(19) DANMARK

(10) **DK/EP 2347690 T3**

Patent- og Varemærkestyrelsen

(12) Oversættelse af europæisk patentskrift

(51) Int.Cl.: ***A 47 L 9/00 (2006.01)*** ***A 47 L 9/20 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2015-03-09**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2015-01-14**

(86) Europæisk ansøgning nr.: **11161193.5**

(86) Europæisk indleveringsdag: **2006-01-26**

(87) Den europæiske ansøgnings publiceringsdag: **2011-07-27**

(30) Prioritet: **2005-04-11 DE 102005017568**

(62) Stamansøgningsnr: **06706421.2**

(84) Designerede stater: **AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR**

(73) Patenthaver: **Alfred Kärcher GmbH & Co. KG, Alfred-Kärcher-Strasse 28-40, 71364 Winnenden, Tyskland**

(72) Opfinder: **Stewen, Christian, Veilchenweg 38, 71672, Marbach a. N., Tyskland**
**Häussermann, Uli, Membergstraße 6, 70734, Fellbach, Tyskland**

(74) Fuldmægtig i Danmark: **Zacco Denmark A/S, Arne Jacobsens Allé 15, 2300 København S, Danmark**

(54) Benævnelse: **Sugerengøringsapparat**

(56) Fremdragne publikationer:
**DE-A1- 1 800 480**
**DE-U1- 29 823 411**
**GB-A- 956 764**
**US-A- 4 124 916**

## Description

The invention relates to a vacuum cleaning device comprising a dirt collection container which has a suction inlet and is in flow connection with at least one suction unit via at least one filter and at least one suction line, and comprising at least one external air inlet which opens into the at least one suction line downstream of the at least one filter and can be closed by means of at least one closing valve, the at least one closing valve having a movable valve body which, in a closed position, bears against at least one valve seat so as to form one or more sealing lines, the at least one sealing line delimiting an area which, in the closed position of the closing valve, is acted upon by a differential pressure.

Vacuum cleaning devices of this type may be designed, for example, as vacuum cleaners or else as suction sweepers. They have a dirt collection container which can be acted upon with negative pressure by one or more suction units, so that a suction stream forms and dirt can be sucked into the dirt collection container under the influence of the suction stream. The dirt collection container is in flow connection with the suction unit via at least one filter and at least one suction line which follows the filter. The at least one filter permits solids, that is to say particles of dirt or dust, for example, to be separated out of the suction stream. During operation of the vacuum cleaning device, more and more solids accumulate at the filter, so that the filter constitutes an increasing resistance to flow and therefore has to be cleaned. To this end, the at least one filter can be acted upon by external air, which can flow into the suction line via the external air inlet downstream of the filter, against the direction of flow which forms during suction operation. The external air used may be, for example, ambient air or else pressurized air which is pressurized by the vacuum cleaning device or stored under pressure in a storage container. During suction operation, the external air inlet is tightly closed by the at least one closing valve which is opened for filter cleaning purposes. The at least one closing valve has a movable valve body which bears in a sealing manner against at least one associated valve seat during the

suction operation, at least one sealing line being formed between the valve seat and the valve body, and the external air inlet being tightly closed along the sealing line. The at least one sealing line delimits an area which is acted upon by a differential pressure in the closed position of the at least one closing valve.

Vacuum cleaning devices of this type are known, for example, from DE 298 23 411 U1 which proposes, for filter cleaning purposes, closing the suction inlet so that a strong negative pressure forms in the dirt collection container. A closing valve should then be opened and a filter cleaned as a result. Effective cleaning can thus be achieved but suction operation has to be completely interrupted to this end. In order to counteract this disadvantage, DE 199 49 095 A1 proposes cleaning only a subregion of the filter in each case, so that suction operation can be maintained over another subregion. Individual subregions of the filter are therefore cleaned one after the other, without suction operation having to be interrupted. However, the supply of external air in each case only to a subregion of the filter requires a closing valve mechanism of complicated design.

It is an object of the present invention to develop a vacuum cleaning device of the type mentioned in the introduction in such a way that the at least one closing valve is of structurally simple design and the at least one filter can be completely cleaned within a short time.

According to the invention, this object is achieved in the case of a vacuum cleaning device of the generic type in that the square of the total length of all sealing lines is at least 25 times the total size of all areas which are delimited by the sealing lines and acted upon by differential pressure, and in that the suction unit is also in flow connection with the at least one filter during a filter cleaning operation.

The invention incorporates the idea that, by providing one or more sealing lines which are as long as possible but which delimit as small an area as

possible, a strong, abruptly occurring external air stream can be provided within a very short time when the valve body is lifted away from the valve seat, so that the negative pressure abruptly drops on that side of the at least one filter which faces away from the dirt collection container, and external air flows through the filter in the countercurrent direction. The abrupt increase in pressure results in the filter being mechanically shaken and cleaned, it being possible for cleaning to be performed within a very short time. The total length of all sealing lines is selected to be considerably greater than the circumference of a circular area whose area corresponds to the area of the surface delimited by the sealing lines. The ratio between the square of the total length of all sealing lines and the size of the area delimited as a whole by the sealing lines is, according to the invention, at least 25 and is therefore at least twice the size as in the case of only one sealing line which surrounds a closed circular area whose circumference is defined by the sealing line. In the case of a circular area, the ratio of the square of the length of the sealing line to the size of the circular area has a value of approximately 12.5, specifically four times the number $\pi$ (3.14).

The area which is delimited by the at least one sealing line is designated that area which is acted upon by the pressure difference which forms across the closing valve in the closed position of the closing valve. This area is delimited by the at least one sealing line, and provision is made, according to the invention, for the area which is acted upon by the differential pressure to be selected to be as small as possible when a sealing line which is as long as possible is provided. Since the area which is acted upon by the differential pressure determines the force with which the closing valve is acted upon in its closed position, the provision of an area which is as small as possible can reduce the mechanical load on the closing valve. This, in turn, has the result that the closing valve can have a small overall size, and nevertheless a strong external air stream can be provided by way of the at least one sealing line, which is selected to be as long as possible, when opening the closing valve, for cleaning the filter.

It is particularly advantageous if the square of the total length of all sealing lines is at least 50 times, preferably more than 100 times, the total size of all areas which are delimited by the sealing lines. Therefore, a very long line is provided, and the external air inlet is sealed along the line. When the closing valve is opened, external air can be supplied to the filter via this sealing line. This makes it possible for effective filter cleaning to be achieved even when the closing valve is opened very briefly. For filter cleaning purposes, it is therefore necessary for the suction operation to be interrupted only for fractions of a second. This has the result that there is virtually no interruption in the suction stream at the free end of a suction hose which is connected to the suction inlet, and therefore virtually continuous suction operation can be maintained with an approximately constant suction power, that is to say with an approximately constant suction volume flow. The vacuum cleaning device according to the invention is therefore distinguished by high efficiency.

The at least one closing valve can have a single sealing line, for example, a sealing line which is configured in a star-shape or in the form of the edge of a clover leaf and has an alternating positive and negative curvature.

It has proven particularly advantageous if the at least one closing valve has a plurality of sealing lines in the form of closed sealing sections. Therefore, for example, two sealing sections can be used which define an outer edge and an inner edge of an area which is acted upon by the differential pressure.

The closed sealing sections can be disposed next to one another. However, the sealing sections preferably form sealing rings which are situated one within the other. The sealing rings are preferably disposed concentrically in relation to one another. For example, four sealing rings can be used which are disposed concentrically in relation to one another, in each case two sealing rings delimiting an annular area which is acted upon by the differential pressure. In this case, the area which is delimited overall by the sealing lines is given by the sum of the two ring areas.

The sealing rings can have a uniform spacing in relation to one another over their entire circumference, but provision may also be made for individual sealing rings to touch.

The sealing sections are preferably round and form, for example, an oval or circle.

If only one sealing line is used, this sealing line is preferably disposed in one plane. However, if a plurality of sealing lines are used, provision may also be made for the individual sealing lines to be disposed in different planes, for example, in planes which are offset or inclined in relation to one another.

In a configuration of the at least one closing valve which is particularly simple in terms of design and not susceptible to faults, the valve body has a valve disk which, with the interposition of at least one sealing element which defines a sealing line, can be engaged sealingly against the at least one valve seat. The valve disk can be very flat, so that the closing valve requires only a very small installation space.

It is advantageous if the valve disk has at least one, preferably annular, passage opening which is delimited by one or more sealing elements in the closed position of the valve disk. A configuration of this type has the advantage that, when the valve disk is lifted away from the valve seat, external air can flow, on the one hand, into the suction line laterally beside the valve disk but, on the other hand, also through the at least one passage opening in the valve disk. A strong external air stream can be achieved even when the valve disk is lifted only slightly away from the valve seat. This not only has the advantage that only a small clearance for movement has to be guaranteed for the valve disk, but, furthermore, has the advantage that even a very brief opening movement is sufficient for external air to act abruptly on the at least one filter and thus to achieve effective cleaning.

In a particularly advantageous embodiment, the at least one valve seat has a plurality of through openings which are each delimited by at least one sealing element in the closed position of the valve disk. Provision may be made, for example, for the at least one valve seat to comprise two annular through openings which are disposed concentrically in relation to one another and via which external air can flow into the suction line when the valve disk is lifted away from the valve seat.

The valve body can be pivotably mounted on the at least one valve seat or on a part which is fixed to the device. However, it is particularly advantageous if the valve body is displaceably mounted, in particular, provision can be made for the valve body to be displaceably mounted in a guide.

In an advantageous embodiment, the guide is cylindrical, since this provides the option of rotating the valve body about the cylinder axis of the guide without the opening and closing movement of the valve body being adversely affected as a result. The provision of a cylindrical guide therefore reduces the risk of the valve body tilting.

Provision may be made for the at least one closing valve to have a guide sleeve into which a guide receptacle enters. The guide sleeve can be disposed on the valve body; the guide sleeve is preferably integrally connected to the valve body.

It is expedient if the valve body is subjected to a closing force by a spring. The spring moves the valve body, which is lifted away from the valve seat when the closing valve is opened, back to its closed position as soon as the negative pressure in the suction line downstream of the at least one filter is reduced by virtue of the action of the suction unit. The suction unit is in flow connection with the at least one filter, specifically also during the filter cleaning operation, so that the external air which flows into the suction line via the closing valve and briefly acts on the filter in the countercurrent direction is sucked away by the suction unit. In the closed position, the spring ensures reliable fixing of the

valve body. When the closing valve is opened, the spring absorbs the energy of the valve body, decelerates the valve body and accelerates it back to its closed position again.

The spring can be of multi-part, in particular, two-part, configuration, it being possible for a relatively long spring part to have a smaller spring constant than a shorter spring part. The shorter spring part with the higher spring constant delimits the opening travel of the valve body and therefore also the quantity of external air entering.

As an alternative, provision may be made for a single spring which preferably has a non-linear characteristic to be used, so that the movement of the valve body at the beginning is only slightly and then more strongly impeded. As a result, a very strong pressure surge can be achieved when the closing valve is opened, by means of which pressure surge the at least one filter can be cleaned in an extremely short time.

As an alternative or in addition to the spring, provision may be made for the valve body to be held in the closed position by a magnetic holder. To this end, at least one permanent magnet can be used, for example, which reliably holds the valve body in its closed position when there are pressure differences as are produced at the at least one closing valve during proper suction operation. If the pressure difference is increased for filter cleaning purposes, the magnetic holder releases the valve body, which then lifts away from the valve seat, so that external air can flow in. The pressure difference can, for example, be increased by the negative pressure within the dirt collection container being increased, for example, by closing the suction inlet or a suction hose which is connected to the suction inlet. As an alternative or in addition, the pressure difference can be increased by external air at an overpressure being supplied to the at least one closing valve. For this purpose, the vacuum cleaning device can have a pressure reservoir which is filled by a compressor. If external air is released from the pressure reservoir, the overpressure which is formed exerts an increased force, which can no longer be compensated by the magnetic

holder, on the valve body in the opening direction, so that the at least one closing valve opens. If the supply of pressurized external air is interrupted, the overpressure then decreases and the valve body returns to its closed position under the action of the magnetic force, possibly assisted by the action of a closing spring.

It is particularly advantageous if the magnetic holder comprises an electromagnet. This permits the magnetic holder to be electrically actuated in such a way that the closing valve maintains its closed position for as long as the electromagnet is supplied with power. If the supply of power is interrupted, the closing valve abruptly opens.

It has proven particularly advantageous to configure the electromagnet as a holding solenoid. Holding solenoids of this type are distinguished by a very low magnetic remanence, so that there is virtually no residual magnetic field remaining when the supply of power is interrupted and the valve body can therefore be lifted away from the valve seat in a very short time.

Provision may be made for the at least one closing valve to be mechanically operated. However, it is advantageous if it is adapted to be electronically operated. Therefore, provision may be made, for example, for the pressure difference which is formed across the filter to be detected by means of pressure sensors. The greater the pressure difference, the greater the resistance to flow of the filter, and the at least one closing valve can be operated by means of control electronics when a predetermined value for the pressure difference is exceeded.

Time-controlled operation of the at least one closing valve is advantageous. In this case, provision may be made for the closing valve to be operated at different time intervals. In particular, further operation can be performed only after a relatively long time interval following a plurality of relatively short time intervals. However, effective filter cleaning can also be achieved when the filter is cleaned at constant time intervals.

The at least one filter is preferably configured as a folded filter, for example, in the form of a filter cartridge or a flat folded filter.

The vacuum cleaning device can have a plurality of filters, but it has proven particularly advantageous if the vacuum cleaning device comprises a single filter. In particular, provision may be made for the filter to be acted upon by external air over its entire surface by simultaneously opening all closing valves.

As explained above, the inventive configuration of the vacuum cleaning device allows the negative pressure in the suction line to be abruptly increased in that region which is adjacent to the at least one filter, and the negative pressure is then again reduced within a very short time by virtue of the action of the at least one suction unit. When the at least one closing valve is opened, the valve body can briefly remain in an open position, and then return to its closed position. However, it is particularly advantageous if the valve body, starting from its closed position, can be continuously moved back to its closed position via its open position. In a configuration of this type, the valve body executes a continuous movement when the closing valve is opened, without the valve body remaining in its open position. When the closing valve is opened, the valve body is powerfully accelerated and then decelerated again, so that it reverses its movement direction and then assumes its closed position again. The entire movement of the valve body, starting from its closed position, via the open position and back to the closed position, can take place in fractions of a second in this case.

In a particularly preferred embodiment, the at least one filter is adapted to be acted upon by external air for less than 200 ms, in particular, for less than 100 ms, by means of the closing valve. Such action does not lead to any noticeable interruption in suction operation for the user, but, on account of the provision of a very long sealing line for the at least one closing valve, results in effective cleaning of the filter.

The at least one filter can preferably be acted upon by external air by means of the at least one closing valve while maintaining a negative pressure in the mouth region of a suction hose which opens into the suction inlet. If the at least one closing valve is opened, the pressure on that side of the filter which faces away from the dirt collection container abruptly increases and is then reduced again. The abrupt increase in pressure brings about effective cleaning of the filter but since it is immediately reduced again by the at least one suction turbine it does not lead to a complete interruption in the negative pressure in the mouth region of the suction hose which opens into the suction inlet. Instead, virtually continuous suction operation can be maintained.

By way of example, provision may be made, when a 2.5m-long suction hose with an inside diameter of 35 mm is connected while the at least one filter is acted upon by external air, for the negative pressure in the suction hose at a distance of 3 cm from the suction inlet to fall, at most for 150 ms, below 40% of the value which forms when closing valves are closed. A standard hose with an inside diameter of 35 mm and a length of 2.5 m is usually connected to the vacuum cleaning device according to the invention. During suction operation, a negative pressure which can be, for example, approximately 50 mbar in the suction hose at a distance of 3 cm from the suction inlet, forms in the suction hose and in the dirt collection container if no tool is connected to the free end of the suction hose, the free end of the suction hose thus being open. If the at least one closing valve is briefly opened for filter cleaning purposes, the negative pressure at the designated point briefly drops to a value of less than 20 mbar, but at the latest after 150 ms, the negative pressure again exceeds the value of 20 mbar and again approaches the original value of 50 mbar. There is therefore no noticeable interruption in suction operation for the user. Provision may be made, for example, for the negative pressure at the designated point to drop below a value of 40% of the value which forms when closing valves are closed for less than 100 ms, in particular, for approximately 50 to approximately 80 ms.

The following description of a preferred embodiment of the invention serves to explain the invention in greater detail in conjunction with the drawings, in which:

Figure 1: shows a schematic sectional view of a vacuum cleaning device according to the invention;

Figure 2: shows an enlarged sectional view of the vacuum cleaning device from Figure 1 in the region of a closing valve;

Figure 3: shows a plan view of a detail of a valve holder of the closing valve;

Figure 4: shows a sectional view along line 4-4 in Figure 3;

Figure 5: shows a sectional view of a valve body of the closing valve;

Figure 6: shows a pictorial representation of the valve body from Figure 5; and

Figure 7: shows the variation in the negative pressure which forms, when the closing valve is operated, in the mouth region of a suction hose which is connected to the vacuum cleaning device.

In the drawing, there is schematically illustrated a vacuum cleaning device in the form of a vacuum cleaner 10, comprising a lower part which forms a dirt collection container 12 and on which an upper part 14 which accommodates a suction unit 16 is fitted. The dirt collection container 12 has a volume of up to 80 l, preferably a volume of approximately 30 l to approximately 80 l. It comprises a suction inlet 18 to which a suction hose 20 can be connected, at whose free end, not illustrated in the drawing in order to provide a better overview, a suction nozzle can be connected. As an alternative, provision may be made for the suction hose 20 to be connected to a working tool, for

example, a drilling unit or a milling unit, so that dust produced during operation of the working tool can be sucked away.

The upper part 14 forms a suction outlet 22 for the dirt collection container 12, a folded filter 24 being mounted at the suction outlet 22 and having connected to it a suction line in the form of a suction channel 26 via which the folded filter 24 is in flow connection with the suction unit 16. The dirt collection container 12 can be acted upon by negative pressure from the suction unit 16 via the suction channel 26 and the folded filter 24, so that a suction stream which is symbolized by the arrows 28 in Figure 1 is formed and dirt can be sucked into the dirt collection container 12 under the action of the suction stream. The dirt particles can be separated out of the suction stream 28 by means of the folded filter 24.

A closing valve 30, which is illustrated in an enlarged manner in Figure 2, is disposed above the folded filter 24 in the upper part 14. The closing valve comprises a valve holder 32 which is disposed in the upper part 14 in a locationally fixed manner, forms a valve seat and interacts with a valve body in the form of a valve disk 34. The valve disk 34 is subjected to a closing force in the direction of the valve holder 32 by means of a closing spring 36 with a non-linear characteristic. The closing spring 36 is clamped between a plate-like filter holder 38, which is disposed in the upper part 14 in a locationally fixed manner, and the valve disk 34.

As shown, in particular, in Figures 3 and 4, the valve holder 32 has two annular through openings 40, 42 which are disposed concentrically in relation to one another and are tightly closed by the valve disk 34 in the closed position of the closing valve 30. The through openings 40 and 42 are formed in a holding disk 44 of the valve holder 32, the holding disk 44 being divided by the through openings 40 and 42 into an outer ring 45 and an inner ring 46, which rings concentrically surround a cylindrical center part 47 and are fixed on the center part 47 by means of holding ribs 49 which protrude from the outside of the center part 47 in a radial direction.

The center part 47 comprises a hollow-cylindrical shell 51 which is covered at the top by an end wall 52 and accommodates a holding solenoid 54. The holding solenoid 54 is surrounded by an annular space 55 within the center part 47 and is electrically connected to a control unit, not illustrated in the drawing, of the vacuum cleaner 10 via connecting cables, likewise not illustrated in the drawing.

The valve disk 34 has an annular passage opening 57 through which a multiplicity of radially directed supporting ribs 58 pass, which connect an outer ring region 60 of the valve disk 34 to a circular central region 61 of the valve disk 34. A guide sleeve 63 protrudes upward from the central region 61 in the direction of the center part 47 of the valve holder 32, enters the annular space 55 in the valve holder 32 and accommodates an iron plate 64, which is adhesively bonded into the guide sleeve 63.

On its upper side which faces the valve holder 32, the valve disk 34 carries an inner sealing ring 66, a middle sealing ring 67 and an outer sealing ring 68, which rings are oriented concentrically in relation to one another and each form a sealing lip. The inner sealing ring 66 runs along an inner edge 70 of the passage opening 57, the middle sealing ring 67 runs along an outer edge of the passage opening 57 and the outer sealing ring 68 runs along the outer periphery 72 of the valve disk 34.

In the closed position of the valve disk 34, the inner sealing ring 66 bears in a sealing manner against the outer edge 74 of the through opening 40 of the valve holder 32, and the middle sealing ring 67 and the outer sealing ring 68 bear in a sealing manner against an inner edge 75 and an outer edge 76, respectively, of the through opening 42. The sealing rings 66, 67 and 68 therefore define annular sealing lines which delimit an area which is acted upon by the pressure difference which forms at the closing valve 30. In this case, the inner sealing ring 66 delimits a first, circular partial area with a radius R1, and the sealing rings 67 and 68 delimit a second, annular partial

area with an inside radius R2 and an outside radius R3. Overall, the closing valve 30 therefore has a sealing line which is defined by the sealing rings 66, 67 and 68 and whose length is given by the sum of the lengths of the sealing rings 66, 67 and 68. The sealing line formed in this way delimits an area which is acted upon by the pressure difference which forms at the closing valve 30 and is given by the sum of the described first and second partial areas. The square of the total length of the sealing line is considerably greater than 25 times the area delimited by the sealing line. Compared with a circular area whose circumference corresponds to the total length of the sealing line, the area actually delimited by the sealing line is significantly smaller than 50% of the circular area. This has the result that an intensive external air stream can form when the closing valve 30 is opened, on account of which the negative pressure in the region between the folded filter 24 and the closing valve 30 falls abruptly, so that the folded filter 24 is subjected to a pressure surge, and external air, which can flow into the upper part 14 via a lateral opening 78, briefly flows through the filter against the suction stream 28, that is to say in the countercurrent direction. The external air stream is illustrated by the arrows 80 in Figure 2.

If the closing valve 30 assumes its closed position, a negative pressure forms in the dirt collection container 12 and in the suction channel 26. If a suction hose with a length of 2.5 m and an inside diameter of 35 mm is connected to the suction inlet 18, the negative pressure in the mouth region of the suction hose, specifically at a distance of 3 cm from the suction inlet 18, is approximately 50 mbar, provided that no tool or suction nozzle is connected to the free end of the suction hose. Figure 7 shows the variation in corresponding pressure measurements. If the supply of power to the holding solenoid 54 is interrupted for operation of the closing valve 30, the magnetic force with which the iron plate 64 is held on the holding solenoid is abruptly cut off. This results in the valve disk 34 being lifted away from the valve holder 32 against the closing force of the closing spring 36 under the action of the pressure difference which prevails at the closing valve 30. The closing spring 36 absorbs the energy of the valve disk 34, decelerates the valve disk and then

accelerates it back again, so that it assumes its closed position again within a short time and closes the through openings 40 and 42 in the valve holder 32 again. The external air stream 80 is formed during the movement of the valve disk 34, so that external air flows into the dirt collection container 12 through the folded filter 24 in the countercurrent direction and the negative pressure in the mouth region of the suction hose 20 falls within approximately 40 to about 60 ms. However, since the valve disk 34 has then already assumed its closed position again and the external air which has flowed in is sucked away by the suction unit 16, the negative pressure then increases again, so as to virtually assume its original value of about 50 mbar after approximately 200 ms. Values below 40% of the value which forms when the closing valve 30 is closed, that is to say values of less than 20 mbar, are assumed by the negative pressure in the mouth region of the suction hose 20 only for a time period of about 60 ms. This results in virtually continuous suction operation being maintained for the user and reliable filter cleaning nevertheless being ensured. In this case, the closing valve has a compact configuration with a small structural shape and can be produced in a cost-effective manner.

## Patentkrav

1. Sugerengøringsapparat med en snavsopsamlingsbeholder, der har en sugeindgang og står i strømningsforbindelse med mindst et sugeaggregat via mindst et filter og mindst en sugeledning, og med mindst en fremmedluftindgang, som nedstrøms af det i det mindste ene filter munder ind i sugeledningen, og som kan lukkes ved hjælp af mindst en lukkeventil, hvor den i det mindste ene lukkeventil har et bevægeligt ventillegeme, der i en lukket stilling ved dannelse af en eller flere tætningslinjer ligger an mod mindst et ventilsæde, hvor den i det mindste ene tætningslinje begrænser en flade, som i lukkeventilens lukkede stilling er påført et differencetryk,
**kendetegnet ved,** at kvadratet af alle tætningslinjers samlede længde er mindst det 25-dobbelte af den samlede størrelse af alle flader, der er begrænset af tætningslinjerne, og som kan påføres differencetryk, og at sugeaggregatet (16) også under en filterrengøring står i strømningsforbindelse med det i det mindste ene filter (24).

2. Sugerengøringsapparat ifølge krav 1, **kendetegnet ved,** at kvadratet af alle tætningslinjers samlede længde er mindst det 50-dobbelte af den samlede størrelse af alle flader, der er begrænset af tætningslinjerne.

3. Sugerengøringsapparat ifølge krav 1 eller 2, **kendetegnet ved,** at den i det mindste ene lukkeventil (30) har flere tætningslinjer i form af lukkede tætningsstrækninger (66, 67, 68).

4. Sugerengøringsapparat ifølge krav 3, **kendetegnet ved,** at tætningsstrækningerne danner tætningsringe (66, 67, 68), der ligger inden i hinanden.

5. Sugerengøringsapparat ifølge krav 3 eller 4, **kendetegnet ved,** at tætningsstrækningerne (66, 67, 68) er anbragt i et fælles plan.

6. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at ventillegemet har en ventiltallerken (34), der ved mellemlægning af mindst et tætningselement (66, 67, 68), der definerer en tætningslinje, kan lægges tæt an mod det i det mindste ene ventilsæde (32).

7. Sugerengøringsapparat ifølge krav 6, **kendetegnet ved,** at ventiltallerkenen (34) har mindst en gennemgangsåbning (57), der i ventiltallerkenens (34) lukkede stilling er begrænset af mindst et tætningselement (66, 67).

8. Sugerengøringsapparat ifølge krav 6 eller 7, **kendetegnet ved,** at det i det mindste ene ventilsæde (32) har flere gennemgangsåbninger (40, 42), der i ventiltallerkenens (34) lukkede stilling hver især er begrænset af mindst et tætningselement (66, 67, 68).

9. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at ventillegemet (34) holdes forskydeligt i en føring (55).

10. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at ventillegemet (34) er påført en lukkekraft ved hjælp af en fjeder (36).

11. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at ventillegemet (34) holdes i den lukkede stilling ved hjælp af en magnetholder (54).

12. Sugerengøringsapparat ifølge krav 11, **kendetegnet ved,** at magnetholderen omfatter en elektromagnet (54).

13. Sugerengøringsapparat ifølge krav 12, **kendetegnet ved,** at elektromagneten er udformet som elektroholdemagnet (54).

14. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at den i det mindste ene lukkeventil (30) kan betjenes elektronisk.

15. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at ventillegemet (34) udgående fra sin lukkede stilling kontinuerligt kan bevæges tilbage til sin lukkede stilling via sin åbnede stilling.

16. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at det i det mindste ene filter (24) kan påføres fremmedluft i mindre end 200 ms ved hjælp af den i det mindste ene lukkeventil (30).

17. Sugerengøringsapparat ifølge et af de foregående krav, **kendetegnet ved,** at det i det mindste ene filter (24) ved hjælp af den i det mindste ene lukkeventil (30) kan påføres fremmedluft ved opretholdelse af et undertryk i mundingsområdet af en sugeslange (20), der munder ind i sugeindgangen (18).

18. Sugerengøringsapparat ifølge krav 17, **kendetegnet ved,** at, når en 2,5 m lang sugeslange med en indvendig diameter på 35 mm tilsluttes, mens det i det mindste ene filter (24) påføres fremmedluft, undertrykket i sugeslangen i en afstand på 3 cm fra sugeindgangen (18) i bedste fald i 150 ms falder under 40 % af den værdi, der dannes ved lukkede lukkeventiler.

FIG.1

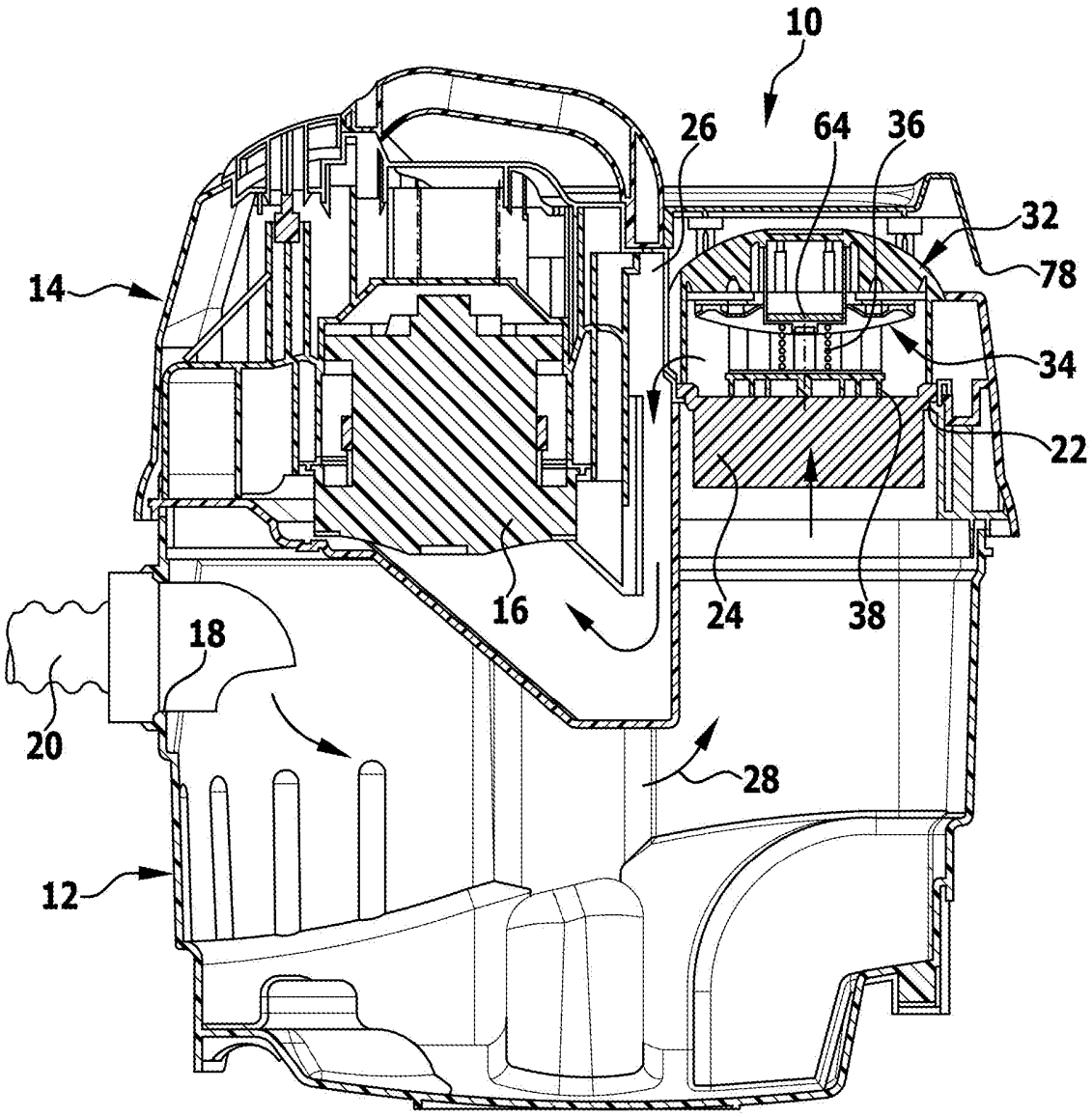


FIG.2

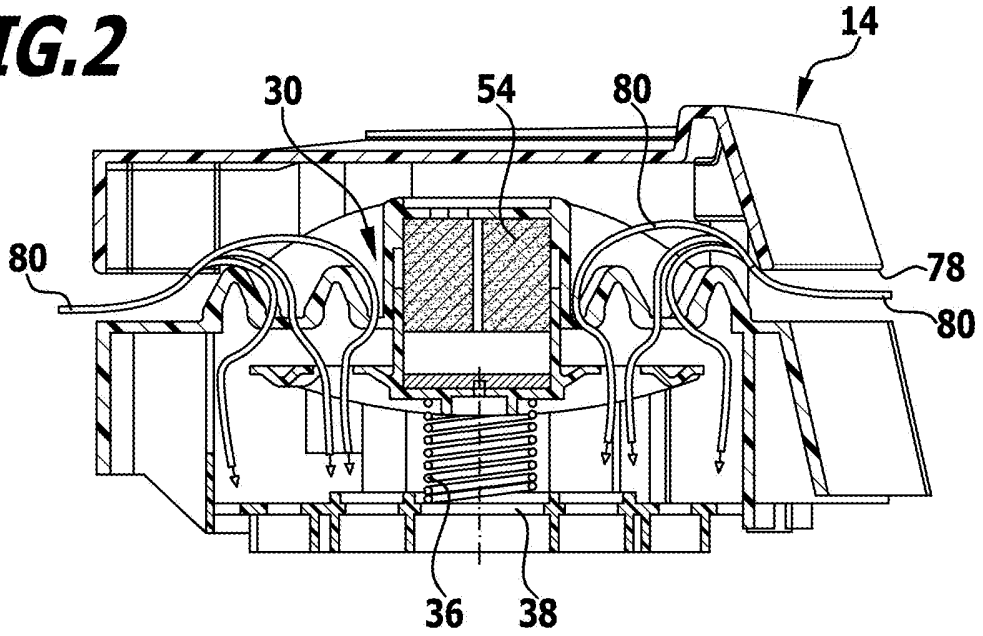



FIG.3

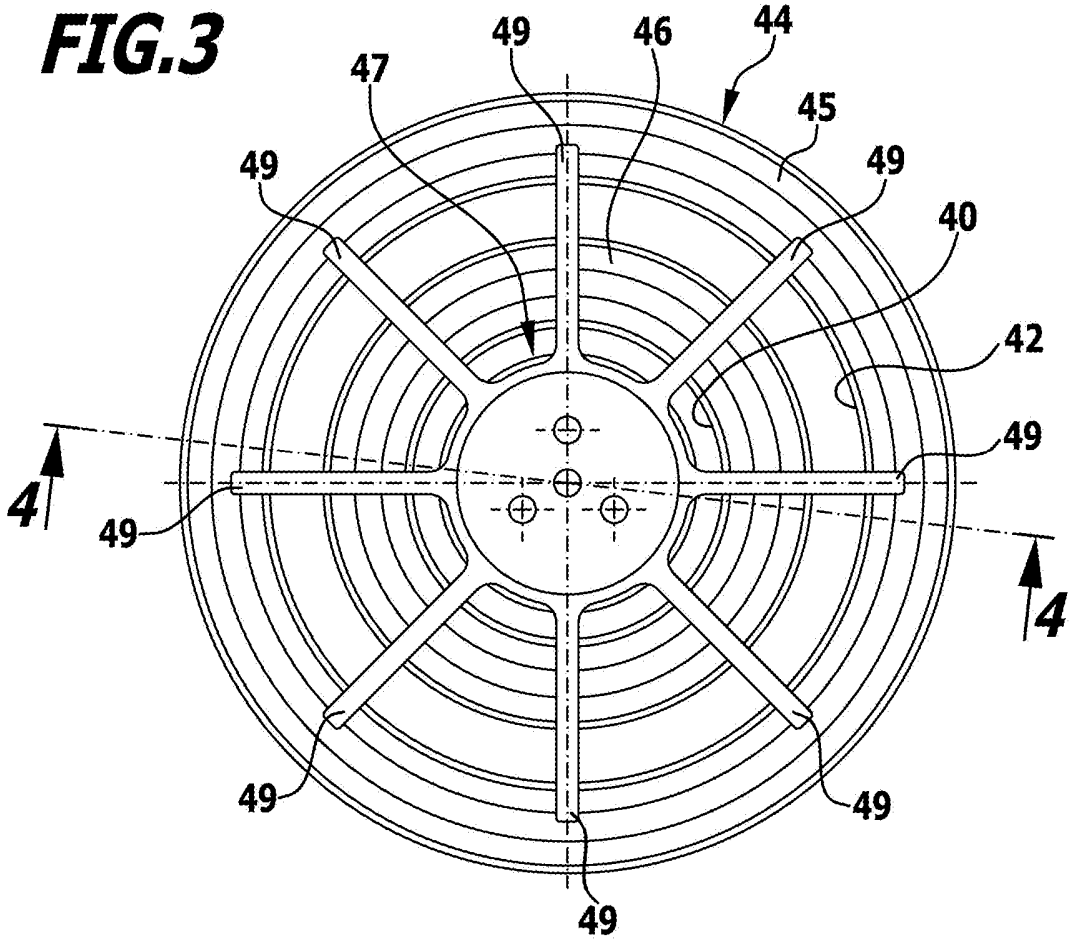


FIG.4

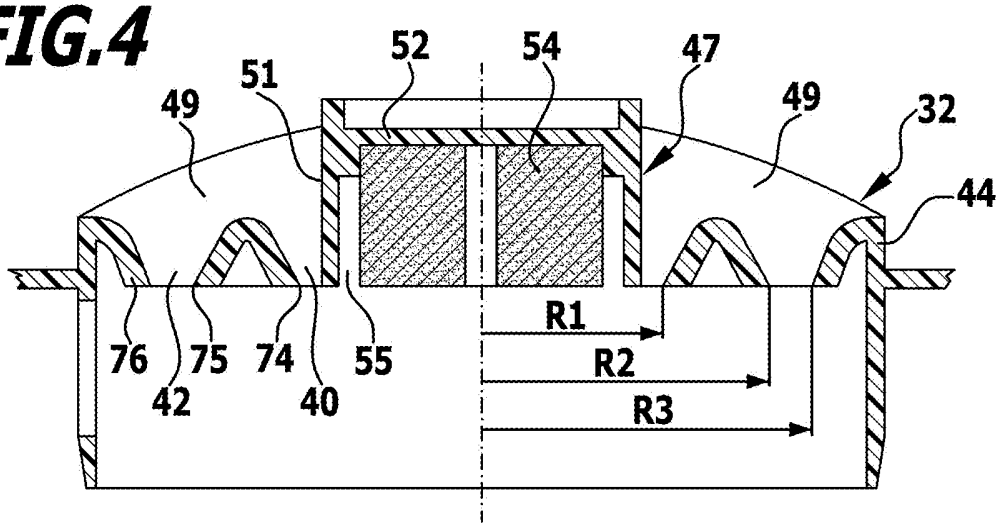



FIG.5

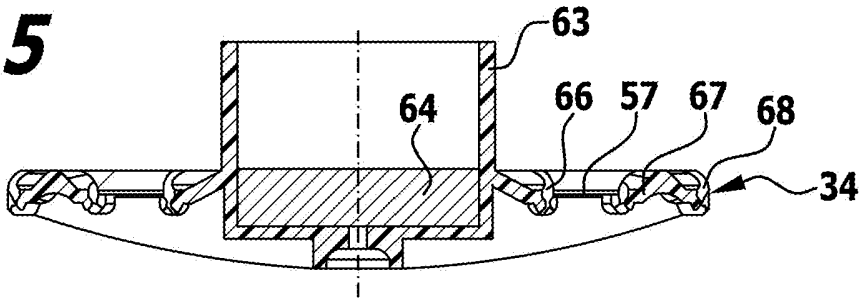



FIG.6

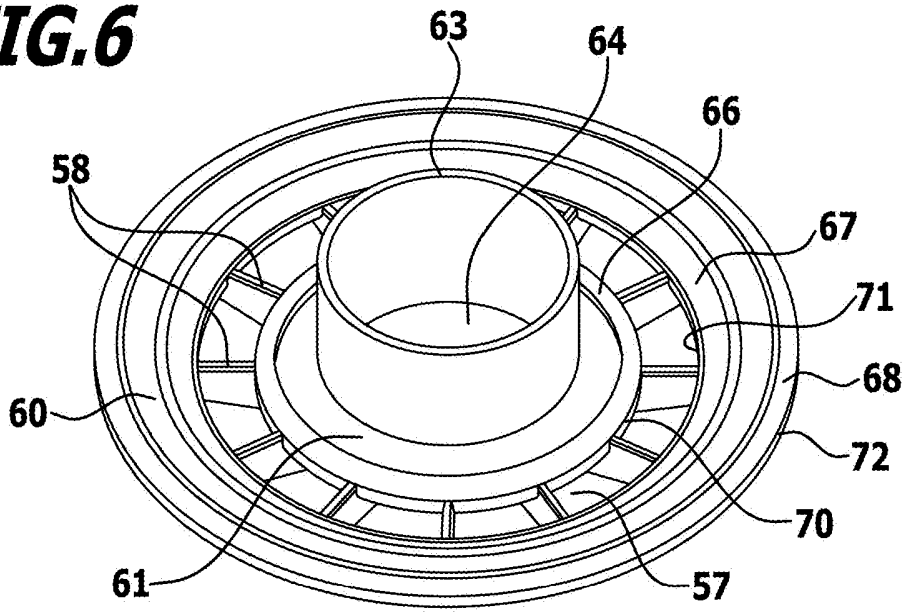
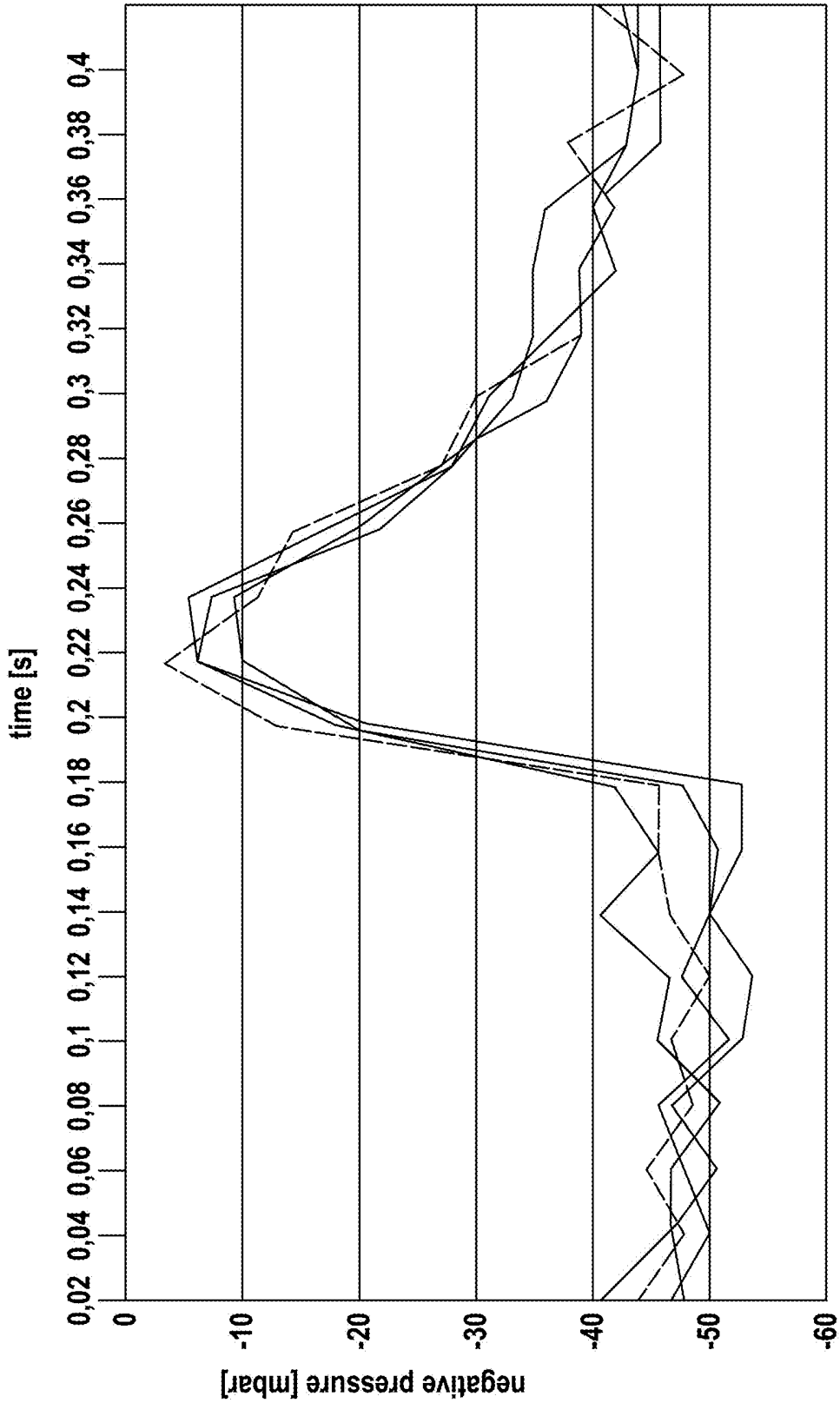


FIG.7


time [s]
0,02 0,04 0,06 0,08 0,1 0,12 0,14 0,16 0,18 0,2 0,22 0,24 0,26 0,28 0,3 0,32 0,34 0,36 0,38 0,4
negative pressure [mbar]
0 -10 -20 -30 -40 -50 -60