

(19) **DANMARK**



Patent- og
Varemærkestyrelsen

(10) **DK/EP 3214926 T3**

(12) Oversættelse af
europæisk patentskrift

-
- (51) Int.Cl.: **A 01 J 7/02 (2006.01)**
- (45) Oversættelsen bekendtgjort den: **2020-07-27**
- (80) Dato for Den Europæiske Patentmyndigheds
bekendtgørelse om meddelelse af patentet: **2020-04-22**
- (86) Europæisk ansøgning nr.: **15808783.3**
- (86) Europæisk indleveringsdag: **2015-11-02**
- (87) Den europæiske ansøgnings publiceringsdag: **2017-09-13**
- (86) International ansøgning nr.: **IB2015058455**
- (87) Internationalt publikationsnr.: **WO2016071820**
- (30) Prioritet: **2014-11-05 IT TO20140914**
- (84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV
MC MK MT NL NO PL PT RO RS SE SI SK SM TR**
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- (54) Benævnelse: **LUFTINJEKTOR TIL MALKEANLÆG**
- (56) Fremdragne publikationer:
GB-A- 2 062 179
GB-A- 2 316 290

DESCRIPTION

Technical Field

[0001] The present invention relates to an air injector for milking plants which is used for injecting air into a milking plant during washing of said plant.

[0002] More particularly, the air injector is arranged to make controlled quantities of air flow into the milking plant in order to create turbulence within the washing fluid for the plant.

Prior Art

[0003] In the field of milking plants it is known to use air injectors for obtaining thorough washing of the milking plant.

[0004] In breeding farms for dairy animals, a thorough washing of the plant, subsequent to its use, is considered fundamental to the protection of the plant components, the hygiene of the milked milk and the health of the animals coming into contact with the parts of the plant.

[0005] In order to obtain a suitable and effective washing of the plant, in addition to using a washing solution having appropriate characteristics in terms of concentration of the detergent or acid and water temperature, it is necessary that the aqueous solution exerts a mechanical action against the pipes and components which make up the plant and with which said solution comes into contact, and that such action is effective even in the case of particularly low levels of vacuum of the milking plant.

[0006] In order to increase the mechanical action exerted by the aqueous solution in known milking plants, a device called "air injector" is inserted, which device, being electrically controlled, cyclically makes controlled quantities of air flow into the plant, said air quantities creating turbulence within the solution with which they come into contact, due to the bubbles forming therein; the air injector during the washing step cyclically injects with a desired frequency controlled quantities of air into the pipes of the milking plant.

[0007] Air injection is obtained by the movement of a membrane, in turn generated by the alternating presence of vacuum and atmospheric air above the membrane.

[0008] Such air becomes mixed with the aqueous washing solution present in the same pipe, thus generating a two-phase fluid because of the presence of air bubbles trapped in the washing solution. During the path of the two-phase mixture inside the pipes, the air bubbles collide against the surfaces of the pipes and components with which they inevitably come into contact, generating a mechanical action of rubbing against said pipes and components by

breaking upon collision.

[0009] However, the devices of the above type have several drawbacks.

[0010] A drawback is caused by the difficulty to obtain a rapid movement of the membrane, such as to cyclically inject at high frequency small quantities of air into the pipes of the plant during its washing cycle, thus generating a highly turbulent motion of the washing fluid for the plant.

[0011] Another drawback is the fact that a high energy consumption is required in order to generate a rapid movement of the membrane.

[0012] A further drawback is caused by the fact that the device has remarkable overall dimensions, which complicate installation, especially on particularly compact plants.

[0013] GB 2 062 179 discloses a valve assembly for milking plants, which valve assembly comprises a first housing member connectable to a vacuum line and defining a first chamber, a second housing member defining a second chamber, a flexible diaphragm mounted between the first and second housing members to separate the first and second chambers, the diaphragm being movable between an unflexed position and a flexed position in response to forces exerted on opposite sides thereof and a valve for placing said first chamber in communication with the atmosphere through one or more openings in the first housing when said diaphragm is in its flexed position and for cutting off the first chamber from the atmosphere when said diaphragm is in its unflexed position. According to the disclosure of GB 2 062 179, this valve is mounted on the membrane and, more precisely, it comprises a disc contacting a first side of the membrane and a supporting counter-plate on the second, opposite side of said membrane.

Summary of the Invention

[0014] One object of the present invention is to provide an air injector that is able to inject at high frequency air into the pipes of the plant, thus generating a highly turbulent motion of the washing fluid.

[0015] Another object of the present invention is to provide an air injector that functions with low energy consumption.

[0016] A further object of the present invention is to provide an air injector which has reduced overall dimensions.

[0017] These and other objects are achieved by the present invention by providing an air injector according to the appended claims.

[0018] It is to be understood that the appended claims are an integral part of the technical teaching provided herein in the present disclosure of the invention.

Brief Description of the Drawings

[0019] Further features and advantages of the present invention will become more apparent from the following detailed description, given merely by way of non-limiting example, with reference to the annexed drawings, in which:

- Figure 1 is a sectional view of an air injector according to the present invention;
- Figure 2 is a perspective view of a detail of an air injector according to the present invention; and
- Figure 3 is a perspective view of a detail of an air injector according to the present invention.

Description of a Preferred Embodiment

[0020] Referring to the Figures, there is illustrated an exemplary embodiment of an air injector 10 for milking plants according to an embodiment of the present invention.

[0021] The air injector 10 comprises a lower body 11 having an air inlet opening 12 for inletting air into the plant, a membrane 14 supportedly mounted on the air inlet opening 12 and a tight-sealed lower chamber 25 inferiorly delimited by the membrane 14 and superiorly delimited by an upper body or cover 15; preferably, the air inlet opening 12 has a rounded rim 13 against which the membrane 14 rests.

[0022] The membrane 14 is connected to the lower body 11, preferably it is held between the lower body 11 and the upper body 15 so as to tightly seal the lower chamber 25 and is formed in known manner, for example is made of silicone, with a convoluted profile which is necessary to enable the membrane to effect a travel so as to open and close the air inlet opening 12.

[0023] The lower body 11 constitutes the supporting structure of the air injector 10 and comprises, in its upper portion, a membrane seat 18 adapted to house the membrane 14, whereas its lower portion is preferably constituted by a cylindrical duct 16 ending in the air inlet opening 12 and being connectable to a washing line of the milking plant, for example by means of a rubber sleeve.

[0024] Preferably suction openings 21 are provided in the membrane seat 18 for sucking atmospheric air to be inlet into the milking plant, said openings being separated from the outside through a filter 22 suitable for retaining impurities present in the inlet air, and a shutter,

which is intended for regulating the flow rate of the incoming air and is controlled for instance by rotating a ferrule 19 fixed thereto and manually operable, is provided between the filter 22 and the suction openings 21.

[0025] Preferably, the filter 22 is located in the lower portion of the air injector 10 and is protected from the jets of washing water for the plant. The air injector 10 of the invention further includes, in sequence from the top, the suction openings 21, arranged in the lower body 11, for sucking the atmospheric air to be inlet into the plant, an annular chamber 20 being provided beneath said openings and being arranged between the lower body 11, the ferrule 19 and a first containment grid 32 of the sponge filter 22. The filter 22, consisting of an annular ring of sponge material having the same diameters as the first containment grid 32 with which it comes into contact, is arranged between the first containment grid 32, which is superposed on the filter 22, and a second containment grid 33 located underneath, in order to create a real barrier against the dirt contained in the air passing through the filter. Preferably, the first containment grid 32 is press-fitted on the second containment grill 33, which in turn is retained on the cylindrical duct 16 by virtue of absence of mechanical clearance between the parts.

[0026] The membrane 14 is supportedly mounted on the air inlet opening 12 and its opening and closing movement cyclically inlets atmospheric air into in the milking plant through the air inlet opening 12; the air that is inlet into the plant is the same air coming from the adjacent suction openings 21, which are adjustable by acting on the rotatable ferrule 19.

[0027] The air injector 10 comprises a coil 23 comprising a mobile core 24 and preferably a control card for the coil 23; the coil 23 and the control card are housed in the upper body 15 and are protected by a hood mounted in a tight sealing manner on the underlying upper body or cover 15, so as to prevent any accidental penetration of water into the card seat, for instance during washing of the environments in which the milking plant is installed, which would cause short-circuiting of the system. The tight-sealing is obtained for instance by providing the hood with a gasket which is compressed onto the upper body 15 with which it comes into contact during its fixing on the product; the control card and the coil 23 are powered by means of a low voltage power cable, this cable, too, being protected in a known manner, for instance by means of sealing gaskets, against undesired penetration of water.

[0028] In particular the coil 23, the movable core 24 and the control card are housed on the surface of the upper body 15 that is opposite to the one delimiting the lower chamber 25. In a known manner, the control card comprises a microcontroller which can be programmable or non-programmable and is connected to a display having the function of displaying the value of the preset parameters.

[0029] The coil 23 is provided with a coil through hole 26 formed in its upper portion, a cylindrical seat 27 housing the movable core 24 extending beneath said upper portion, still in its internal part; the coil hole 26 connects the cylindrical seat 27 to the outside.

[0030] Preferably, the coil 23 has a power lower than 3.2 W and comprises a metal insert

which is inserted in its upper portion and in which the coil through-hole 26 is formed; according to the invention, the metal insert is inserted in the upper portion of the cylindrical seat 27.

[0031] The movable core 24 in turn is constituted by a metal cylinder movable in the cylindrical seat 27 and for example made of steel of the same type as the metal insert mentioned above, and preferably comprises a protruding plastic plug 28 connected to each of its two ends. In the upper body 15, beneath the coil 23, there is provided a tight-sealed upper chamber 35, obtained for example with a sealing gasket of the O-ring type, said chamber being superiorly delimited by the coil 23 and being connected to the outside through the coil hole 26 by means of the cylindrical seat 27 connected to the upper chamber 35.

[0032] The upper chamber 35 has its size, in particular its volume, smaller than that of the lower chamber 25 and has a width smaller than the width of the coil 23; preferably, the upper chamber 35 has a circular section with a diameter smaller than the diameter of the coil 23, in particular smaller than 20.5 mm.

[0033] The upper body 15 further comprises a first hole 29 having a small diameter, preferably smaller than 2 mm, which connects the upper chamber 35 to a vacuum duct 36.

[0034] The mobile core 24 and preferably the plastic plug 28 connected thereto rests on the first hole 29, which is open or close depending on whether the mobile core 24 is lifted from the coil or not.

[0035] When the mobile core 24 rests on the first hole 29, thus closing it, the coil hole 26 is open and the atmospheric air can freely pass from the coil hole 26 to a gap provided between the cylindrical seat 27 and the mobile core 24, so as to arrive to the upper chamber 35; conversely, when the mobile core 24 is lifted, the coil hole 26 is closed by the mobile core 24, or preferably by the plastic plug 28, and the first hole 29 is open, as will be described in more detail below; preferably, the coil hole 26 connects the upper chamber 35 to the outside through the cylindrical seat 27 of the coil.

[0036] The first hole 29, on which the mobile core 24 rests when it is in its rest position, ends in the vacuum duct 36 connected to the vacuum pipe of the milking plant; therefore, when the vacuum pump is working and the mobile core 24 is lifted, the first hole 29 and the vacuum duct 36 allow to create vacuum in the upper chamber 35.

[0037] The first hole 29 and the vacuum duct 36 are provided in the upper chamber 15. Preferably, the upper chamber 35 has a substantially round shape and the first hole 29 is provided at the center of the upper chamber 35; in a preferred manner, the vacuum duct 36 is horizontal and is formed by portions of different diameter.

[0038] The upper body 15 further comprises a second hole 30 provided in the upper chamber 35 and connecting the upper chamber 35 to an annular connecting chamber 31 that is an integral part of the chamber 25, shown in Figure 3, in which the cover 15 is shown upside

down with respect to how it is shown in Figures 1 and 2; the annular connecting chamber 31 in turn is an integral part of the lower chamber 25; therefore, when the mobile core 24, in its rest position, closes the first hole 29 and opens the coil hole 26, the annular connecting chamber 31 and the second hole 30 allow to connect the lower chamber 25 to the outside, thus bringing said lower chamber to the atmospheric pressure.

[0039] The second hole 30 and the annular connecting chamber 31 are provided in the upper body 15. Preferably, the second hole 30 is provided on the periphery of the upper chamber 35, next to the first hole 29; in a preferred manner, the annular connecting chamber 31 is cylindrical and has a diameter greater than that of the second hole 30.

[0040] The operation of the air injector 10 of the invention is as follows.

[0041] During the washing cycle, the air injector 10 cyclically inlets at high frequency small quantities of air into the milking plant through the air inlet opening 12, by virtue of the alternating opening and closing movement of the membrane 14.

[0042] The air is inlet into the plant with the same power supply frequency as the coil 23 and thus generates an extremely turbulent motion inside the piping of the plant; the power supply frequency is generated by an external power supply, or by a control card housed in the upper body 15, if the control card is programmable.

[0043] The motion imparted to the membrane 14 is generated by the action of the vacuum alternated to the atmospheric air within the lower chamber 35 which is arranged above the membrane 14.

[0044] The presence of air at atmospheric pressure or of vacuum in the lower chamber 25 is obtained by opening and closing alternately at the desired frequency the coil hole 26, which connects the upper chamber 35 to the outside, and the first hole 29, which connects the upper chamber 35 to the vacuum duct 36 connected to the vacuum pipe of the milking plant.

[0045] By energizing the coil 23 and de-energizing the same alternately the mobile core 24 is displaced so as to open or close the coil hole 26 and the first hole 29, in order to allow inflow of atmospheric air into or vacuum creation in the upper chamber 35 and in the lower chamber 25 connected thereto through the second hole 30 and the annular connecting chamber 31.

[0046] During its operation, the membrane 14 therefore moves from a rest position in which its lower side is in contact with the rim 13 of the air inlet opening 12 through which the air injector 10 inlets air into the plant while atmospheric air is present in the lower chamber 25, to a working position in which the membrane 14 is lifted and detached from the air inlet opening 12 on which it was resting before, thus connecting the suction openings 21 for sucking atmospheric air to the air inlet opening 12 so as to inlet air into the milking plant, and the lower chamber 25 is under negative pressure and not at atmospheric pressure.

[0047] When the coil 23 is not energized, the movable core 24 is located in its rest position in the lower portion of its cylindrical seat 27 in which it can slide, and closes the first hole 29 connected to the vacuum duct 36 and to the vacuum pipe of the plant. When the movable core 24 rests on the first hole 29, in its rest position, the coil hole 26 is open and connects the inside of the coil to the inside of the hood which is at atmospheric pressure. Consequently, also the upper chamber 35 and the lower chamber 25, connected thereto through the second hole 30 and the annular connecting chamber 31, are at atmospheric pressure, thus maintaining the membrane 14 resting on the air inlet opening 12 and preventing entrance of air into the milking plant.

[0048] When the coil is energized, the metal insert with through hole incorporated in it is magnetized and attracts to itself the movable core 24, lifting it from the rest position in which it rests on the first hole 29 that serves as a vacuum source. When lifted, the movable core 24 opens the first hole 29 fed with vacuum, while closing the coil hole 26 which communicates with the atmospheric air external to the coil itself. In this way, the upper chamber 35 located beneath the coil 23 is put under vacuum together with the lower chamber 25 delimited by the membrane 14, as said lower chamber 25 is in communication with the upper chamber 35 through the second hole 30 and the annular connecting chamber 31. The membrane 14, being subjected to the action of vacuum in its upper portion, is lifted, thus opening the underlying air inlet opening 12 on which it has been resting until now; the surrounding air which has been inlet into the air injector 10 through the filter 22, the annular chamber 20 and the suction openings 21 then enters through the air inlet opening 12 now open and, passing beneath the membrane 14, becomes mixed with the washing solution circulating inside the pipes of the milking. The coil will stay energized for a very short time, quantifiable in a few seconds, after which the power supply is interrupted.

[0049] Advantageously, the air injector of the invention allows to obtain a rapid movement of the membrane and a consequent high frequency of air injection into the pipes of the plant during the washing cycle, thus generating a highly turbulent motion of the washing fluid for the plant.

[0050] Another advantage is given by the fact that a low energy consumption is required to generate a rapid movement of the membrane.

[0051] A further advantage is brought by the limited overall dimensions of the device, which allow easy installation thereof in the milking plant.

[0052] Of course embodiments and embodiment details may be widely varied with respect to what has been described and illustrated merely as a non-limiting example. The scope of the present invention is defined by the appended claims.

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- GB2062179A [0013] [0013]

Patentkrav

1. Luftinjektor (10) til malkeanlæg der omfatter:

- et nedre legeme (11) med en luftindløbsåbning (12) til indføring af luft i malkeanlægget;
 - 5 - en membran (14) der er monteret understøttet på luftindløbsåbningen (12);
 - et tæt forseglet nedre kammer (25) som nedadtil er afgrænset af membranen (14) og opadtil af et øvre legeme (15);
 - 10 - en spole (23) der er indeholdt i det øvre legeme (15) og som omfatter en mobil kerne (24) og et spolehul (26) der er forbundet til ydersiden;
 - et tæt forseglet øvre kammer (35) der er dannet i det øvre legeme (15), er opadtil afgrænset af spolen (23) og er forbundet med ydersiden gennem spolehullet (26),
- hvilket øvre legeme (15) omfatter et første hul (29), der står i forbindelse med
- 15 det øvre kammer (35) via en vakuumkanal (36), der er forbundet til malkeanlægget via med et vakuumrør, og hvor det øvre legeme (15) omfatter et andet hul (30) der er dannet i det øvre kammer (35), hvilket andet hul (30) fører ind i et ringformet forbindelseskammer (31) der er forbundet til det nedre kammer (25), hvilken mobile kerne er indrettet til at bevæge sig fra en hvileposition, i
- 20 hvilken den lukker det første hul (29) og åbner spolehullet (26), til en position, hvor den mobile kerne (24) er løftet og åbner det første hul (29), mens den lukker spolehullet (26), for således at lade luft strømme ind i eller skabe vakuum i det øvre kammer (35) og i det nedre kammer (25), der er forbundet dertil for at generere en bevægelse af membranen (14), hvilken spole (23) omfatter et cy-
- 25 lindrisk sæde (27), i hvilket den mobile kerne (24) er indeholdt, og som er forbundet til det øvre kammer (35), hvilket spolehul (26) forbinder det cylindriske sæde (27) med ydersiden, og hvilken spole (23) omfatter en metalindsats, der er indsat i den øvre del af det cylindriske sæde (27), og i hvilken spolehullet (26) er dannet.
- 30 **2.** Luftinjektoren (10) ifølge krav 1, **kendetegnet ved, at** det øvre kammer (35) har en størrelse, der er mindre end størrelsen af det nedre kammer (25) og har en bredde, der er mindre end bredden af spolen (23).

3. Luftinjektoren (10) ifølge krav 2, **kendetegnet ved, at** det øvre kammer (35) har en cirkulær sektion med en diameter, der er mindre end diameteren af spolen (23).
- 5 4. Luftinjektor (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** membranen (14) holdes mellem det nedre legeme (11) og det øvre legeme (15) således at det forsegler det nedre kammer (25) tæt.
- 10 5. Luftinjektor (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** det nedre legeme (11) omfatter i sin øvre del et membransæde (18) til at indeholde membranen (14) og at sugeåbninger (21) er tilvejebragt i membransædet (18) for at suge atmosfærisk luft ind i indløbet af malkeanlægget, hvilke åbninger adskilles fra ydersiden gennem et filter (22), der er egnet til at tilbageholde urenheder, som er til stede i indløbsluften.
- 15 6. Luftinjektoren (10) ifølge krav 5, **kendetegnet ved, at** membranen (14) der er monteret understøttet på luftindløbsåbningen (12), er tilpasset, i kraft af sin åbne- og lukkebevægelse, til cyklisk at indtage atmosfærisk luft ind i malkeanlægget gennem selve luftindløbsåbningen (12), og at luften der er indløbet i malkeanlægget, er den samme luft der kommer fra sugeåbningerne (21), og som kan justeres ved at virke på en drejelig rørring (19).
- 20 7. Luftinjektor (10) ifølge krav 5 eller 6, **kendetegnet ved, at** filteret (22) er anbragt mellem et første indeslutningsgitter (32), der er placeret på filteret (22), og et andet indeslutningsgitter (33), der er anbragt under filteret (22).
- 25 8. Luftinjektor (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** det omfatter et kontrolkort til spolen (23), hvilket kontrolkort er indeholdt i det øvre legeme (15) og beskyttet sammen med spolen (23) af en hætte, der er monteret på en tæt forsegrende måde på det underliggende øvre legeme (15), således at det forhindre vand i at komme ind i luftinjektoren (10).
- 30

9. Luftinjektor (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** vakuumkanalen (36) er vandret og er dannet af dele med forskellig diameter.

5 **10.** Luftinjektor (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** det andet hul (30) er tilvejebragt på periferien af det øvre kammer (35) ved siden af det første hul (29).

10 **11.** Luftinjektor (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at** luftindløbsåbningen (12) har en afrundet kant (13), mod hvilken membranen (14) hviler.

DRAWINGS

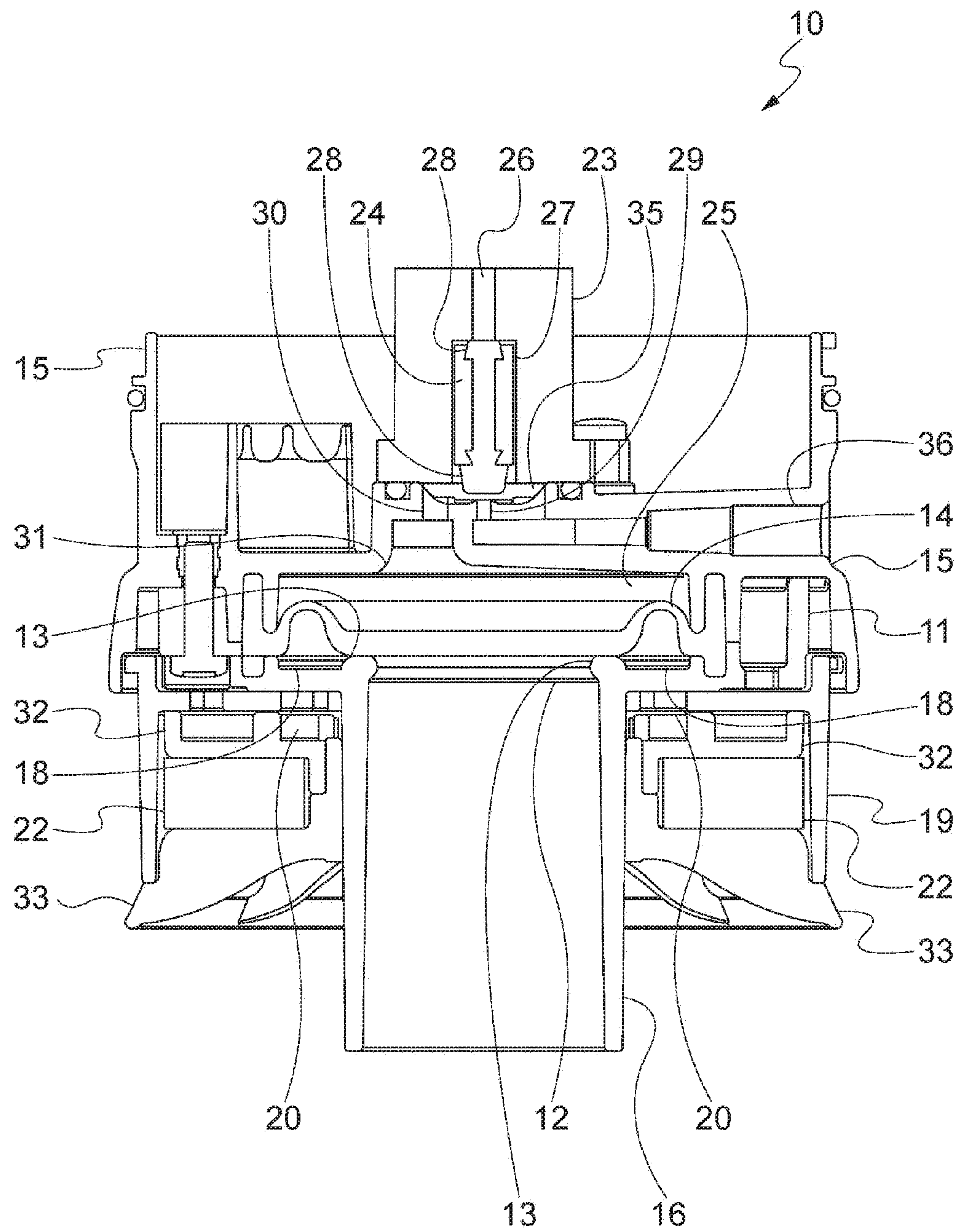


Fig. 1

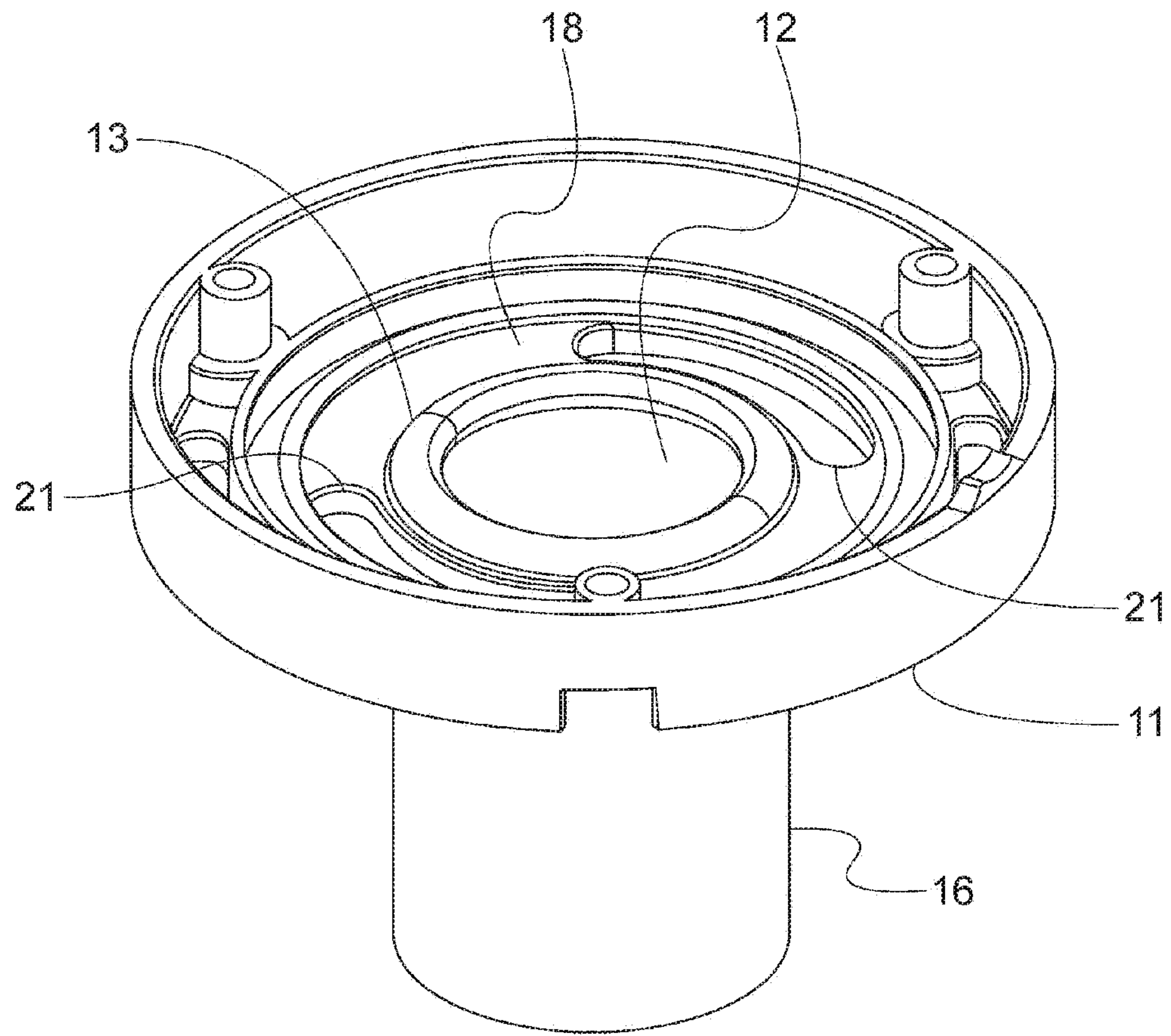


Fig. 2

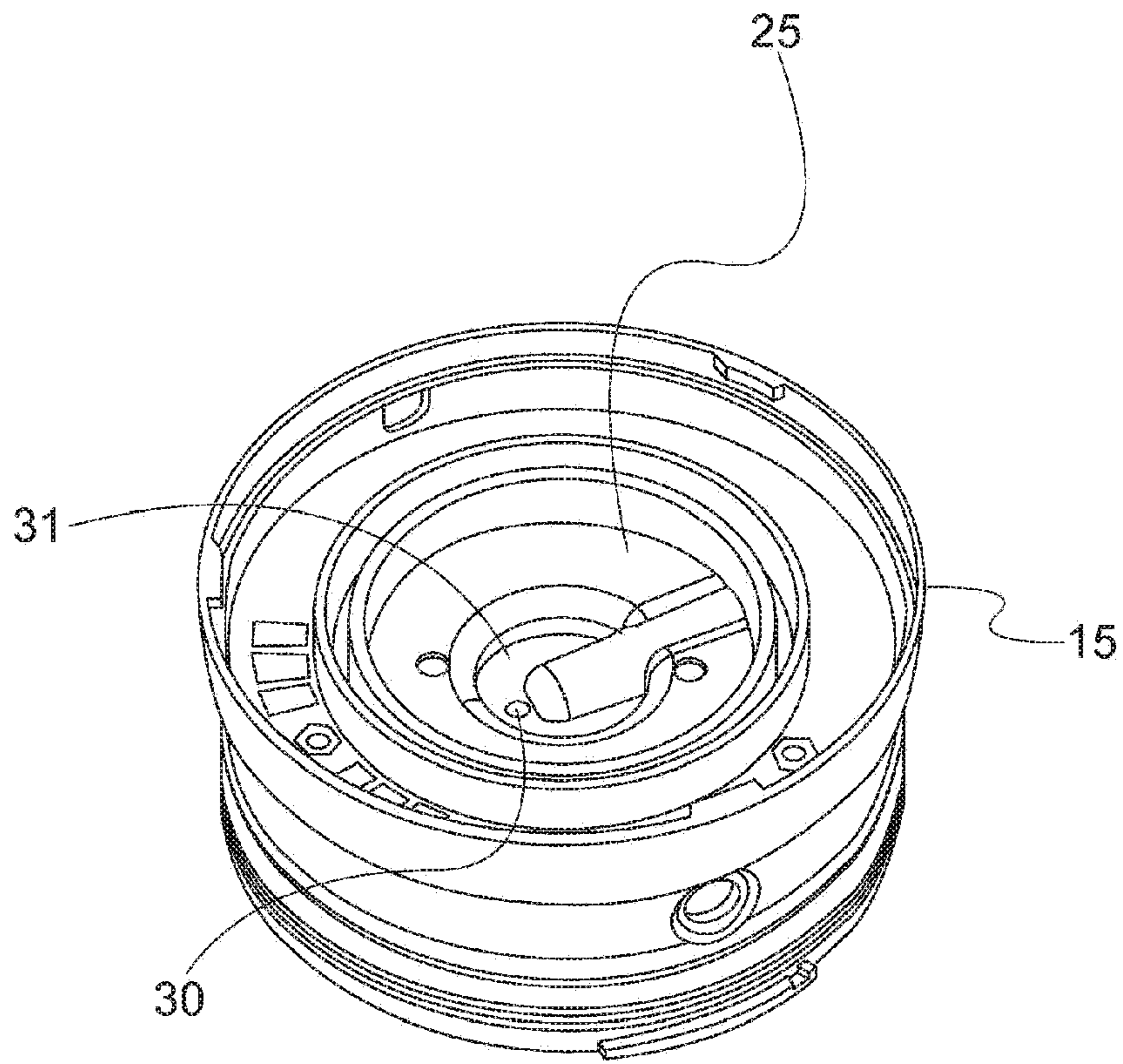


Fig. 3