(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 210 145 A2**

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 86830213.4

(51) Int. Cl.⁴: F04C 29/02

(22) Date of filing: 17.07.86

(30) Priority: 26.07.85 IT 6769785

(43) Date of publication of application: 28.01.87 Bulletin 87/05

(84) Designated Contracting States: DE FR GB SE

(71) Applicant: CORINT S.r.l.
Strada degli Alberoni 18/2
I-10133 Torino(IT)

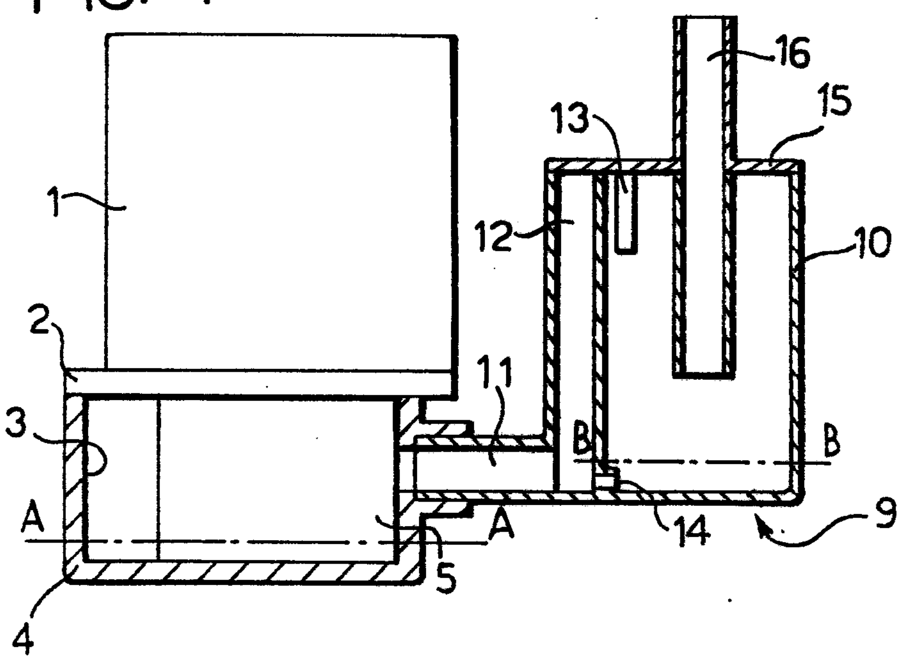
(72) Inventor: Cordiano, Ettore c/o Corint S.r.l
Strada degli Alberoni 18/2
I-10133 Torino(IT)

(74) Representative: Notaro, Giancarlo et al
c/o Jacobacci-Casetta & Perani S.p.A. Via Alfieri, 17
I-10121 Torino(IT)

(54) **Intermittently working pneumatic vane pump.**

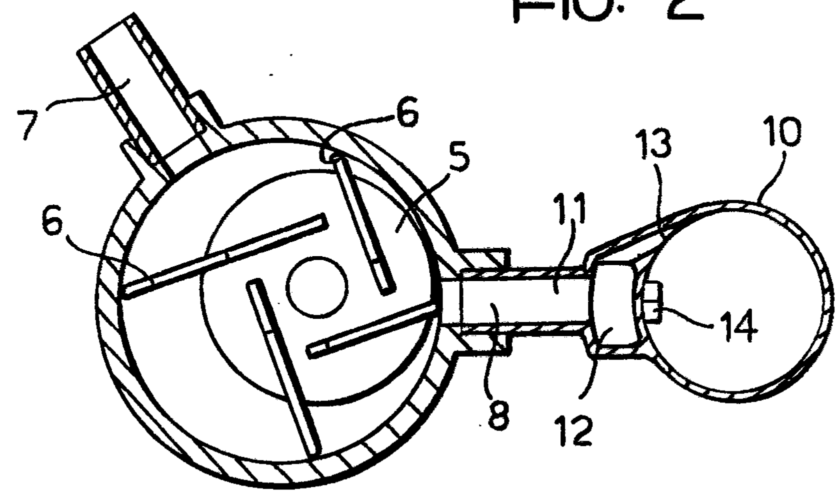
(57) An intermittently working pneumatic pump is lubricated with oil which, when the pump is stationary, is contained inside the seat for the rotor (5), and, in operation, is expelled with the air and held in a separator/container (9), from which it reenters into the pump when the latter stops.

FIG. 1



EP 0 210 145 A2

FIG. 2



INTERMITTENTLY WORKING PNEUMATIC VANE PUMP

The present invention relates to an entermittently working pneumatic vane pump of the kind comprising:

a rotor provided with slots in which the vanes are lodged,

a cylindrical seat in which said rotor rotates.

Intermittently working vane pump, driven by electrical engines are often used, with the purpose of increasing the vacuum in the servo-brake systems, when the vacuum in the intake manyfold of a gasoline engine is not sufficient, either because the engine is designed for high performances or because other user devices are added to the servo-brake, which absrob part of the vacuum built in the manyfold.

Also in case of diesel engines, such pump can become unavoidable to increase the vacuum delivered by the normal vacuum pump, driven by the engine, when this vacuum is no more sufficient, even because other users have been added to the servo-brake.

Normally these kinds of pumps are fed with pressurized oil, as those used on diesel engines, and oil is drawn from the engine lubrication circuit and returns into the engine crankcase together with the air aspirated from the user devices.

These pumps have various drawbacks. Firstly they require connections with the engine for the arrival and return of pressurized oil, with pipes withstanding to the oil pressure and perfect sealings. Furthermore, as they must pump oil together with air, they have to be rather powerful, even for limited flowrate. Consequently, their cost becomes too high, preventing their spread.

Object of the present invention is to eliminate these drawbacks by realizing a pump which does not require any connection with the engine for the oil feeding and return, which absorbs a lower power than the pumps with pressurized oil and does not require expensive machinery for its production.

This object is obtained through the invention in that on its pipeline a capacity is inserted of suitable shape and sizes, all being arranged in such a way that, when the pump is stationary, a certain quantity of oil is contained inside the same pump whereas, when the pump is rotating, said oil is expelled from the pump and stopped by said capacity, the oil reentering into the pump when this latter stops.

As, every time, the pump operates only for a short time, the lubrication provided by the oil initially contained in the pump is sufficient to ensure opertaion with a small friction and a good sealing between vanes and surfaces in contact.

On the other side, except for the first turns of the rotor, the pump operates dry and thus absorbes a much lower power than if it were continually fed with oil.

In addition, the various pump components -i.e. cylindrical seat, container for the oil collection, rotor and electrical engine mounting -can be made in sintered metal, so as to avoid all precise machining operations which require expensive machineries and long working times. All this allows to reduce the costs of the system and also, last but not least, the energy absorbed from the vehicle battery.

Further advantages of the invention will become evident from the following description, made with reference to the annexed figures, of which:

Figs. 1 and 2 are a longitudinal and a transversal cross-section, respectively, of a pump according to the invention;

Figs. 3 and 4 show an embodiment of the same system with separator and pump body in one single piece;

Figs. 5 and 6 show a variation of the same pump with a second outlet port.

On all figures, all parts with the same function have been indicated with the same reference number.

With reference to Figs. 1 and 2, 1 indicates the electrical engine driving the pump, 2 the mounting of said engine, closing at the top the cylindrical seat built in the body 4; 5 is the rotor of the pump in which the vanes 6 are lodged.

The operation of these kinds of pump is well known and does not require any explanation. Air is aspirated from duct 7 and expelled through outlet duct 8. The pressure difference between in and outlet air depends, as known, on the pump sizes, number of vanes, and position of inlet and outlet ports. It is also known that such a pump can be used either to compress or to depress air or any other gas.

On the outlet pipeline, which starts from duct 8 and continues with the tube 16, the container/separator 9 is inserted, consisting of cylindrical container 10 and cover 15. Cover 15 is provided with an inlet duct 11 and a vertical duct 12, wherein said duct 11 comes out. The vertical duct 12 comes up to cover 15 and provided at the top with the slot 13 wherefrom air comes out, arriving from the pump, approximately tangentially to the container wall. The same duct 12 is provided at the bottom with a small bore 14, wherefrom the oil collected in the container during the pump operation returns into the pump when this latter stops.

The outlet duct 16 is disposed on the axis of the container and protrudes into its insdie in such a way that the inlet air is compelled to move centerwards for entering into duct 16. Obviously, duct 16 must be not long enough to arrive under the level of the oil collected at the bottom of the container when the pump is operating. The operation of the system is the following. By stationary pump a certain quantity of oil is collected inside the pump and, in some case, also in the container 10. In Fig. 1 the oil level in the pump is indicated with line AA.

When the pump starts to rotate, driven by motor 1, during the first turns oil is expelled with air and arriving into container 9, separates from air because of centrifugal effect. Oil is deposited and drops on the container wall and is collected in the container bottom. Oil would tend to reenter into the pump through bore 14, but it is impeded by the air arriving from the pump and blowing the wall where the bore 14 is biult. Oil particles which could go through would, anyway, dragged upwards by the air and separated from air with the above described process.

In order to limit this oil leakages and also to prevent air form straining through bore 14, it is convenient that bore 14 have a small diameter and a length of, at least, 2-3 millimiter, as indicated in Fig. 1. When the pump stops, the oil collected in the container at the level indicated by the line BB of the same figure, returns to the pump through bore 14 and duct 11.

The container/separator 9 can, obviously, have different shapes, all the same operating in the same way.

In case the outlet pipeline has a vertical section of sufficient dimensions, the same vertical section can be used as oil container/separator. In this case separation occurs only by gravity, when air slows down in the large vertical section.

Figures 3, 4 show a possible embodiment of a pump/separator system which can be particularly advantageous from the standpoint of production costs. In such embodiment, the cylindrical seat of pump 3 is constituted by a sintered ring 17, in a single piece with ring 18 of the container/separator. The upper plate 2, supporting the electric motor, and the lower plate 19 complete the assembly.

The cylindrical seat of the pump and the container/separator are connected to each other through passage 20 formed in ring 17, the vertical channel 21 and passage 22 which opens into the container/separator in a substantially tangential direction. The oil returns from the separator into the pūmp through the little groove 23 formed in the bottom of ring 18.

With such an arrangement, it is possible to manufacture a completely finished sintered piece with no need of any mechanical working, which allows a great economy in time and in investments on equipments.

In case the pump is used to create vacuum, a further power reduction can be obtained in the following way. Under these conditions the pump aspirates air from the users circuit until the absolute pressure p_o in the latter reaches values of 0.2 ÷ 0.4 bar. Obviously, the pump is designed in such a way that it can aspirate air at pressure p_o, compress it up to atmospheric pressure and discharge it into atmosphere.

But, if the pressure in the users circuit is still near to the atmospheric one, the air aspirated by the pump is compressed up to values of the order of 3 ÷ 5 bar, before it is dischraged into atmosphere through the outlet port. The energy necessary for the compression is not restored and must be delivered by the electrical engine.

This must, consequently, have a much higher power than that required under steady conditions. This results in higher engine costs and greater load for the vehicle battery.

The problem can be solved by adding a second outlet port, provided with a non-return valve - as shown in Fig. 5, 6 -which is opened before the normal outlet and prevents air from reaching too high pressures.

Figs. 5, 6 show the same pump of Figs. 3, 4 with this variation. Flange 2, supporting the electrical engine, is provided with the outlet bore 24 that, through duct 27, discharges air into vertical duct 21. Disc 25, pressed upon by spring 28, rests against sealing seat 26 born by the same flange 2. Flange 31, intepoosed between engine 1 and flange 2, closes the outlet duct 27.

The device operates as follows.

Let be supposed that the cell C corresponding to the position of vanes 29, 30 has the maximum volume in a turn of the rotor, and the pressure p_o in it is the same as in the users circuit.

While the rotor keeps on rotating, the cell C volume diminishes and pressur einside it increases. If, on the starting position (maximum volume) pressure was near to the atmospheric one, in the following positions it becomes higher than the same atmosphere, even much more, before vane 30 opens the outlet port 20.

This could happen if the second outlet port 24 were not there. If fact, by disposing this latter in a suitable position, it can be obtained that the pressure inside the cell goes not beyond a given value, even if the pressure in the users circuit is near to atmosphere. On the contrary, when the circuit pressure is low, the outlet port 24 does not come into action because disc 25 works as a non-return valve and prevents air from reentering from duct 21 into the pump.

Other forms of embodiment are, obviously, possible always remaining in the field of the present invention. Those indicated in the figures are only to illustrate the operation principle of the system.

Claims

1. An intermittently working pneumatic vane pump of the kind comprising:

a rotor provided with slots in which the vanes are lodged

a cylindrical seat in which said rotor rotates,

characterized in that in its air outlet pipeline a capacity (9) is inserted of suitable shape and sizes, all being arranged in such a way that, when the pump is stationary, a certain quantity of oil is contained inside the same pump whereas, when the pump is rotating, said oil is expelled from the pump and stopped by said capacity, the oil reentering into the pump when this latter stops.

2. An intermittently working pneumatic vane pump according to Claim 1, characterized in that the capacity for separating and collecting the oil consists of a substantially vertical section of the same outlet pipeline.

3. A pneumatic vane pump according to Claim 1, characterized in that the capacity for collecting the oil when the pump is rotating consistes of a container (9) through which the air flows, coming out of the pump, said container being so disposed that, by stationary pump, the oil therein contained returns by gravity into the pump.

4. A pneumatic vane pump according to Claim 1, characterized in that the capacity for the oil collection consists of a container/separator (9) of a substantially cylindrical shape into which air enters in a tangential direction in order to enable the separation of oil from air by centrifugal effect, the outlet (16) from the container being disposed in a substantially central position, parallel to the cylinder axis, means being provided to obstructs the outlet of the oil from the container during the pump operation and to enable the oil to reenter into the pump when this latter stops.

5. A pneumatic vane pump according to Claims 1 and 5, characterized in that the container/separator (9) is made up of two parts in plastics, one a) of which consists of a container -(10) in plastics, substantially cylindric, with an inlet pipe (11) which comes out into a vertical duct (12), said vertical duct being provided at its top part with an outlet aperture (13) which directs the air tangentially to the container's wall, and at its bottom with a small bore (14) through which the oil collected by the container returns to the pump when it stops, and the other b) of a cover (15) the same in plastics, provided with an outlet pipe (16) which intrudes into the container (10) for a length which must be sufficient to prevent the exit of the centrifuged oil but not arrive under the level of the oil collected in the container, the two parts -container -(10) and cover (15) -being to each other connected with whatever known process, as for instance ultrasonic welding.

6. A pneumatic vane pump according to Claim 5 characterized in that the bore (14) for the oil return, at the bottom of the vertical duct (12) is under the pressure of the air arriving from the pump and is realized in a wall thicker than that of the same vertical duct (12), in order to obstacle the return of the oil into the pump when this is operating.

7. A pneumatic vane pimp according to Claims 1 and 4, characterized in that the cylindrical seat -(3) and the container/separator (9) are realized in a single piece, preferably in sintered material, said single piece substantially consisting of a first annulus (17) in which the cylindrical seat is lodged and of a second annulus (18) which forms the container/separator, said annuluses being closed at their ends by a flange (2) supporting an electrical driving engine (1) and by a second bottom flange (19) and being to each other connected through a vertical duct (21), which is in communication a) at its bottom with the cylindrical seat through a groove (20) realized in the wall of the same cylindrical seat, and b) at the top with the container/separator through a substantially tangential duct (22) realized in the wall of the container's annulus (18), a further small passage (23) being realized at the bottom between container and vertical duct (21) through a small indentation (23) in the wall, through which the oil collected in the container during the pump operation returns to the same pump when it stops.

8. A pneumatic vane pump according to Claim 1, characterized in that it is provided with a second outlet port (24), coupled with a non-return valve -(25, 26, 28), said second port being opened before the normal outlet port and having the function of preventing air from being compressed at uselessly high pressure when the pressure in the users circuit is near to atmospheric pressure, thus reducing the power required for driving the pump.

FIG. 1

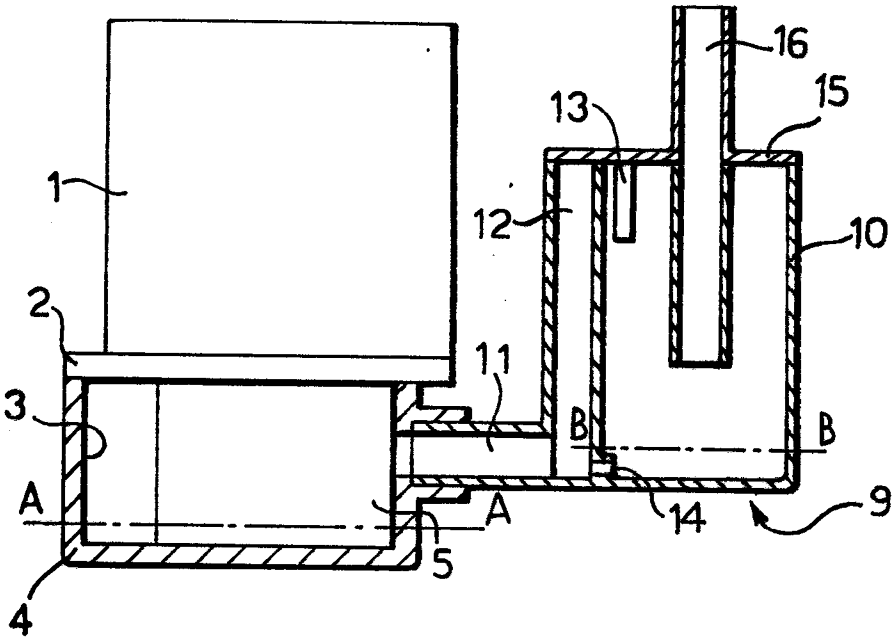


FIG. 2

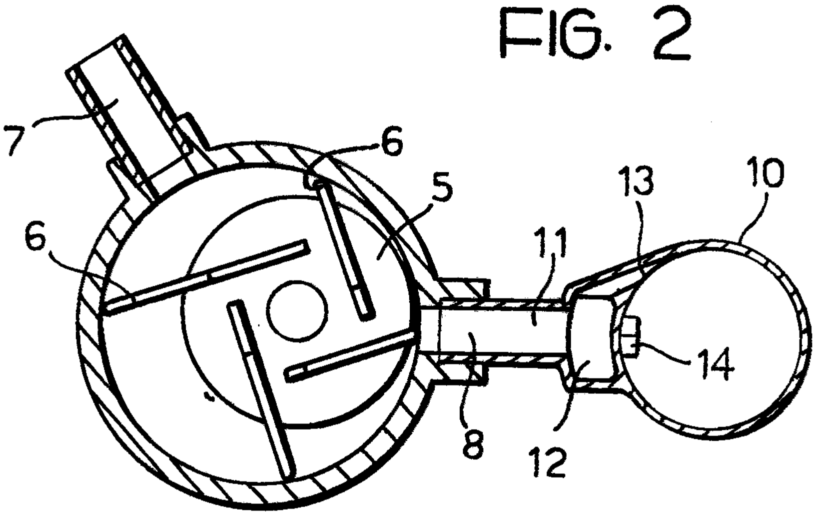


FIG. 3

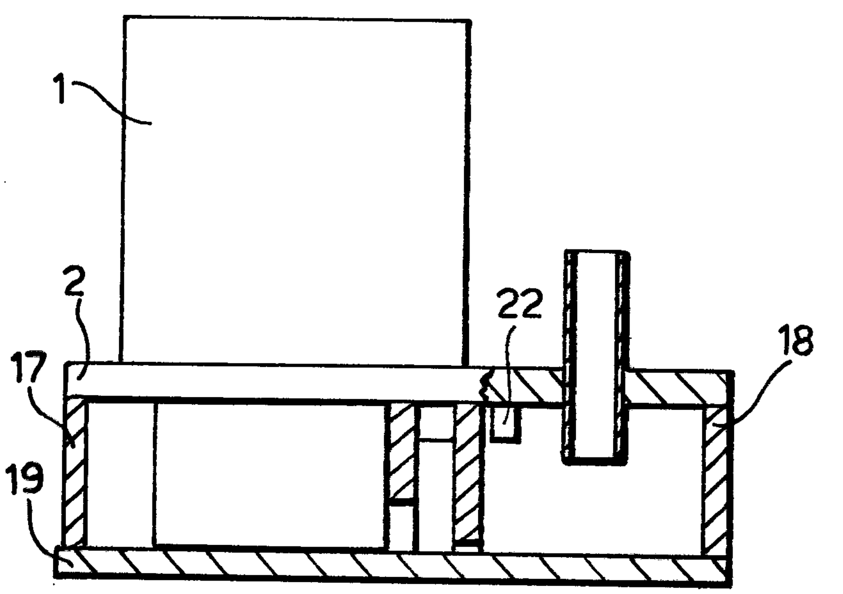


FIG. 4

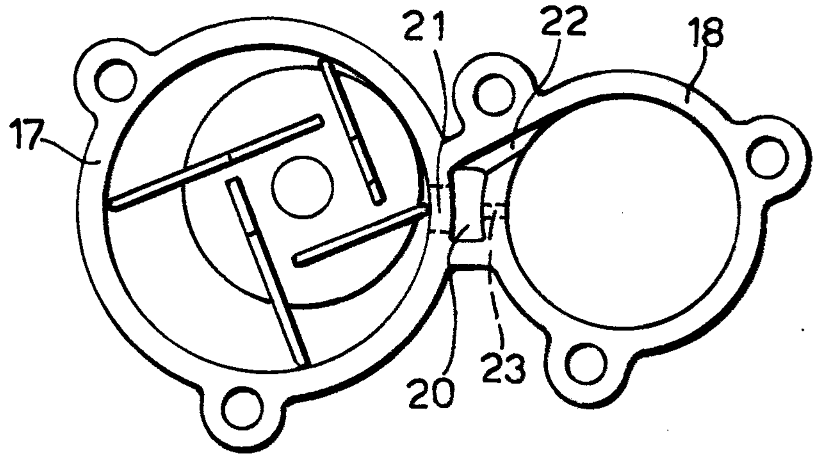


FIG. 5

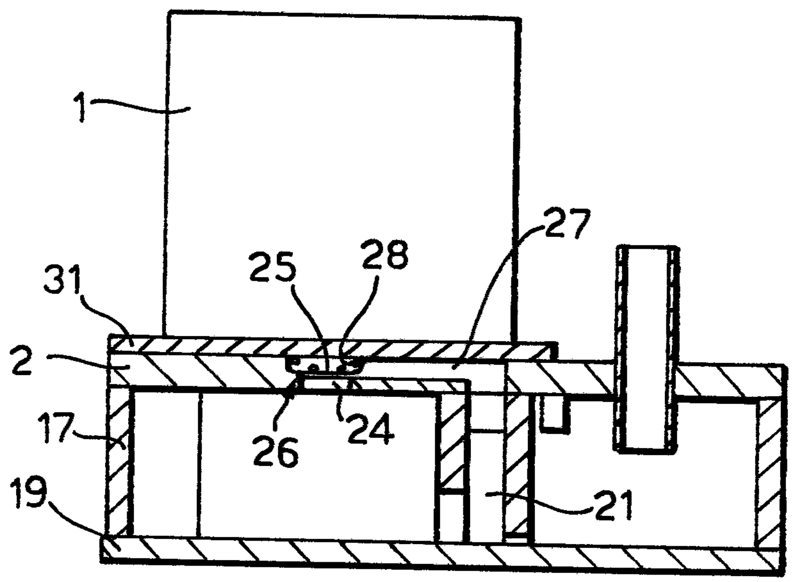


FIG. 6