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

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US-A- 3 040 973

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Description

The present invention relates to 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,

wherein on its air outlet pipeline a capacity is inserted of suitable shape and sizes.

A vane pump of this type is known from US-A-3 040 973. This document shows a vane pump provided with a leaf spring spaced from the outlet port and which provides intentional leakage of oil coming from the capacity into the pump mechanism. The oil is sucked into the pump during the portion of the operating cycle when the pressure within the outlet port is at or only slightly below atmospheric pressure. During a subsequent portion of the pumping cycle, the oil which has been drawn in is forcibly expelled and the cycle is repeated.

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 absorb 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 pump 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 all is 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 operation 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 absorbs 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 inside 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 built. 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 pump 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 discharged 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, inteposed 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,

wherein on its air outlet pipeline a capacity (9) is inserted of suitable shape and sizes,

characterized in that all is 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 consists 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 obstruct 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 Claim 4, 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 pump 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 th esame 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 openend 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.

Revendications

1. Pompe pneumatique à palettes à fonctionnement intermittent du type comportant :

   un rotor pourvu de fentes dans lesquelles sont logées les palettes,

   un siège cylindrique dans lequel tourne le dit rotor,

   dans laquelle est insérée sur sa conduite de sortie d'air une capacité (9) de forme et de taille appropriées

   caractérisée en ce que tout est disposé d'une manière telle que, lorsque la pompe est immobile, une certaine quantité d'huile est contenue à l'intérieur de cette pompe tandis que, lorsque la pompe est en rotation, la dite huile est expulsée de la pompe et arrêtée par la dite capacité, l'huile entrant de nouveau dans la pompe lorsque cette dernière s'arrête.

2. Pompe pneumatique à palettes à fonctionnement intermittent selon la revendication 1, caractérisée en ce que la capacité pour la séparation et la collecte de l'huile consiste en une section sensiblement verticale de la même conduite de sortie.

3. Pompe pneumatique à palettes selon la revendication 1, caractérisée en ce que la capacité pour la collecte de l'huile lorsque la pompe tourne consiste en un réservoir (9) à travers lequel s'écoule l'air, sortant de la pompe, le dit réservoir étant disposé de telle sorte que, avec la pompe immobile, l'huile qui y est contenue retourne par gravité dans la pompe.

4. Pompe pneumatique à palettes selon la revendication 1, caractérisée en ce que la capacité pour la collecte de l'huile consiste en un réservoir/séparateur (9) de forme sensiblement cylindrique dans lequel entre l'air dans une direction tangentielle afin de permettre la séparation de l'huile de l'air par effet centrifuge, la sortie (16) du réservoir étant disposée dans une position sensiblement centrale, parallèle à l'axe du cylindre, des moyens étant prévus pour boucher la sortie de l'huile du réservoir pendant le fonctionnement de la pompe et pour permettre à l'huile d'entrer de nouveau dans la pompe lorsque cette dernière s'arrête.

5. Pompe pneumatique à palettes selon la revendication 4, caractérisée en ce que le réservoir/séparateur (9) est réalisé en deux parties en matière plastique, dont une a) consiste en un réservoir (10) en matière plastique, sensiblement cylindrique, avec une conduite d'entrée (11) qui débouche dans une conduite verticale (12), la dite conduite verticale étant pourvue à sa partie supérieure d'une ouverture de sortie (13) qui dirige l'air tangentiellement à la paroi du réservoir, et à sa partie inférieure d'un petit alésage (14) à travers lequel l'huile collectée par le réservoir revient dans la pompe lorsqu'elle s'arrête, et dont l'autre b) est un couvercle (15) en matière plastique, pourvu d'une conduite de sortie (16) qui pénètre dans le réservoir (10) sur une longueur qui doit être suffisante pour empêcher la sortie de l'huile centrifugée mais qui n'arrive pas sous le niveau de l'huile collectée dans le réservoir, les deux parties - réservoir (10) et couvercle (15) - étant reliées l'une à l'autre par n'importe quel procédé connu, par exemple par soudage par ultra-sons.

6. Pompe pneumatique à palettes selon la revendication 5, caractérisée en ce que l'alésage (14) pour le retour de l'huile, au niveau du fond de la conduite verticale (12), est sous la pression de l'air provenant de la pompe et est réalisé dans une paroi plus épaisse que celle de cette même conduite verticale (12) afin de faire obstacle au retour de l'huile dans la pompe lorsque celle-ci est en fonctionnement.

7. Pompe pneumatique à palettes selon les revendications 1 et 4, caractérisée en ce que le siège cylindrique (3) et le réservoir/séparateur (9) sont réalisés d'une seule pièce, de préférence en matière frittée, la dite pièce unique consistant sensiblement en une première bague (17) dans laquelle est logé le siège cylindrique et une deuxième bague (18) qui forme le réservoir/séparateur, les dites bagues étant fermées à leurs extrémités par une bride (2) supportant un moteur d'entraînement électrique (1) et par une deuxième bride inférieure (19) et étant reliées l'une à l'autre par une conduite verticale (21), qui est en communication a) au niveau de sa partie inférieure avec le siège cylindrique par une rainure (20) réalisée dans la paroi de ce même siège cylindrique, et b) au niveau de sa partie supérieure avec le réservoir/séparateur par une conduite sensiblement tangentielle (22) réalisée dans la paroi de la bague de réservoir (18), un autre petit passage (23) étant réalisé au niveau de la partie inférieure entre le réservoir et la conduite verti-

cale (21) au moyen d'une petite strie (23) dans la paroi, à travers laquelle l'huile collectée dans le réservoir pendant le fonctionnement de la pompe retourne dans cette même pompe lorsqu'elle s'arrête.

8. Pompe pneumatique à palettes selon la revendication 1, caractérisée en ce qu'elle est pourvue d'un deuxième orifice de sortie (24), relié à un clapet anti-retour (25, 26, 28), le dit deuxième orifice étant ouvert avant l'orifice de sortie normal et ayant la fonction d'empêcher l'air d'être comprimé à une pression inutilement élevée lorsque la pression dans le circuit d'accessoires est proche de la pression atmosphérique, réduisant ainsi la puissance nécessaire pour entraîner la pompe.

Patentansprüche

1. Periodisch arbeitende, pneumatische Flügelzellenpumpe der Art, die umfaßt:

einen mit Schlitzen versehenen Rotor, in denen die Flügel angeordnet sind;

einen zylindrischen Sitz, in dem der Rotor sich dreht,

wobei an ihrer Auslaßleitung ein Vorratsbehälter (9) einer geeigneten Form und Größe eingesetzt ist,

dadurch gekennzeichnet, daß alles so angeordnet ist, daß, wenn die Pumpe stationär ist, eine bestimmte Menge Öl innerhalb der Pumpe enthalten ist, wohingegen, wenn die Pumpe sich dreht, das Öl aus der Pumpe herausgedrängt und von dem Vorratsbehälter aufgefangen wird, wobei das Öl wieder in die Pumpe eintritt, wenn letztere anhält.

2. Periodisch arbeitende, pneumatische Flügelzellenpumpe nach Anspruch 1, dadurch gekennzeichnet, daß der Vorratsbehälter zum Trennen und Sammeln des Öls aus einem im wesentlichen vertikalen Abschnitt des Ausloßrohrs besteht.

3. Periodisch arbeitende, pneumatische Flügelzellenpumpe nach Anspruch 1, dadurch gekennzeichnet, daß der Vorratsbehälter zum Sammeln des Öls, wenn sich die Pumpe dreht, aus einem Behälter (9) besteht, durch den die Luft, die aus der Pumpe kommt, strömt, wobei der Behälter so angeordnet ist, daß bei stationärer Pumpe das darin enthaltene Öl durch Schwerkraft in die Pumpe zurückkehrt.

4. Periodisch arbeitende, pneumatische Flügelzellenpumpe nach Anspruch 1, dadurch gekennzeichnet, daß der Vorratsbehälter zum Sammeln des Öls aus einem Behälter/Abscheider (9) einer im wesentlichen zylindrischen Form besteht, in den Luft in einer tangentialen Richtung eintritt, um die Trennung des Öls von der Luft durch den Zentrifugaleffekt zu ermöglichen, wobei der Auslaß (16) aus dem Behälter in einer im wesentlichen zentralen Position parallel zur Zylinderachse angeordnet ist und eine Vorrichtung vorgesehen ist, um den Ausgang des Öls aus dem Behälter während des Pumpenbetriebs zu blockieren und dem Öl den Wiedereintritt in die Pumpe zu ermöglichen, wenn letztere anhält.

5. Periodisch arbeitende, pneumatische Flügelzellenpumpe nach Anspruch 4, dadurch gekennzeichnet, daß der Behälter/Abscheider (9) aus zwei Plastikteilen besteht, wovon eines a) aus einem im wesentlichen zylindrischen Plastikbehälter (10) mit einem Einlaßrohr (11), das in eine vertikale Führung (12) mündet, besteht, wobei die vertikale Führung an ihrem oberen Bereich mit einer Auslaßöffnung (13) versehen ist, die die Luft tangential zur Behälterwand leitet, und an ihrem unteren Bereich mit einer engen Bohrung (14) versehen ist, durch die das von dem Behälter gesammelte Öl zur Pumpe zurückkehrt, wenn diese anhält, und wovon das andere b) aus einer Abdeckung (15) ebenfalls aus Plastik besteht, die mit einem Auslaßrohr (16) versehen ist, daß in den Behälter (10) über eine Länge hineinragt, die ausreichen muß, um das Austreten des zentrifugierten Öls zu verhindern, aber nicht unter den Pegel des in dem Behälter gesammelten Öls reichen darf, wobei die beiden Teile -der Behälter (10) und die Abdeckung (15)- durch jedes bekannte Verfahren miteinander verbunden sein können, zum Beispiel durch Ultraschallschweißen.

6. Periodisch arbeitende, pneumatische Flügelzellenpumpe nach Anspruch 5, dadurch gekennzeichnet, daß die Bohrung (14) für die Ölrückführung am Boden der vertikalen Führung (12) unter dem Druck der von der Pumpe kommenden Luft steht und in einer Wand ausgeführt ist, die dicker als die derselben vertikalen Führung (12) ist, um den Rückfluß des Öls in die Pumpe zu verhindern, wenn diese arbeitet.

7. Periodisch arbeitende, pneumatische Flügelzellenpumpe nach den Ansprüchen 1 und 4, dadurch gekennzeichnet, daß der zylindrische Sitz (3) und der Behälter/Abscheider (9) aus einem einzigen Stück, vorzugsweise aus gesintertem Material, bestehen, wobei das einzige

Stück im wesentlichen aus einem ersten Ring (17), in dem der zylindrische Sitz angeordnet ist, und aus einem zweiten Ring (18) besteht, der den Behälter/Abscheider bildet, wobei die Ringe an ihren Enden von einem Flansch (2), der eine elektrische Antriebsmaschine (1) trägt, und einem zweiten Bodenflansch (19) verschlossen werden und miteinander über eine vertikale Führung (21) verbunden sind, die a) in ihrem untern Bereich mit dem zylindrischen Sitz über eine in der Wand desselben zylindrischen Sitzes ausgeführte Vertiefung (20) in Verbindung steht und b) in ihrem oberen Bereich mit dem Behälter/Abscheider über eine im wesentliche tangentiale Führung (22) in Verbindung steht, die in der Wand des Behälterrings (18) gearbeitet ist, wobei ein weiterer schmaler Durchlaß (23) am Boden zwischen Behälter und vertikaler Führung (21) durch eine kleine Einkerbung (23) in der Wand ausgeführt ist, durch die das Öl, das während des Pumpenbetriebs in dem Behälter gesammelt wurde, in die Pumpe zurückkehrt, wenn diese anhält.

8. Periodisch arbeitende, pneumatische Flügelzellenpumpe nach Anspruch 1, dadurch gekennzeichnet, daß sie mit einer zweiten Auslaßöffnung (24) versehen ist, die mit einem Rückschlagventil (25, 26, 28) verbunden ist, wobei die zweite Öffnung vor der normalen Auslaßöffnung geöffnet wird und die Funktion hat, zu verhindern, daß Luft auf einen unnötig hohen Druck komprimiert wird, wenn der Druck in dem Benutzerkreislauf nahe dem Atmosphärendruck ist, wodurch die für die Pumpe erforderliche Leistung reduziert wird.

FIG. 1

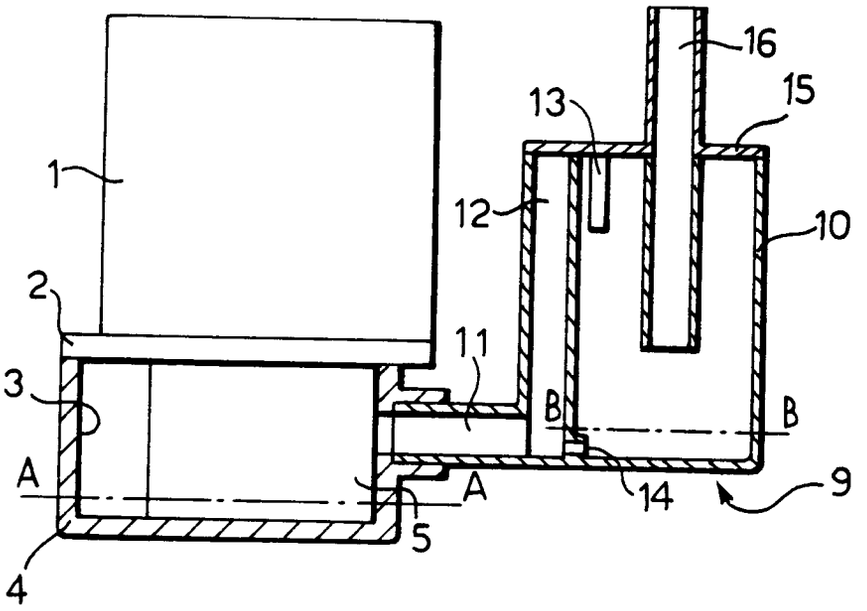

FIG. 2

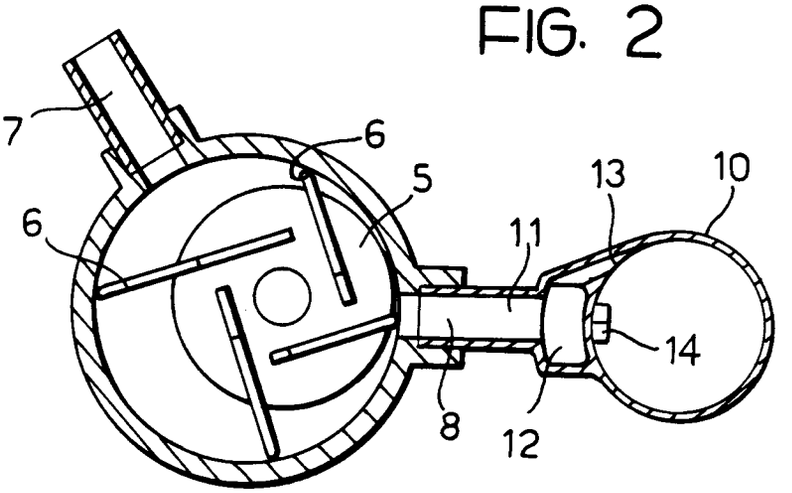

FIG. 3

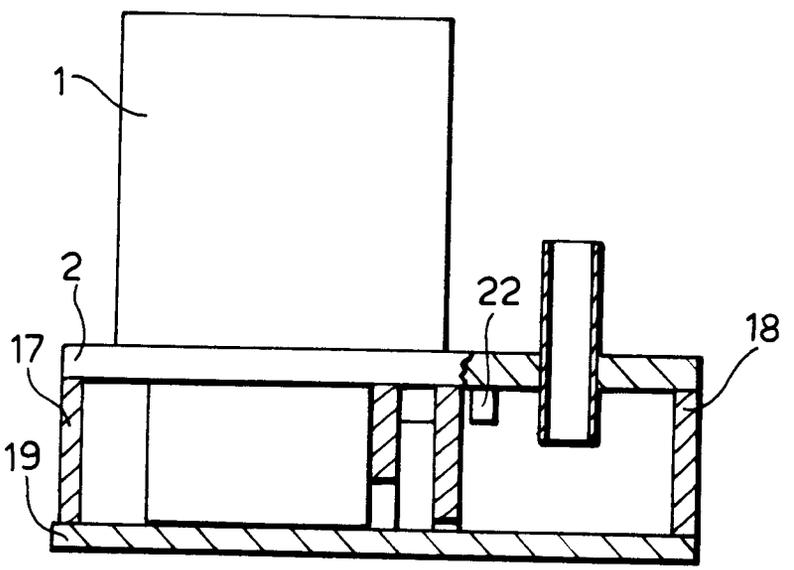

FIG. 4

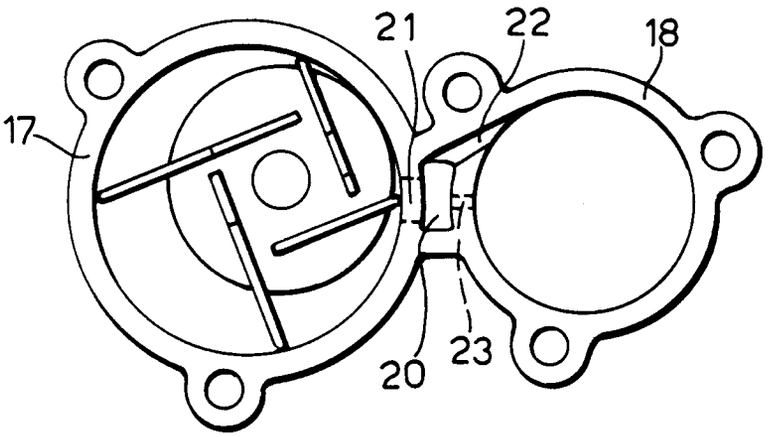

FIG. 5

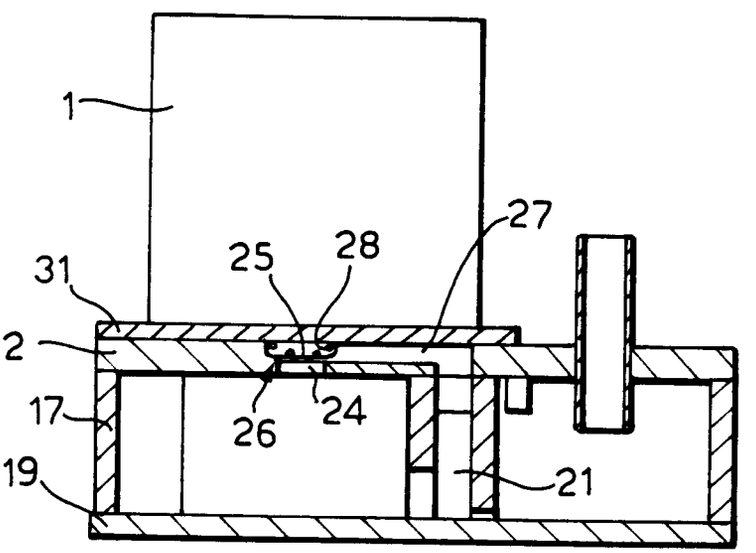

FIG. 6