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EP-A1- 2 383 553
WO-A1-2006/027548
WO-A1-2012/154642

DESCRIPTION

[0001] The invention relates to pumps.

[0002] It is known to provide a pump formed by a housing having an inlet and outlet for a fluid and containing a rotor provided with at least one surface recess that forms with the interior surface of the rotor a chamber that, on rotation of the rotor, conveys fluid from the inlet to the outlet. In order to prevent fluid passing from the outlet to the inlet, a flexible seal is provided on or as part of the housing and is located between the inlet and the outlet. The seal is urged into engagement with the rotor by a spring, which can take many forms such as a block of resilient material or a resilient tube of material or a spring. Pumps of this general kind are disclosed in WO2006/027548.

[0003] EP 2 383 553 A1 discloses a package for storing and dosing a fluid, comprising a flexible container that presents an outlet connected to a dosing means, and a visco-elastic valve. The dosing means comprises a housing that presents a pump inlet and a pump outlet, and a part of the housing between the inlet and the outlet is flexible and resilient. A rotor inside the housing presents a chamber formed between the rotor surface and the housing. The housing pump inlet is connected to the flexible container outlet, and the housing pump outlet is connected to the visco-elastic valve.

[0004] US2012/0285992 discloses a foam dispensing system comprising a rotary pump for the liquid component and a pancake air pump provides for a supply of air to the outlet. The air outlet is in fluid communication with the mixing chamber and the mixing chamber is in fluid communication with an outlet nozzle. A one-way check valve is provided in fluid communication with the air inlet for preventing liquid from passing through the air inlet of the mixing chamber.

[0005] There can be a requirement to add a second fluid to a pumped fluid. For example, a drink concentrate may require dilution with water before it can be consumed or detergents might be added to a wash solution in car washes. Carbon dioxide might be added to drinks to carbonate them. Such a second fluid can be introduced into the pumped fluid as it passes through the outlet of a pump of the kind described above.

[0006] According to a first aspect of the invention, there is provided a pump formed by a housing having an inlet and an outlet for a fluid and containing a rotor provided with at least one surface recess that forms with the interior surface of the rotor a chamber that, on rotation of the rotor, conveys fluid from the inlet to the outlet, a flexible seal being provided on or as part of the housing and located between the inlet and the outlet to engage the rotor to prevent fluid passing from the outlet to the inlet, the housing including a seal chamber surrounding a surface of the seal opposite a rotor-engaging surface of the seal, and a second inlet is provided for the supply of a second fluid to the outlet for the supply to the outlet of a second fluid; characterised in that said second inlet also supplies said second fluid to the seal chamber to apply said second fluid to the surface of the seal opposite a rotor-engaging surface of the

seal to urge the seal against the rotor.

[0007] According to a second aspect of the invention, there is provided a method of mixing first and second fluids comprising pumping the first fluid from an inlet to an outlet with the pump according to the first aspect of the invention, including a rotor having a flexible seal urged against the rotor; passing the second fluid to the outlet to mix with the first fluid; and characterised in that the method further comprises applying second fluid to a surface of the seal opposite a rotor-engaging surface of the seal, to urge the seal against the rotor.

[0008] In this way, the requirement for a spring or other means for urging the seal against the rotor is obviated so simplifying the pump, making it more reliable and reducing its cost.

[0009] The following is a more detailed description of an embodiment of the invention, by way of example, reference being made to the accompanying drawings, in which:

Figure 1 is a schematic cross-sectional view of a first form of pump including a housing, a rotor, first and second inlets and an outlet,

Figure 2 is an expanded view of the pump of Figure 1,

Figure 3 is a schematic perspective view of the pump of Figures 1 and 2,

Figure 4 is a schematic view of an alternative form of pump, and

Figure 5 is a schematic cross-sectional view of the pump of Figures 1 to 4 including check valve in the outlet.

[0010] Referring first to Figures 1 to 3, the pump comprises a housing 10 with an inlet 11 and an outlet 12. A rotor 13 is rotatable in the housing 10 by a drive 14 (see Figure 3). A seal 15 engages the rotor 13 and a second inlet 16 leads to the housing 10.

[0011] The housing 10 may be formed from a plastics material by a moulding process and may be resilient. The inlet 11 and the outlet 12 are, as seen in Figure 2, axially aligned and are located to one side of a diameter of the housing 10. The rotor 13 may also be formed from a plastics material and includes four recessed surfaces 17a, 17b, 17c, 17d (see Figure 2) arranged between circular cross-section end portions (one of which is seen at 18 in Figure 3). The rotor 13 is mounted for rotation within the housing 10 with the circular cross-section end portions 18 being received in correspondingly shaped portions of the housing 10. Where the housing 10 is resilient, the rotor 13 may slightly distend the housing 10 to form a seal between the engaging parts.

[0012] The recessed surfaces 17a, 17b, 17c, 17d may be concave in planes including the axis of the rotor, as described, for example, in WO2006/027548, and form, with the interior surface 19 of the housing 10, four chambers 20a, 20b, 20c and 20d for conveying fluid from the inlet

11 to the outlet 12 in a manner to be described below. Between the recessed surfaces 17a, 17b, 17c, 17d are portions 21a, 21b, 21c, 21d of the rotor 13 that engage the interior surface 19 of the housing 10.

[0013] The housing includes an opening 22 that is filled by the seal 15 whose axial length is at least as great as the axial length of the surfaces 17a, 17b, 17c, 17d and that extends, in a circumferential direction, between the periphery of the inlet 11 where it enters the interior of the housing 10 and the periphery of the outlet 12 where it leaves the interior of the housing 10.

[0014] The seal 15 is formed from a flexible resilient material and may be co-moulded with the housing 10 in a one-shot or two shot moulding process. The seal 15 is backed by a seal chamber 24 formed by a wall 25 surrounding the opening 22 and having an open end opposite the seal 15 closed by a cap 26.

[0015] The second inlet 16 leads into the chamber 24 via the cap 26 and, as seen in Figure 1, is controlled by a flow control valve 30, a shut-off valve 31 and a check valve 32 arranged in series along the second inlet 16 towards the cap 26. As an alternative, the second inlet 16 may enter the chamber 24 through the wall 25, as seen in Figure 3. This aligns the axis of the second inlet 16 with the axis of the rotor 13 and so makes it easier to connect the rotor 13 to the drive 14 simultaneously with the connection of the second inlet 16 to a source of fluid. The chamber 24 is provided with an outlet 33 formed by a portion of the housing 10 leading from the wall 25 of the seal chamber 24 to the housing outlet 12 (see Figure 2). At the housing outlet 12, the chamber outlet 33 is formed with a pressure-reducing constriction 34 for a purpose to be described below.

[0016] In use, the inlet 11 is connected to a source of a first fluid, such as a reservoir of liquid. Examples of suitable liquids are drink concentrates and detergents. The second inlet 16 is connected to a source of a second fluid under pressure such as water or another liquid. The first fluid will be at a lower pressure than the second fluid - the first fluid, may, for example, be fed to the inlet 11 by gravity and the second fluid pumped or fed from a pressurised source. The rotor 13 is connected to the drive 14 via a splined connection (see Figure 3).

[0017] The second fluid has its pressure regulated by the flow control valve 30 to a constant pressure. The shut-off valve 31 is provided to allow immediate shut-off of the second fluid when a dosing cycle has been completed and the check valve 32 prevents back flow.

[0018] The rotor 13 is rotated by the drive 14 in a clockwise direction, as seen in Figure 2. The first fluid passes from the inlet 11 to the chamber 20a that is covering the inlet 11 to fill the chamber 20a. The chamber 20a then passes around the housing 10 until it reaches the position of the chamber 20d in Figure 2 when the fluid in the chamber 20a exits the outlet 12. Successive chambers 20b, 20c, 20d and so on convey fluid in the same way. In this way the fluid is pumped from the inlet 11 to the outlet 12.

[0019] As the rotor 13 rotates, the housing-engaging portions 21a, 21b, 21c and 21d prevent

circumferential leakage between the chambers 20a, 20b, 20c and 20d. The seal 15 ensures that fluid in the chamber 20a, 20b, 20c, 20d that is adjacent the outlet 12 is squeezed into the outlet 12 and that fluid cannot leak past from the outlet 12 to the inlet 11. The seal 15 is urged into contact with the rotor 13 by the pressure of the second fluid in the seal chamber 24. The pressure of the second fluid is greater than the pressure of the first fluid so that, as a housing-engaging portion 21a, 21b, 21c, 21d engages and passes the seal 15 on rotation of the rotor 13, the seal 15 is urged into the housing 10 against a housing-engaging portion 21a, 21b, 21c, 21d and then against the succeeding recessed surface 17a, 17b, 17c, 17d before being moved moving radially outwardly again by the rotor 13 as the succeeding housing-engaging portion 17a, 17b, 17c, 17d approaches.

[0020] The second fluid flows through the seal chamber 24 and through the chamber outlet 33 to the constriction 34. At the constriction 34, the pressure of the second fluid is reduced to a pressure appropriate for mixing with the first fluid in the outlet 12 and to ensure that the pressure of the mixed liquids is insufficient to flow back through the pump between the seal and the rotor engaging surfaces. The second fluid may formed into a spray or jet to assist mixing by profiling the shape of the constriction 34.

[0021] In this way, the pump of Figures 1 to3 operates with only two moving parts - the rotor 13 and the seal 15. It is therefore inexpensive to manufacture and reliable in operation. The pressure of the second fluid can be adjusted as required and the constriction 33 designed to give any required pressure and flow pattern to the second fluid as it emerges into the outlet 12. The pump of Figures 1 to 3 can be used, for example, to pump a drink concentrate as the first fluid and a diluting liquid, such as water, as the second fluid or water as the first fluid and car wash chemicals as the second fluid. There could also be other janitorial applications where detergent concentrate needs dosing into water or fabric care concentrates into washing machines or medical applications where concentrates need re-constituting into liquid foods. It could also be used to carbonate drinks where the second fluid is CO_2 or to foam dairy products using N_2

[0022] There are a number of variations that could be made to the pump described above with reference to Figures 1 to 3. Figure 4 shows an alternative structure in which parts common to Figures 1 to 3 and to Figure 4 are given the same reference numerals and will not be described in detail.

[0023] Referring to Figure 4, in this embodiment, the outlet 12 T's into the second inlet 16 at a junction 40 to mix the first fluid with the second fluid. Upstream of the T-junction 40 is a flow control valve 41 that reduces the pressure of the second fluid before mixing. Upstream of the valve 41 is a branch 42 from the second inlet 16 leading to the seal chamber 24 and so supplying the second fluid to the seal 15 at full pressure. The outlet 12 contains a check valve 43 to prevent flow back through the outlet 12 to the rotor 13. In this case, therefore, the second fluid is applied to the seal 15 and the outlet 12 in parallel rather than in series, as in Figures 1 to 3. In other respects, the pump of Figure 4 operates as described above with reference to Figures 1 to 3. Such an arrangement could be used for example for injecting chemicals into a

high pressure water line, for example for water treatment or irrigation purposes or to foam dairy products using N_2.

[0024] The embodiments described above with reference to Figures 1 to 4 are able to accommodate low backpressures in the outlet 12 of the kind that might, for example, be generated where the first fluid is a drink concentrate and the second fluid is diluting water and the combination is dispensed into a cup. Where, however, the second fluid is at higher pressure and/or the combined first and second fluids are not immediately dispensed, a higher back pressure may be generated that could have a propensity to force fluid back through the outlet 12 into the housing 10 to cause leaks past the rotor engaging surfaces 21a, 21b, 21c, 21d and past the seal 15. Figure 5 shows a proposal for dealing with this problem. Parts common to Figures 1 to 3, on the one hand, and to Figure 5, on the other, are given the same reference numerals and will not be described in detail.

[0025] Referring to Figure 5, a check valve 50 is provided in the outlet 12 between the junction of the outlet 12 with the interior of the housing 10 and the constriction 33 and so upstream of the junction between the outlet 12 and the chamber outlet 33. This valve allows fluid flow along the outlet 12 away from the interior of the housing but prevents or restricts reverse flow.

[0026] Of course, a similar check valve could be provided in the embodiment of Figure 4.

[0027] In any of the embodiments described above with reference to the drawings, there may be more or less recessed surfaces 17a, 17b, 17c 17d and associated housing-contacting portions 21a, 21b, 21c, 21d. Although the housing 10 as being right cylindrical, it may, for example, be frusto-conical. The recessed surfaces 17a, 17b, 17c 17d may have any convenient shape. They may have a convex surface profile in planes normal to the rotor axis. The drive 14 may be computer controlled together with the flow control valve 30 or 41 and the shut-off valve 31. The seal 15 need not be as described above. It could be formed separately and sealed to the housing 10.

[0028] In order to prevent flow from the inlet 11 to the outlet 12 past the seal 15 in the case where there is no supply of the second fluid and the rotor 13 is stationary, a small spring may be provided to apply a small force to the under surface of the seal 15 to urge the seal 15 against the rotor 13.

[0029] In a modification shown in broken line in Figure 2, a one-way valve, shown in broken line at 50 in Figure 2, (such as an umbrella or duckbill) is positioned in the chamber outlet 33 thereby only allowing fluid to pass into the pump outlet 12 and a second one-way valve, shown in broken line at 51 in Figure 2, is positioned in the chamber inlet 16 only allowing fluid into the chamber 24. The movement of the seal 15 into and out of the chamber 24 caused by rotation of the rotor 13 changes the volume of the chamber 24 thus, as a result of the presence of the valves 50, 51, pumping a fixed volume of fluid from the inlet 16 through the chamber outlet 33. This arrangement requires a spring means (rubber extrusion), shown in broken line at 52 in Figure 2, to assist the fluid in actuating the seal 15 as the fluid entering the inlet 16 cannot be

at a pressure that would allow the fluid to freely flow through the valves. The spring means 52 may be any suitable spring means of the kind shown and described in WO2013/050491. This arrangement provides a fixed ratio mixing of two fluids. From experimentation, the ratio may, for example, be approximately three parts through the pump from inlet 11 to outlet 12 and one part from inlet 16 to outlet 33.

[0030] The action of the outer surface of the seal 15 in the chamber 24 is thus akin to a diaphragm pump so it is not a true fixed displacement pump as the amount of movement of the seal 15 can vary depending, for example, on the back pressure in the outlet 12 which in turn acts on the seal 15.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO2006027548A **[0002]** **[0012]**
- EP2383553A1 **[0003]**
- US20120285992A **[0004]**
- WO2013050491A **[0029]**

Patentkrav

1. Pumpe dannet af et hus (10), der har

et indløb (11) og

et udløb (12) til et fluid, og som indeholder

en rotor (13) forsynet med mindst én overfladeindskæring (17a, 17b, 17c, 17d) af rotoren (13), der med en indre flade (19) danner et kammer (20c, 20b, 20c, 20d), som, ved rotation af rotoren (13), leder fluid fra indløbet (11) til udløbet (12),

hvor en fleksibel tætning (15) er tilvejebragt på eller som en del af huset (10) og er placeret mellem indløbet (11) og udløbet (12) for at gå i indgreb med rotoren (13) for at forhindre fluid i at blive ført fra udløbet (12) til indløbet (11);

hvilket hus (10) indbefatter et tætningskammer (24), der omgiver en flade af tætningen (15) modsat en rotorindgrebsflade af tætningen (15); og

et andet indløb (16) er tilvejebragt til tilførsel af et andet fluid til udløbet til blanding med fluid i udløbet (12); **kendetegnet ved, at**

det andet indløb (16) også tilfører det andet fluid til tætningskammeret (24) for at anbringe det andet fluid mod tætningens (15) flade modsat en rotorindgrebsflade af tætningen (15) for at presse tætningen (15) mod rotoren (13).

2. Pumpe ifølge krav 1, hvor det andet fluid tilføres udløbet (12) ved et første tryk og tilføres tætningen (15) ved et andet tryk, hvor det første tryk er lavere end det andet tryk.

3. Pumpe ifølge krav 2, hvor det andet indløb (16) har en første forgrening (42) og en anden forgrening, hvilken første forgrening (42) fører til tætningskammeret (24) og den anden forgrening fører til udløbet (12).

4. Pumpe ifølge krav 3, hvor den anden forgrening indbefatter et regulator (41) til reduktion af trykket på det andet fluid til det første tryk, inden fluidet føres til udløbet (12).

5. Pumpe ifølge krav 1, hvor det andet indløb (16) leder det andet fluid ind i tætningskammeret (24), hvor det andet fluid derefter forlader tætningskammeret (24) til udløbet (12).

6. Pumpe ifølge krav 2, hvor det andet indløb (16) leder det andet fluid ind i tætningskammeret (24), hvor det andet fluid derefter forlader tætningskammeret (24) til

udløbet (12); og hvor det andet fluid forlader tætningskammeret (24) gennem et kammerudløb (33), hvilket kammerudløb (33) indbefatter en trykreduktionsanordning (34) til reduktion af trykket på det andet fluid til det første tryk, inden fluidet føres til udløbet (12).

7. Pumpe ifølge krav 6, hvor andet indløb (16) og kammerudløbet (33) indbefatter tilsvarende kontraventiler (32), således at rotation af rotoren (13) for at bevæge tætningen (15) ind og ud af tætningskammeret (24) pumper det andet fluid fra tætningskammeret (24) til kammerudløbet (33).

8. Pumpe ifølge et hvilket som helst af kravene 2 til 7, hvor det andet indløb (16) indbefatter en trykstrømningsregulator (30) til styring af trykket på det andet fluid til det andet tryk.

9. Pumpe ifølge et hvilket som helst af kravene 1 til 7, hvor det andet indløb (16) styres af en afspærringsventil (31).

10. Pumpe ifølge et hvilket som helst af kravene 1 til 9, hvor en reguleringsventil (43) er tilvejebragt i udløbet (12) opstrøms for forbindelsen mellem det andet indløb (16) og udløbet (12) for at forhindre eller begrænse tilbagestrømning gennem udløbet (12)

11. Fremgangsmåde til blanding af første og andet fluid omfattende pumpning af det første fluid fra et indløb (11) til et udløb (12) med en pumpe ifølge et hvilket som helst af kravene 1 til 10, der indbefatter en rotor (13) med en fleksibel tætning (15), der er presset mod rotoren (13); føring af det andet fluid til udløbet (12) for blanding med det første fluid; og
kendetegnet, ved
at fremgangsmåden endvidere omfatter
anbringelse af andet fluid mod en flade af tætningen (15) modsat en rotorindgrebsflade af tætningen (15) for at presse tætningen (15) mod rotoren (13).

DRAWINGS

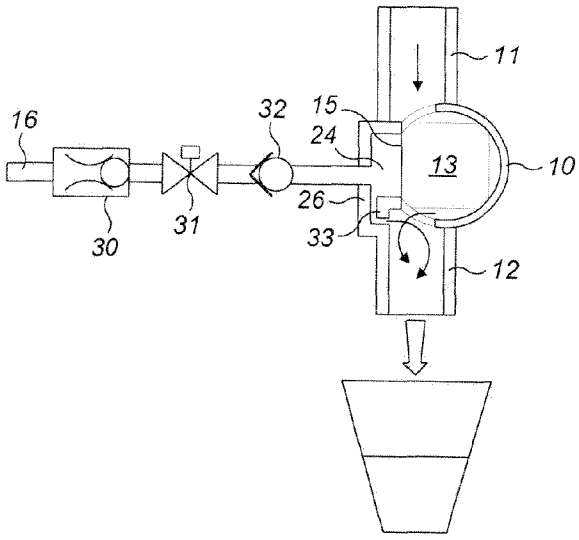


FIG. 1

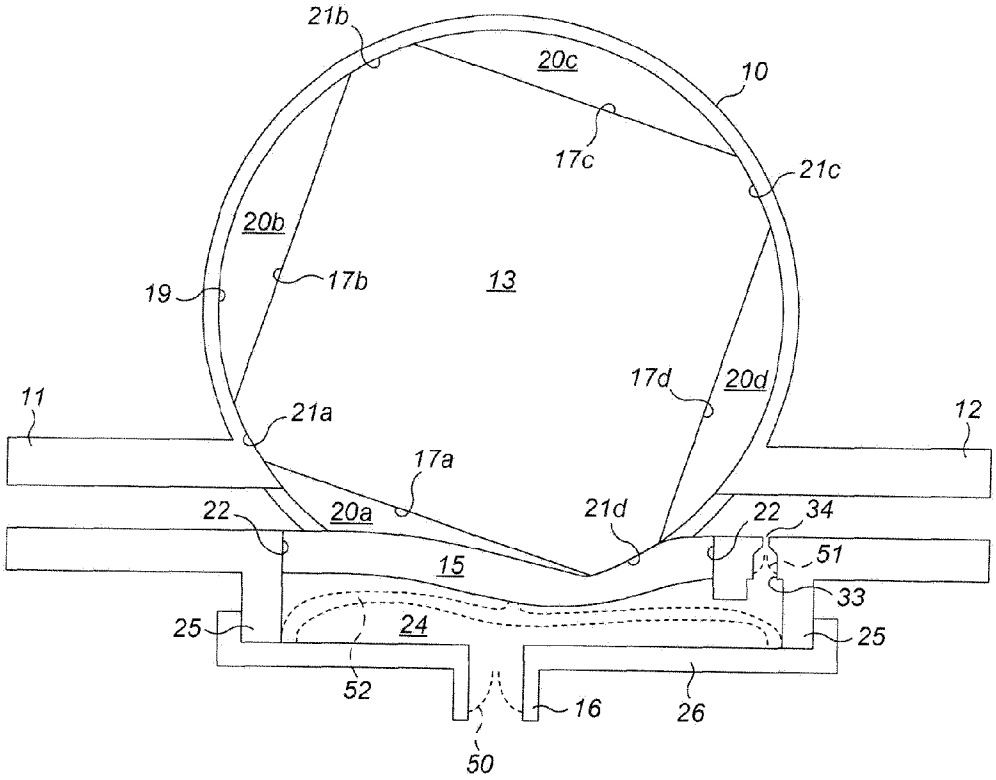


FIG. 2

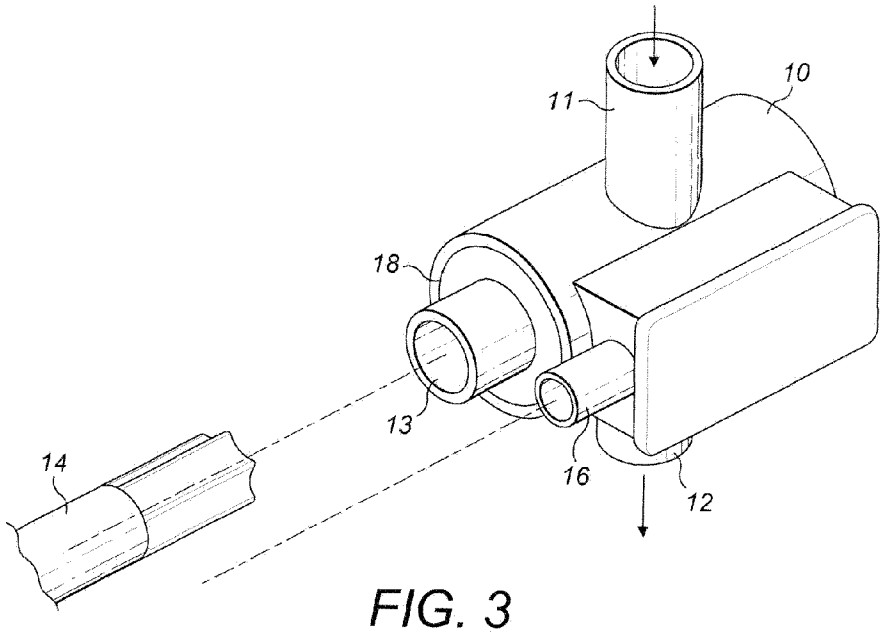


FIG. 3

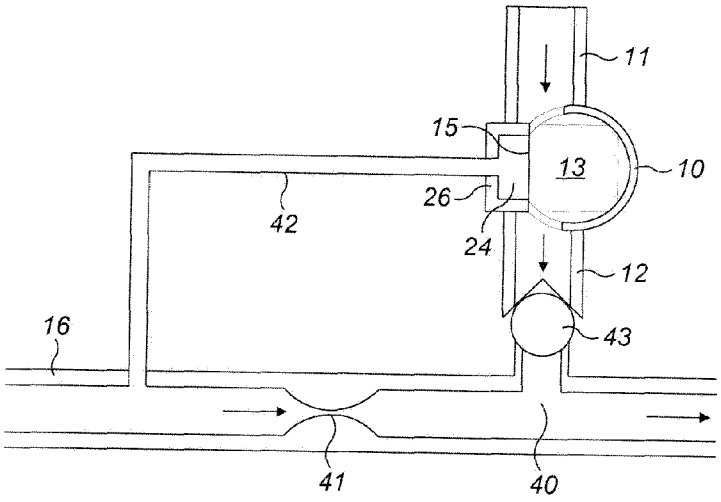
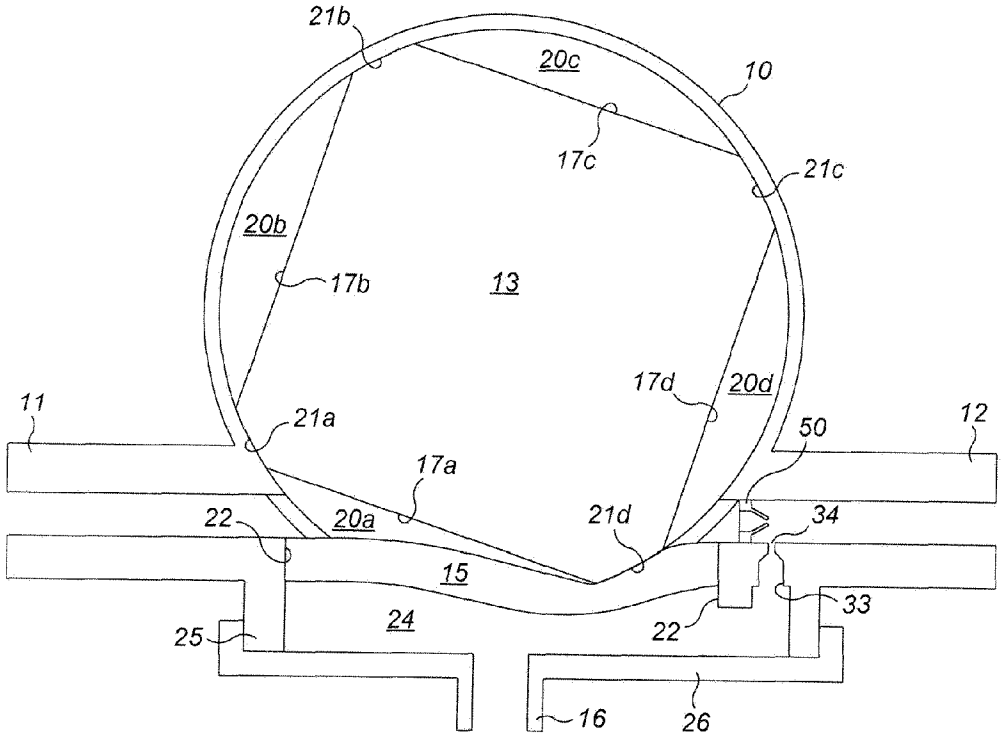


FIG. 4


21b
20c
10
17c
21c
20b
17b
13
17d
20d
11
21a
50
12
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22
20a
21d
34
15
33
24
25
22
16
26

FIG. 5