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(54) Atomizer and diaphragm valve for an atomizer

(57) The invention relates to an atomizer provided with an integrated diaphragm valve (1), provided with a control input (5) for a gaseous or liquid control medium. The membrane (7) is disk-shaped and is made of a flexible synthetic material, like polyurethane. The valve seat (10) is concave-shaped, in such a way that the exit channel (11) is placed slightly recessed and is provided with annular elevations (12,13), positioned concentrically round the exit channel (11).

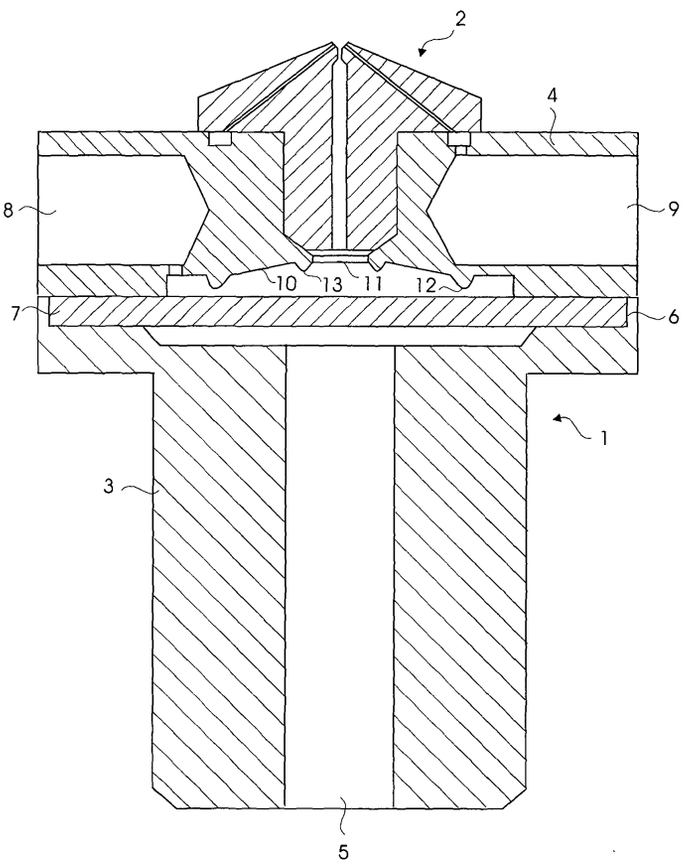

Fig. 1

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Description

[0001] The invention relates to an atomizer provided with an integrated valve. Atomizers of this type are known. For atomizers, it is disadvantageous when material to be atomized remains behind in or near the nozzle, once the valve is closed. For that reason, a valve of the needle valve type is usually employed. Even with a needle valve, some material to be atomized will inevitably remain behind in or near the nozzle. Another disadvantage of the needle valve is that it may get stuck. If for example egg yolk or sugared water or a gelatine containing liquid or a liquid containing solid particles is atomised and if subsequently the needle valve is not operated for some time, then the needle valve easily gets stuck and the nozzle may block. The atomizer according to the invention substantially obviates this disadvantage and is characterised in that the valve comprises a diaphragm valve. The diaphragm valve cannot stick and moreover the diaphragm valve may be controlled while closed in such a manner that material that is situated between the valve and the nozzle will firmly be thrusted out, as a result of which the nozzle will practically never block.

[0002] A favourable embodiment with which the material, situated between the valve and the nozzle will be thrusted out in a relatively simple way is characterised in that the atomizer is provided with a control input for a gaseous or liquid control medium for the diaphragm valve. An additional advantage of a control of this kind is that opening of the valve may take place slowly, so that the atomizer may deliver a slowly increasing amount of material to be atomized.

[0003] A further favourable embodiment is characterised in that the diaphragm valve is disk-shaped. A membrane shaped this way may be moved very fast. Preferably, the diaphragm valve is made of a flexible synthetic material, like polyurethane, so that the membrane may bend in a direction of the nozzle and give an extra impulse to the material to be driven out.

[0004] A favourable embodiment with which this effect may be increased even further is characterised in that a valve seat of the diaphragm valve is concave-shaped, such that an exit channel of the diaphragm valve is located at a slightly recessed position.

[0005] A further favourable embodiment is characterised in that the valve seat of the diaphragm valve is provided with at least one annular elevation, located concentrically round the exit channel of the diaphragm valve. In this case, the membrane will land on the annular elevation when the valve is closing and thereupon it will bend within this annular elevation with an increased speed towards the nozzle.

[0006] A further favourable embodiment is characterised in that the valve seat of the diaphragm valve is provided with two annular elevations, located concentrically round the exit channel of the diaphragm valve. While the valve is closing, the membrane will land on the outer annular elevation and thereupon it will bend within this annular elevation with an increased speed towards the nozzle. Subsequently, the membrane will land on the inner annular elevation and it will bend with a still increasing speed towards the nozzle. Preferably, the outer annular elevation is higher than a more centrally located annular elevation, the outer annular elevation has a diameter which amounts to 75 to 85 percent of a diameter of the valve seat and the inner annular elevation has a diameter which amounts to 20 to 30 percent of a diameter of the valve seat.

[0007] A favourable embodiment is according to a further aspect of the invention characterised in that the membrane is provided with a needle with which the nozzle can be kept clean.

[0008] The invention also relates to a diaphragm valve, provided with a disk-shaped membrane, made of a flexible synthetic material and with a control input for a gaseous or liquid control medium. The inventive diaphragm valve is characterised in that a valve seat of the diaphragm valve is concave-shaped, such that an exit channel of the diaphragm valve is located at a slightly recessed position. Preferably, the valve seat of the diaphragm valve is provided with at least one annular elevation, located concentrically round the exit channel of the diaphragm valve. A diaphragm valve of this type is, when well dimensioned, very suitable for feeding a nozzle, because when the valve is closed, the material present between the valve and the nozzle will be thrusted powerfully, as a result of which the nozzle will stay behind clean.

[0009] A very favourable embodiment of the inventive diaphragm valve is characterised in that the valve seat of the diaphragm valve is provided with two annular elevations, located concentrically round the exit channel of the diaphragm valve. Preferably, the outer annular elevation is higher than a more centrally located annular elevation, the outer annular elevation has a diameter which amounts to 75 to 85 percent of a diameter of the valve seat and the inner annular elevation has a diameter which amounts to 20 to 30 percent of a diameter of the valve seat.

[0010] A favourable embodiment of the inventive diaphragm valve is according to another aspect of the invention characterised in that the membrane is provided with a needle, with which an opening of the nozzle can be kept clean.

[0011] The invention will now be explained further with a reference to the following figures, in which:

- Fig. 1 represents a possible embodiment of an atomizer according to the invention in cross section;
- Fig. 2 represents an alternative embodiment provided with a needle in cross section;
- Fig. 3A represents more in detail a control part in side view;
- Fig. 3B represents this control part in top view;

Fig. 4A represents more in detail a valve body in side view;
Fig. 4B represents this valve body in bottom view;
Fig. 5A represents a membrane with an open steered valve;
Fig. 5B represents a membrane in a first phase of closing;
Fig. 5C represents a membrane in a second phase of closing;
Fig. 5D represents a membrane in a final phase of closing.

[0012] Fig. 1 represents a possible embodiment of an atomizer according to the invention in cross section. The atomizer consists of a valve 1 and a commercially available nozzle 2, that can be screwed into valve 1. Valve 1 consists of a control part 3 and a valve body 4, both made of for example stainless steel. On a first side, control part 3 is provided with a connection 5 for a gaseous or liquid control medium, like compressed air or water, and a chamber 6 in which a disk-shaped membrane 7 is placed. Valve body 4 is provided with a connection 8 for liquid to be atomised and a connection 9 via which a gas may be fed towards atomizer 2 if desired, which will be blown out together with the liquid. Valve body 4 is provided with a slightly concave shaped valve seat 10, provided with a few annular elevations 12,13, located concentrically round an exit opening 11. Valve 1 may be closed, in which case a pressurised control medium is supplied via connection 5 and membrane 7 is pushed against the valve seat and more in particular to elevations 12,13 or valve 1 may be open, in which no pressurised control medium is supplied via connection 5 while liquid to be atomised will be supplied via connection 8, which will bend membrane 7 slightly towards connection 5.

[0013] In this embodiment, nozzle 2 is provided with channels for letting pass the liquid and for letting pass a gas, supplied via connection 9. Of course the atomizer may also be used in combination with a commercially available nozzle with which only a liquid can be atomised. In that case connection 9 is simply not used or connection 9 is not present.

[0014] Fig. 2 represents an alternative embodiment provided with a needle in cross section. The construction of the atomizer corresponds completely with the construction of the atomizer shown in Fig. 1, but centrally in membrane 7 a needle 14 is placed, which enters nozzle 2 when the valve is closed and which cleans in doing so the channel in nozzle 2 from liquid to be atomised.

[0015] Fig. 3A represents more in detail a control part 3 in side view, with connection 5, usually provided with an internal threading of the kind that fits to standard connecting material and with a chamber 6 in which an elastic membrane 7 can be placed. Membrane 7 is for example made of polyurethane, which is extremely flexible so that it can clear valve seat 10 very well during the closing of valve 1 in cooperation with elevations 12,13 as shown in Fig. 1. Moreover, control part 3 is provided with an auxiliary chamber 15, which provides membrane 7 with space for bending towards connection 5 when valve 1 is open, in this way reducing the hydraulic resistance of valve 1. Fig. 3B represents this control part 3 in top view, with connection 5, chamber 6, auxiliary chamber 15 and a three mounting holes 16a,16b,16c via which control part 3 can be mounted to valve body 4.

[0016] Fig. 4A represents more in detail a valve body 4 in side view, with connections 8,9 which are usually provided with an internal threading of a type fitting to standard connecting material. Valve body 4 is provided with a slightly concave shaped valve seat 10, provided with a number of annular elevations 12,13 which are located concentrically round the exit opening 11. The shape of valve seat 10 and elevations 12,13 are determined experimentally, so that during the closing of the valve substantially all liquid present in valve body 4 will be thrusted out via exit opening 11 and via a nozzle connected to it, leaving the nozzle relatively clean and dry behind. In this process, elevations 12,13 play an important role. Their diameters amount in the embodiment shown here to about 80% respectively 25% of the diameter of valve seat 10.

[0017] Fig. 4B represents this valve body in bottom view, with connections 8,9 for respectively liquid to be atomised and for gas to be added to the liquid, valve seat 10, exit opening 11, elevations 12,13 and a three mounting holes 17a,17b,17c via which control part 3 can be mounted to valve body 4.

[0018] Fig. 5A represents a membrane 7 with an open steered valve, whereby membrane 7 slightly bulges out due to the liquid pressure and in this way reduces the hydraulic resistance of the valve.

[0019] Fig. 5B represents a membrane 7 in a first phase of closing, whereby the pressure of the control medium via connection 5 substantially exceeds the liquid pressure. In this situation, elevation 12 in combination with membrane 7 provides for the actual closing of the valve.

[0020] Fig. 5C represents a membrane 7 in a second phase of closing, whereby membrane 7 further bulges in inside elevation 12, pushing the liquid present inside the space enclosed by elevation 12 further towards exit opening 11.

[0021] Fig. 5D represents a membrane 7 in a final phase of closing, whereby membrane 7 bulges in far inside elevation 13 and pushes substantially all liquid present inside the space enclosed by elevation 13 outwards. After this phase, membrane 7 will bounce back and in doing so it will suck liquid that is possibly left behind out of the nozzle.

Claims

1. Atomizer provided with an integrated valve, **char-**

acterised in that the valve comprises a diaphragm valve.

2. Atomizer according to claim 1, **characterised in that** the atomizer is provided with a control input for a gaseous or liquid control medium for the diaphragm valve.

3. Atomizer according to claim 2, **characterised in that** the diaphragm valve is disk-shaped.

4. Atomizer according to claim 3, **characterised in that** the diaphragm valve is made of a flexible synthetic material.

5. Atomizer according to one of the previous claims, **characterised in that** a valve seat of the diaphragm valve is concave-shaped, such that an exit channel of the diaphragm valve is located at a slightly recessed position.

6. Atomizer according to claim 5, **characterised in that** the valve seat of the diaphragm valve is provided with at least one annular elevation, located concentrically round the exit channel of the diaphragm valve.

7. Atomizer according to claim 6, **characterised in that** the valve seat of the diaphragm valve is provided with two annular elevations, located concentrically round the exit channel of the diaphragm valve.

8. Atomizer according to claim 7, **characterised in that** an outer annular elevation is higher than a more centrally located annular elevation.

9. Atomizer according to claim 8, **characterised in that** the outer annular elevation has a diameter which amounts to 75 to 85 percent of a diameter of the valve seat.

10. Atomizer according to claim 8 or 9, **characterised in that** the inner annular elevation has a diameter which amounts to 20 to 30 percent of a diameter of the valve seat.

11. Atomizer according to one of the previous claims, **characterised in that** the membrane is provided with a needle.

12. Diaphragm valve, provided with a disk-shaped membrane, made of a flexible synthetic material and with a control input for a gaseous or liquid control medium, **characterised in that** a valve seat of the diaphragm valve is concave-shaped, such that an exit channel of the diaphragm valve is located at a slightly recessed position.

13. Diaphragm valve according to claim 12, **characterised in that** the valve seat of the diaphragm valve is provided with at least one annular elevation, located concentrically round the exit channel of the diaphragm valve.

14. Diaphragm valve according to claim 13, **characterised in that** the valve seat of the diaphragm valve is provided with two annular elevations, located concentrically round the exit channel of the diaphragm valve.

15. Diaphragm valve according to claim 14, **characterised in that** an outer annular elevation is higher than a more centrally located annular elevation.

16. Diaphragm valve according to claim 15, **characterised in that** the outer annular elevation has a diameter which amounts to 75 to 85 percent of a diameter of the valve seat.

17. Diaphragm valve according to claim 15 or 16, **characterised in that** the inner annular elevation has a diameter which amounts to 20 to 30 percent of a diameter of the valve seat.

18. Diaphragm valve according to one of the claims 12 to 17, **characterised in that** the membrane is provided with a needle.

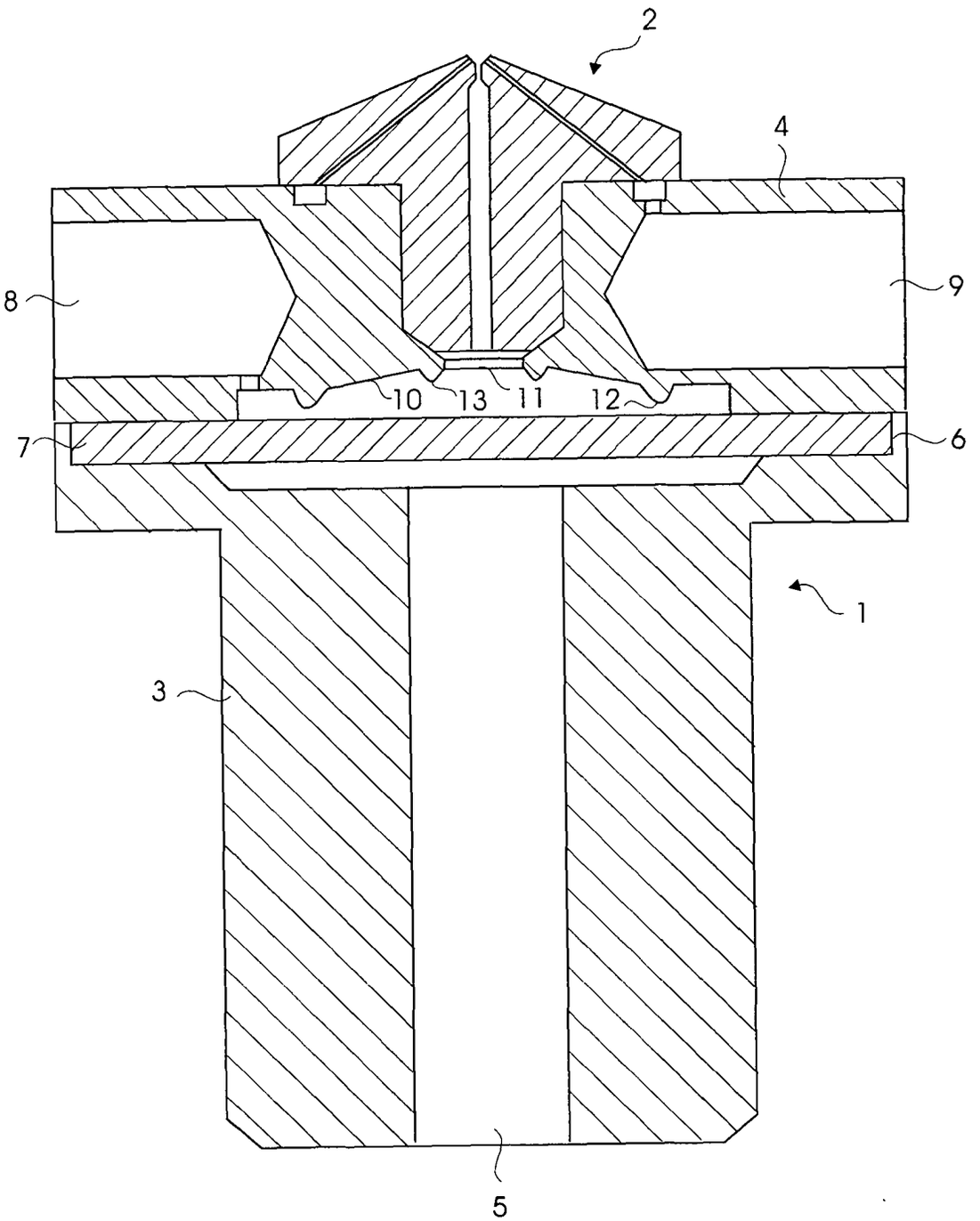

Fig. 1

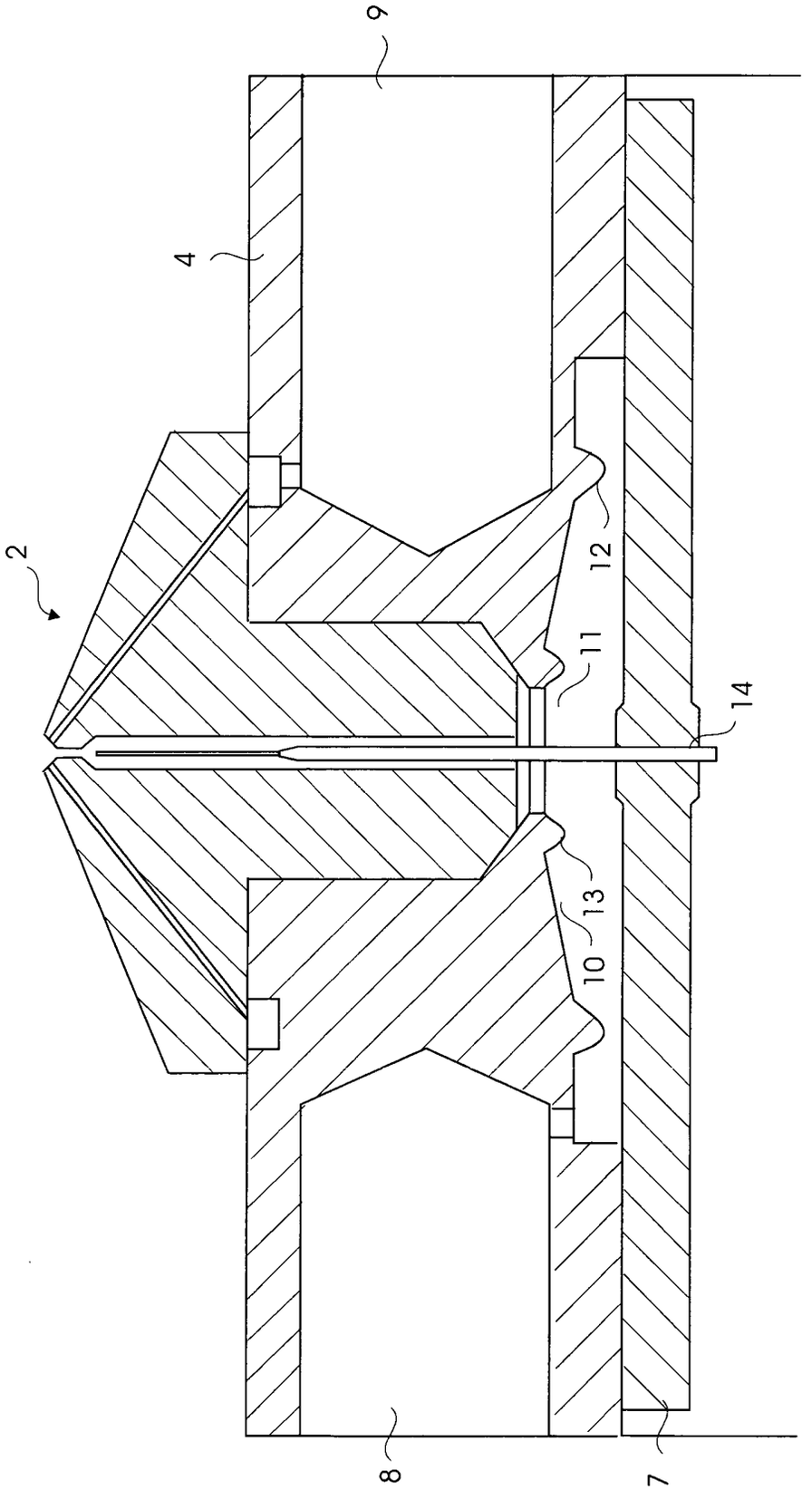

Fig. 2

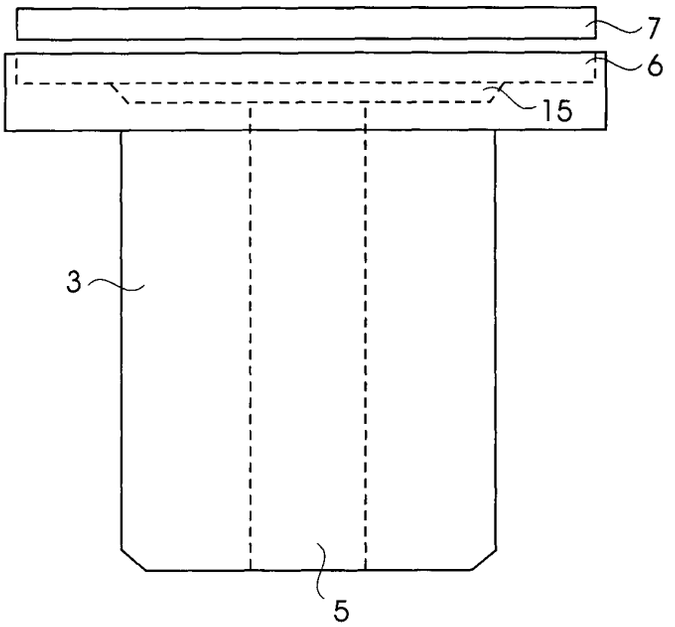

Fig. 3A

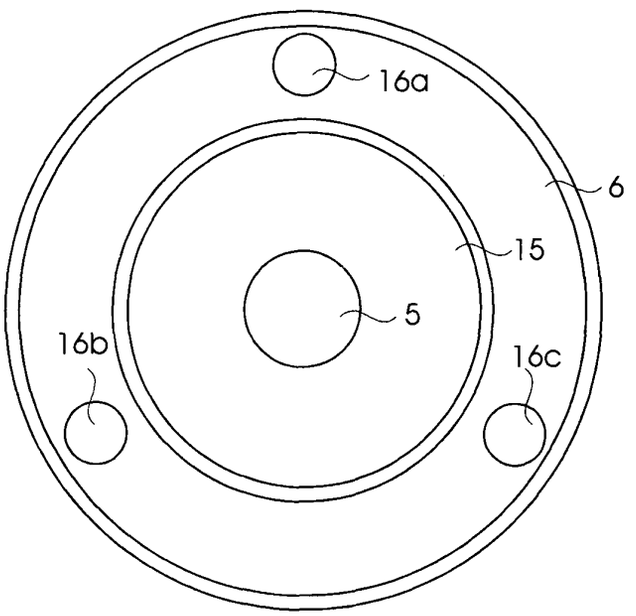

Fig.3B

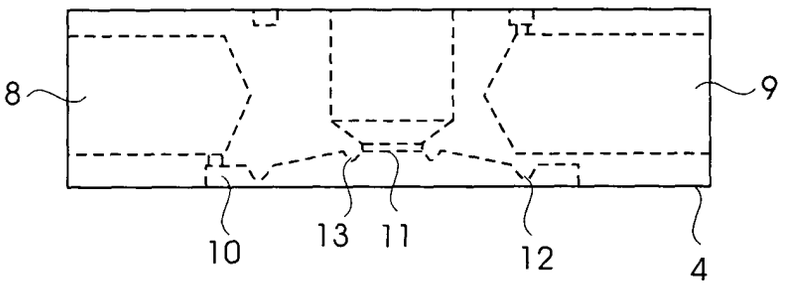

Fig. 4A

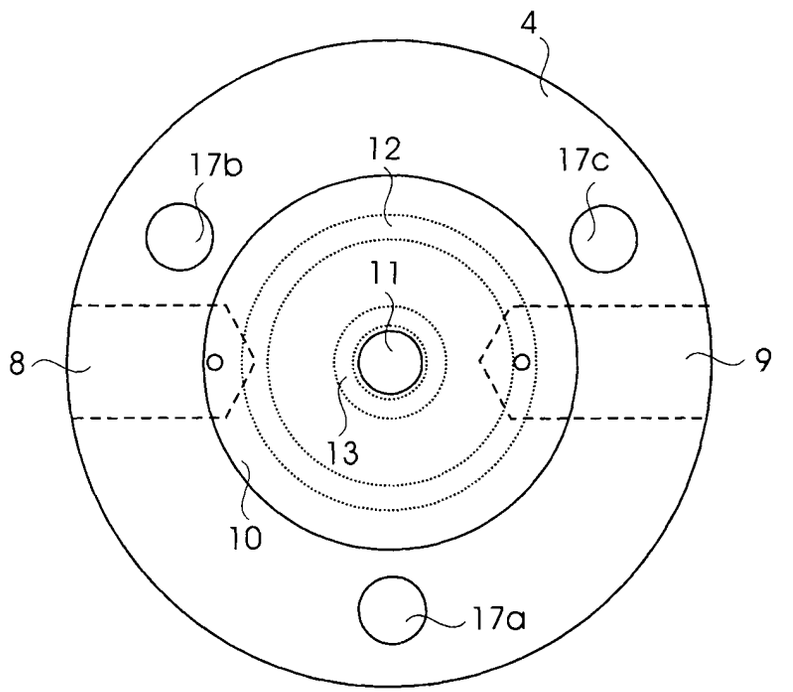

Fig. 4B

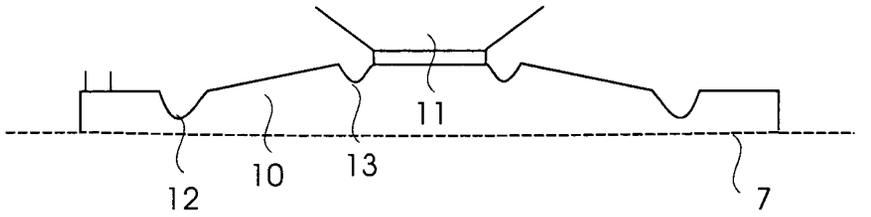

Fig. 5A

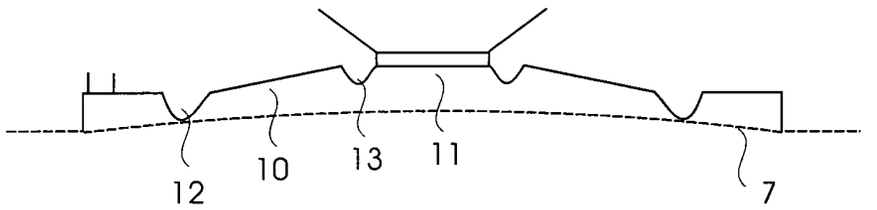

Fig. 5B

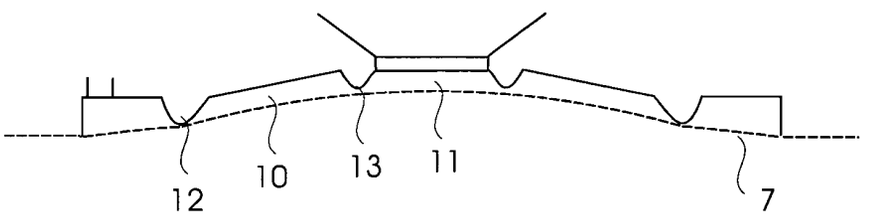

Fig. 5C

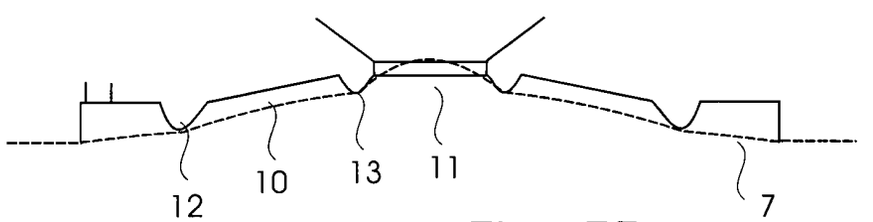

Fig. 5D