (9) linked to the top of said magnetic core (6) by a set of semi-housing (11); an energy exchange system composed by a compression spring (19) positioned below the bottom of the magnetic core (6) and a return spring (8) positioned above the top of the magnetic core (6); a compression chamber (12) with an inlet (17) and an outlet (18) assembled to the driver chamber (5) and fixed by a fork shape clip (13) **characterized in that:** the stud (4) is axially aligned and positioned below the bottom of the magnetic core (6) so that this stud (4) is made part of the metallic structure (2, 3, 4, 7.1, 7.2) and the plunger (9) has axial flexibility relative to the magnetic core (6) due to a patella on the side where the plunger (9) is linked to the magnetic core (6) by the set of semi-housings (11).
2. Vibrating piston pump according to claim 1, **characterized in that:** the compression chamber (12) is housed on the upper side of the driver chamber (5) and fixed by the fork shape clip (13) that holds the compression chamber (12) assembled and free to rotate 360°; wherein a sealing means (14) and a washer (15) prevents the fluid to leak from the com-

pression chamber (12) to the driver chamber (5) and a further seal (16) keeps the compression chamber (12) and the driver chamber (5) under tension to prevent vibration noise.

Patentansprüche

1. Vibrierende Kolbenpumpe für Flüssigkeiten, die bei der Verdrängung von Flüssigkeiten zum Einsatz kommt und ein elektromagnetisches System umfasst, das besteht aus einer Spule (1) und einer Metallstruktur in Form eines U-förmigen Stücks (2) um die genannte Spule herum (1), zwei in der genannten Spule (1) eingelassenen Buchsen (7.1, 7.2), einem unteren Plattenverschluss (3), der sich unter der offenen Seite dieses U-förmigen Stücks befindet, und einem diese Metallstruktur vervollständigenden Bolzen (4), einer Treiberkammer (5) in dieser Kammer (1) und zwei Buchsen (7.1, 7.2), einer Pumpeinrichtung, die sich axial bewegen und die Richtungen innerhalb der aus (5) einem Magnetkern (6) und einem Kolben (9) bestehenden Treiberkammer (6), die am oberen Ende des Magnetkerns in Form eines Halbgehäuses (11) (11) angebracht sind, verändern kann, einem Energieaustauschsystem, das eine sich unterhalb des Bodens des Magnetkerns (6) befindliche Kompressionsfeder (19) und eine sich oberhalb der Oberkante des Magnetkerns befindliche Rückstellfeder (8) umfasst, eine Kompressionskammer (12) mit Einlass (17) und Auslass (18), die an der Treiberkammer (5) montiert sind, durch eine gabelförmige Schelle (13) gehalten werden und **sich charakterisieren durch:** Der Bolzen (4) ist axial ausgerichtet und unterhalb des Bodens des Magnetkerns (6) angebracht, so dass dieser Bolzen (4) zur Metallstruktur (2, 3, 4, 7.1, 7.2) gehört. Der Kolben (9) verfügt über axiale Flexibilität in Bezug auf den Magnetkern (6) aufgrund eines Gleitlagers auf der Seite, wo der Kolben mit dem Magnetkern (6) durch eine Reihe von Halbgehäusen (11) verbunden ist.
2. Vibrierende Kolbenpumpe gemäß Aussage 1, **gekennzeichnet durch** Folgendes: Die Kompressionskammer (12) befindet sich auf der Oberseite der Treiberkammer (5) und ist durch die gabelförmige Schelle (13) befestigt, welche die Kompressionskammer (12) zusammenhält und bis zu 360° bewegen kann; wobei eine Dichtungseinrichtung (14) und eine Unterlegscheibe (15) verhindern, dass die Flüssigkeit von der Kompressionskammer (12) in die Treiberkammer (5) leckt. Eine weitere Dichtung (16) hält die Kompressionskammer (12) und die Treiberkammer (5) unter Druck, um Vibrationsgeräusche zu vermeiden.

Revendications

1. Pompe à piston vibrante pour liquides applicable au déplacement de fluides, comportant un système électromagnétique comprenant une bobine (1) et une structure métallique composée d'une pièce en forme de "U" (2) placée autour de ladite bobine (1), deux bagues (7.1, 7.2), placés à l'intérieur de ladite bobine (1), une plaque inférieure (3) placée en dessous du côté ouvert de la pièce en forme de "U" (2) et un goujon (4) complétant la structure métallique; une chambre de guide (5) qui est positionnée à l'intérieur de la bobine (1) et les deux bagues (7.1, 7.2); un moyen de pompage capable de se déplacer axialement et alternativement à l'intérieur de la chambre de guide (5) composé d'un noyau magnétique (6) et d'un plongeur (9) relié au sommet dudit noyau magnétique (6) par un ensemble de demi-coquilles (11); un système d'échange d'énergie composé d'un ressort de compression (19) placé sous le bas du noyau magnétique (6) et d'un ressort de rappel (8) placé au-dessus du sommet du noyau magnétique (6); une chambre de compression (12) avec une entrée (17) et une sortie (18) assemblée à la chambre de guide (5) et fixée par un attache en forme de fourche (13) ; **se caractérisant par le fait que** le goujon (4) est axialement aligné et positionné en dessous du bas du noyau magnétique (6) de sorte que ce goujon (4) fasse partie de la structure métallique (2, 3, 4, 7.1, 7.2) et que le plongeur (9) présente une flexibilité axiale par rapport au noyau magnétique (6) en raison d'une rotule du côté où le plongeur (9) est relié au noyau magnétique (6) par l'ensemble des demi-coquilles (11).
2. Pompe à piston vibrante selon la revendication 1, **se caractérisant par le fait que** la chambre de compression (12) est logée sur la face supérieure de la chambre de guide (5) et fixée par l'attache en forme de fourche (13) qui maintient la chambre de compression (12) assemblée et libre de faire une rotation de 360°; dans lequel un moyen d'étanchéité (14) et une rondelle (15) empêchent le fluide de s'échapper de la chambre de compression (12) vers la chambre de guide (5) et un joint supplémentaire (16) maintient la chambre de compression (12) et la chambre de guide (5) sous tension pour éviter les bruits de vibration.

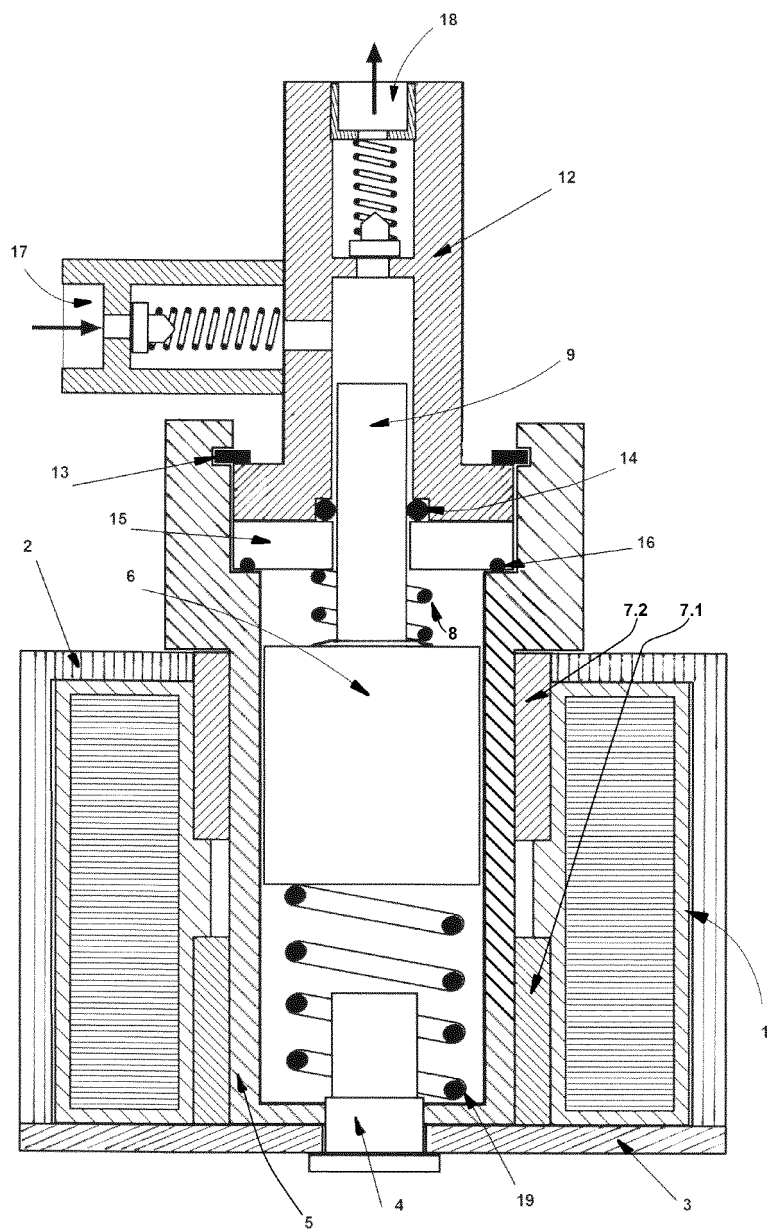


Fig. 1

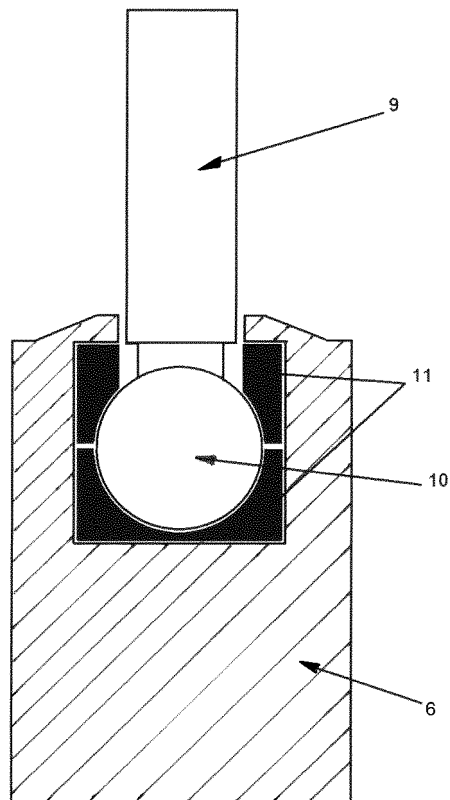


Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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