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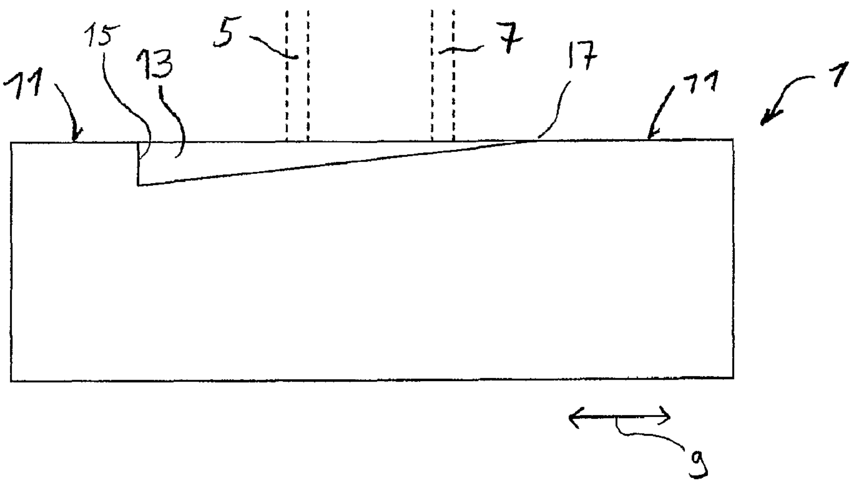

(57) **Abstract:** A valve slider (1;35;53;65;79;97) for a microfluidic coupling device (63;77;95). The slider comprises a flat foil and is adapted for flow-controlling the flow within at least one flow path (5,7) of the microfluidic coupling device (63;77;95). The slider slides relatively to the microfluidic coupling device (63;77;95). The slider has at least one control element (3; 13) and controls the flow within the flow path (5,7).

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VALVE SLIDER FOR A MICROFLUIDIC COUPLING DEVICE

BACKGROUND ART

[0001] The present invention relates generally to microfluidic laboratory technology for chemical, physical, and/or biological analysis, separation, or synthesis of substances on a substrate with a microfluidic structure. It relates in particular to microfluidic assemblies with microfluidic coupling devices adapted to control the flow of a liquid, and more specifically, to the component parts of the assemblies. Besides this, the invention relates to a method for controlling a microfluidic process.

[0002] There is a growing demand for biological fluid processing systems that have generated a need for small fluidic coupling devices. Such miniaturized microfluidic devices have to fulfill a variety of requirements such as low dead volume and short flow paths with a cross section as constant as possible. This generally results in an improved performance characteristic. An approach in the field – compared for example with the use of valves with threaded connections – is the use of microfluidic chips coupled to revolving valve elements for flow-controlling the microfluidic processes executed within the chip. Solutions are disclosed for example in the US 2003/0015682 A1 or in the European Patent Application No. 04102250.0.

[0003] Due to enormous amounts of samples and microfluidic processes to be handled, efforts in the field are made to integrate the processes in microfluidic devices. These efforts have led to highly integrated microfluidic systems and complex processes to be executed, and consequently to an increased expenditure for controlling. In particular, coupling and flow-controlling is an important matter of the latest developments in the technical field of microfluidic devices as shown for example in the European Patent Application No. 03104413.4. Increasing the complexity of the processes executed and the miniaturization of microfluidic devices generally results disadvantageously in a higher expenditure for microfluidic interconnections to be realized, switched, and/or flow-controlled.

DISCLOSURE OF THE INVENTION

[0004] It is an object of the invention to provide an improved controlling, in particular flow-controlling, and/or coupling of microfluidic devices. The object is solved by the independent claims. Preferred embodiments are shown by the dependent claims.

[0005] According to the present invention, the objects indicated are achieved by a valve slider for a microfluidic coupling device. The slider comprises a flat foil and is adapted for flow-controlling the flow within at least one flow path of the microfluidic coupling device. Advantageously, the flow within the flow path can be flow-controlled by moving the slider. Therefore, the slider comprises at least one microfluidic control element. Embodiments may include one or more of the following. The slider can be moved rectilinearly or rotated relatively to the microfluidic coupling device. For flow-controlling, the flow path can be coupled to at least one groove, slit, recess, bevel, hole, and/or step of the control element. The flow path can be coupled to or separated from the groove, slit, recess, bevel, hole, and/or step by moving the slider. Advantageously, the groove, slit, recess, bevel, and/or step are tapered for realizing a flow regulator. Preferred, the flat foil of the valve slider comprises at least two layers, for example a middle layer and two sealing layers. The middle layer can be adapted to stabilize the foil.

[0006] The invention further relates to a microfluidic coupling device with at least one port, at least one microfluidic flow path coupled to the port, and at least one control device, for example a valve slider as described above. The valve slider is adapted for controlling the flow within the flow path. Advantageously, the valve slider is integrated within the chip. Embodiments may include one or more of the following. The valve slider realizes a valve within the device. Advantageously, no additional external valve component parts are needed for flow-controlling the flow within the flow path. The control device is integrated between a top layer and a bottom layer of the chip. The layers are separated by a separating layer of the same thickness as the control device. The thickness of the top layer and the bottom layer of the chip may vary. The separating layer comprises a cut-out for accepting the valve slider. Advantageously, the valve slider is supported to be slit or rotated at the surfaces of the top layer and the bottom layer. The top and the bottom layer together with the cut-out of the separating layer form a flat and rectangular recess for accepting the valve slider and bearing it slidable rectilinearly. The flow path can be coupled to a second flow path or to the port of the microfluidic coupling device via the control element. Advantageously, a flow between the two ports can be controlled. The ports can be coupled to any other microfluidic device. The microfluidic devices can be coupled with the coupling device.

[0007] Besides this, the invention relates to a microfluidic device adapted for processing a microfluidic process. The device comprises advantageously a coupling device for controlling the microfluidic process. This enables a highly integrated device adapted for executing complex microfluidic processes.

[0008] The invention further relates to an assembly for handling liquid within a microfluidic device with at least one integrated control device, for example a valve slider as described above. The microfluidic device comprises at least one port and at least one microfluidic flow path coupled to the port. The flow path and/or the port are flow-controlled by the control device, in particular sealed, switched, or coupled. Advantageously, the control device, the flow path, and/or the port can be sealed by an external sealing element. Embodiments may include one or more of the following. The sealing element is put against the microfluidic device, in particular pressed against the microfluidic device close to the control device by a piezoelectric element or an other suited actor element, for example a electromagnet. The pressure induces a sealing force at the microfluidic device. The sealing element comprises an outer actuator and an inner actuator arranged within the outer actuator. The actuators can be pressed against the surface of the microfluidic device separately for inducing different sealing forces needed in different operating states of the microfluidic process executed with the microfluidic device. The outer actuator can be pressed against the microfluidic device passively by a spring and the inner actuator actively by the piezoelectric or actor element. Advantageously, the inner actuator can be released by the piezoelectric element for changing the switching state of the control device, for example for sliding the valve slider. In embodiments, the sealing element can be a component part of a laboratory apparatus. The assembly can be adapted for interacting with the apparatus.

The assembly can be inserted into the apparatus. Advantageously, the apparatus comprises a device for handling, moving, positioning and/or connecting the assembly. Preferably, the assembly and/or the apparatus comprise any guides for guiding the assembly within the apparatus.

[0009] The invention finally relates to a method for controlling a microfluidic process executed with a microfluidic assembly with a microfluidic device having a microfluidic coupling device. In a first step, an external sealing element is released. Advantageously, this step reduces the friction of moving parts of the coupling device. Subsequently, the controlling element is set; in particular, the valve slider is moved, for controlling the microfluidic flow within the microfluidic device. Finally, the sealing element is tightened again for sealing the fluid containing components of the microfluidic device.

BRIEF DESCRIPTION OF DRAWINGS

[00010] Other objects and many of the attendant advantages of embodiments of the present invention will be readily appreciated and become better understood by reference to the following more detailed description of preferred embodiments in connection with the accompanied drawings. Features that are substantially or functionally equal or similar will be referred to with the same reference signs.

[00011] Fig. 1 and 2 show top plan views of a valve slider with different control elements;

[00012] Fig. 3 A to C show cross sectional views of different embodiments of the valve slider 1 of figure 1, taken along the lines A – A of Figure 1.

[00013] Fig. 4 shows another valve slider;

[00014] Fig. 5 shows a schematic partly top plan view of a microfluidic device with a microfluidic valve slider.

[00015] Fig. 6 and 7 show schematic partly top plan views of another microfluidic device with another microfluidic valve slider in different settings;

[00016] Fig. 8 shows a partly longitudinal view of the microfluidic device of Fig. 6 with the microfluidic valve slider in a first setting, taken along the lines B – B of figure 6;

[00017] Fig. 9 shows a partly longitudinal view of the microfluidic device of fig. 7 with the microfluidic valve slider in a second setting, taken along the lines C – C of figure 7;

[00018] Fig. 10 shows a microfluidic coupling device;

[00019] Fig. 11 shows a longitudinal view of the microfluidic coupling device of fig. 10, taken along the lines D – D of Figure 10;

[00020] Fig. 12 shows a three-dimensional top plan view of another microfluidic coupling device;

[00021] Fig. 13 shows a three-dimensional part sectional top plan view of a microfluidic assembly with the microfluidic coupling device of fig. 12 and an external sealing element;

[00022] Fig. 14 shows a top plan view of the front side of the external sealing element;

[00023] Fig. 15 shows a top plan view of another microfluidic coupling device; and

[00024] Fig. 16 shows a sectional view of a multi-layer valve slider.

[00025] Fig. 1 shows a top plan view of a valve slider 1 comprising a flat material, for example a foil, with a control element 3 for flow-controlling the flow within two flow paths 5 and 7 –indicated with dotted lines. The valve slider 1 realizes a control device for flow-controlling the flux or rather the flow within the flow paths 5 and 7.

[00026] The flow paths 5 and 7 can be part of a microfluidic device (not shown in this figure). The valve slider 1 is shaped like a rectangle and can be moved perpendicularly, in embodiments angularly, to the flow direction of the flow paths 5 and 7 – as illustrated with a double arrow 9. The control element 3 realizes a fluid conducting element. It can be coupled to the flow paths 5 and 7. The flow paths 5 and

7 may be coupled via the control element 3. Consequently, the length of the control element 3 is at least as long as the distance between the flow paths 5 and 7 adjacent to the valve slider 1. The flow paths 5 and 7 can be optionally coupled or separated by moving the valve slider perpendicularly to the flow direction of the flow paths 5 and 7. Not visible sidewalls 11 adjacent to the control element 3 of the valve slider 1 can close one or both flow paths 5 and 7. In embodiments, the sidewalls 11 realize sealing surfaces for the flow paths 5 and 7 with a leakage less than 1 percent of the flow within the flow paths 5 and 7.

[00027] Fig. 2 shows the valve slider 1, but with another tapered control element 13.

[00028] The tapered control element 13 realizes a tapered flow path with a variable flow resistance. The flow resistance can be varied by sliding the valve slider 1 from a minimum value to a maximum value. At the maximum value the flow paths 5 and 7 are quasi-sealed. The minimum value can be realized by moving a first end point 15 of the tapered control element 13 to the flow path 5. The maximum value can be realized by moving a second end point 17 of the tapered control element 13 or rather the side wall 11 of the valve slider 1 close to the end point 17, to the flow path 7. The tapered flow path of the tapered control element 13 has a maximum cross-sectional area at the first end point 15 and a minimum cross-sectional area at the second end point 17.

[00029] Fig. 3 A to C show cross sectional views of different embodiments of the valve slider of figure 1, taken along the lines A – A of Figure 1. The principal construction of the shown control elements 3 can be transferred to tapered ones as shown in Figure 2.

[00030] In fig 3 A the flat material of the valve slider 1 or rather the control element 3 comprises a bevel 19, in fig. 3 B a step 21, and in fig 3 C a recess 23. In embodiments, the shape of the control element 3 realizing a linking flow path between the flow paths 5 and 7 can be varied to any other suitable shape.

[00031] Fig. 4 shows another valve slider 1 with four control elements 3 comprising grooves 25 or rather a cornered groove 27. The grooves 25 and 27 each can be coupled to or separated from flow paths 5 and 7 by sliding the valve slider 1 as

described above. In addition, the cornered groove 27 can couple or separate a parallel flow path 29. In the setting as shown in fig. 4, the groove 27 of the valve slider 1 realizes a switchable forking 31. The flow path 7 can be connected to the flow paths 5 and 29 via the cornered groove 27. In embodiments, the cornered groove 27 is adapted for optionally separating just one or both of the flow paths 5 and 29 from the flow path 7 in different settings of the valve slider 1. For realizing a valve slider 1 with these three settings the cornered groove 27 can be "U" or "Z" shaped. The flow paths 5, 7, and 29 can be part of a fluid conducting layer of the not shown microfluidic device. One of the flat sides of the valve slider 1 can be put against the layer comprising the flow paths 5, 7, and 29. For switching – connecting or separating – flow paths 5, 7, and 29 in different fluid conducting layers of the not shown microfluidic device, the control element 3 can comprise slits or through holes similarly shaped as the grooves 25 and 27.

[00032] Fig. 5 shows a schematic partly top plan view of a microfluidic device 33 with a microfluidic valve slider 35.

[00033] The valve slider 35 comprises a control element 13 with a tapered slit 37. The valve slider 35 is integrated within the microfluidic device 33. Not visible parts are drawn with dotted lines. The microfluidic device 33 comprises a top layer 39, a separating layer 41 (not visible), and a bottom layer 43 (not visible also). The valve slider 35 is movable – arrow 9 – and is arranged in a cut-off 45 of the separating layer 41 between the top layer 39 and the separating layer 41. The top layer 39, the cut-off 45 of the separating layer 41, and the bottom layer 43 realize a bearing for the valve slider 35. The thickness of the layers 39, 41, and 43 of the microfluidic device 33 may vary.

[00034] The slit 37 is coupled to a flow path 5 inserted in the bottom layer 43 of the microfluidic device 33 and to a hole 47 in the top layer 39 of the microfluidic device 33. The hole 47 realizes a port 49 of the microfluidic device 33, for example an inlet or a outlet port. The port 49 can be flow-controlled by the valve slider 35 with the control element 13. The slit 37 of the control element 13 realizes a flow regulator with the same functionality as described above (see fig. 2). In difference, the end point 15 of

the control element 13 has to be moved to the hole 47 for reaching the minimum flow resistance and consequently the maximum flux through the port 49 of the microfluidic device 33. In embodiments, the slit 37 can be substituted by a tapered groove. The hole 47 can be realized by a through bore or by any other through hole of any shape.

[00035] Fig. 6 and 7 show schematic top plan views of a part of another microfluidic device 51 with a microfluidic valve slider 53 in different settings.

[00036] The control elements 3 of the valve slider 53 are realized by holes 55, for example through bores. In difference to the microfluidic device 33 as described in fig. 5, three holes 47 of three ports 49 of the microfluidic device 51 are arranged substantially in the same position as the ends of five flow paths 5, but implemented in different layers, the top layer 39 and the bottom layer 43.

[00037] Fig. 8 shows a longitudinal view of the part of the microfluidic device of fig. 6 with the microfluidic valve slider 53 in a first setting, taken along the lines B – B of Figure 6.

[00038] Fig. 9 shows a longitudinal view of the part of the microfluidic device of fig. 7 with the microfluidic valve slider 53 in a second setting, taken along the lines C – C of Figure 7.

[00039] In a first setting as shown in the figures 6 and 8, the port 49 of the microfluidic device 51 is coupled to the flow path 5 of the bottom layer 43 of the microfluidic device 51 via the hole 47 of the top layer 39 and via the hole 55 of the control element 3 of the valve slider 53.

[00040] In a second setting, the port 49 of the microfluidic device 51 is closed or rather separated from the flow path 5 by a top sealing surface 57 and a bottom sealing surface 59 of the valve slider 53.

[00041] The bottom and the top layers 43 and 39 comprise each an inner surface 61. The sealing surfaces 57 and 59 are put against the inner surfaces 61 of the layers 39 and 43 of the microfluidic device 51 for sealing the flow path 5 and closing the port 49.

[00042] The valve slider 53 can be slit perpendicularly, in embodiments angularly, to

the flow direction of the flow path 5 or rather the picture plane of the figures 8 and 9 for changing the settings.

[00043] The microfluidic devices 33 and 51 can be adapted for executing microfluidic processes such as analyzing and separation processes or synthesis processes, for example a PCR process.

[00044] Fig. 10 shows a microfluidic coupling device 63 with a valve slider 65.

[00045] Fig. 11 shows a longitudinal view of the microfluidic coupling device 63 of fig. 10, taken along the lines D – D of Figure 10;

[00046] Not visible parts are indicated dotted.

[00047] The coupling device 63 comprises three first ports 67 in the top layer 39 and three second ports 69 in the bottom layer 43 realizing three couples of ports 67 and 69. The couple of ports 67 and 69 can be selected each by the valve slider 65 and coupled via the flow path 5 implemented in the separating layer 41, via a rectilinear groove 71 of the control element 3 of the valve slider 65, via the flow path 7 implemented in the top layer 39, and via a hole 72, for example a bore, in the separating layer 41. The rectilinear groove 71 can be moved with the valve slider 65 in three different coupling positions. In fig. 10 is one of the coupling positions illustrated. The couple of ports 67 and 69 – drawn bottom sided in figure 10 – is coupled to a continuous flow path 73. For all other positions of the valve slider 65 within the coupling device 63, all flow paths 5 and 7 of the coupling device 63 are sealed by longitudinal sidewalls 75 of the valve slider 65. Consequently, all couples of port 67 and 69 are disconnected.

[00048] The coupling device 63 can be coupled to other microfluidic devices.

[00049] Fig. 12 shows a three-dimensional top plan view of a microfluidic coupling device 77 with a valve slider 79 with the same essential functionality as the microfluidic device 51 as described in the figures 6 to 9. Therefore, only the differences are described.

[00050] The valve slider 79 comprises gripping recesses 81, for example an

automatic gripper. The microfluidic coupling device 77 comprises one port 69 that can be coupled or separated from one port 49 having a hole 47 via a flow path 5 and via the control element 3 of the valve slider 79 comprising a hole 55.

[00051] Fig. 13 shows a three-dimensional part sectional top plan view of a microfluidic assembly 81 with the microfluidic coupling device 77 of fig. 12 and an external sealing element 83.

[00052] The external sealing element 83 comprises an outer actuator 85 and an inner actuator 87 within the outer actuator 85.

[00053] In embodiments, the port 49 can be inserted in the top layer 39 – indicated with a dotted circle 86. The external sealing element 83 can face the bottom layer 43 of the microfluidic coupling device 77 or can comprise a centric flow path within the inner actuator 87 coupled to the port 49.

[00054] Fig. 14 shows a top plan view of the front side of the external sealing element 83. The front side is facing the microfluidic coupling device 77 with an outer sealing surface 91 of the outer actuator 85 and an inner sealing surface 93 of the inner actuator 87.

[00055] Fig. 15 shows a top plan view of another microfluidic coupling device 95 with a valve slider realized with a valve rotor 97. Sliding is understood in this application as any even movement, in particular rectilinearly and/or rotationally. Not visible parts are indicated dotted. In the following, only the differences to the coupling device of the figures 10 and 11 are described.

[00056] The valve rotor 97 comprises a hole 55 connecting a flow path 5 inserted in the top layer 39 of the microfluidic coupling device 95 and a flow path 7 inserted in the bottom layer 43 of the microfluidic coupling device 95. The flow paths 5 and 7 can be disconnected by rotating the valve rotor 97. Fig. 15 shows a first setting of the valve rotor 97, wherein the flow paths 7 and 9 are connected, and wherein the hole 55 of the valve rotor 97 is positioned close to the flow paths 7 and 9 for connecting them. In a second setting, the flow paths 5 and 7 are disconnected by sealing surfaces 57 and 59 of the valve rotor 97. Consequently, the ports 67 and 69 are disconnected in this

setting. The diameter of the valve rotor 97 is greater than the lateral dimension of the microfluidic coupling device 95. The separating layer 41 of the microfluidic coupling device 95 comprises a partly circular cut-off 99 realizing together with the inner surfaces 61 of the layers 39 and 43 a bearing for the valve rotor 97. The valve rotor 97 can be rotated by gripping and actuating the recesses 81 in any sense of rotation – indicated with a double arrow 9.

[00057] Fig. 16 shows a sectional view of a microfluidic multi-layer valve slider 101 with a multilayer foil comprising three layers, a middle layer 103 and two sealing layers105. The middle layer 103 can comprise a material adapted for stiffening the microfluidic multi-layer valve slider 101. The two sealing layers 105 can comprise a material adapted for sealing and reducing the friction. For example, the middle layer 103 can be coated with surface modifying material and/or material having a low friction coefficient, for example Teflon ®, rubber, or alike, for realizing the sealing layers 105. Besides this, the layers 39 and 43 can comprise a material adapted for sealing and reducing the friction and/or a material adapted for stiffening.

[00058] In the following, a method of controlling a microfluidic process executed with a microfluidic assembly with a microfluidic coupling device with a valve slider is described by referring to the figures above, in particular to the figures 13 and 14.

[00059] In a first step, at least one of the actuators 85 or 87 of an external sealing element 83 is released. Advantageously, this step reduces the friction of moving parts of the coupling device 77. Friction occurs at the inner surfaces 61 of the layers 39 and 42 of the microfluidic coupling device 77 and at the sealing surfaces 57 and 59 of the valve slider 79.

[00060] In embodiments, the outer sealing surface 91 of the outer actuator 85 is pressed against an outer surface 107 of the top layer 39 of the microfluidic coupling device 77 by a spring. This guarantees slight sealing contact between the surfaces 61 of the layers 39, 43 and of the sealing surfaces 57, 59 of the valve slider 79. The valve slider 79 can be slit in spite of this slight sealing force.

[00061] In embodiments, an inner sealing surface 93 of the inner actuator 87 is

pressed against the outer surface 107 of the top layer 39 by a piezoelectric element or a suited actor element before releasing it.

[00062] Subsequently the valve slider 97 is moved for controlling the microfluidic flow within the microfluidic coupling device 77.

[00063] Finally, at least one of the actuators 85 and/or 87 of the sealing element 83 is tightened again for sealing the fluid containing components, the flow path 5, of the microfluidic coupling device 77.

[00064] In embodiments, the bottom layer 43 of the microfluidic coupling device 77 can be pressed against a flat counter bearing (not shown) for carrying the sealing forces.

[00065] In embodiments, features disclosed in different figures, in particular different control elements 3 and/or 13, can be combined.

[00066] In other embodiments, microfluidic devices and/or assemblies with more than one valve slider and/or more than one microfluidic coupling device are possible.

[00067] In further embodiment, the microfluidic device can be bended or twisted. In particular the microfluidic device comprises an elastic material for bending and/or twisting.

[00068] The microfluidic devices can be produced easily by a laminating process known in the art.

[00069] Finally, the multilayer microfluidic devices can comprise more than three layers and/or more than one microfluidic coupling device.

[00070] It is to be understood that this invention is not limited to the particular component parts of the devices described or to process steps of the methods described as such devices and methods may vary. It is also to be understood, that the terminology used herein is for purposes describing particular embodiments only and it is not intended to be limiting. It must be noted that, as used in the specification and the appended claims, the singular forms of "a", "an", and "the" include plural referents until

the context clearly dictates otherwise. Thus, for example, the reference to "a microfluidic coupling device" or "a slider" includes two or more such functional elements.

CLAIMS

1. A valve slider (1;35;53;65;79;97) for a microfluidic coupling device (63;77;95), wherein the slider comprises a flat foil and is adapted for flow-controlling the flow within at least one flow path (5,7) of the microfluidic coupling device (63;77;95), wherein the slider is adapted for sliding relatively to the microfluidic coupling device (63;77;95), wherein the slider (1;35;53;65;79;97) comprises at least one microfluidic control element (3;13) for flow-controlling the flow within the flow path (5,7).

2. The slider of the above claim, wherein the slider (1;35;53;65;79;97) is adapted for sliding rectilinear or rotating relatively to the microfluidic coupling device (63;77;95).

3. The slider of the above claim, wherein the control element (3;13) comprises at least one of the following features:
   - a groove (25,27;71) adapted for coupling with the flow path (5,7);
   - a slit adapted for coupling with the flow path (5,7);
   - a recess (23) adapted for coupling with the flow path (5,7);
   - a bevel (19) adapted for coupling with the flow path (5,7);
   - a step (21) adapted for coupling with the flow path (5,7);
   - a tapered groove adapted for coupling with the flow path (5,7);
   - a tapered slit (37) adapted for coupling with the flow path (5,7);
   - a tapered recess (23) adapted for coupling with the flow path (5,7);
   - a tapered bevel (19) adapted for coupling with the flow path (5,7);
   - a tapered step (21) adapted for coupling with the flow path (5,7);
   - a through hole (55), in particular a bore, adapted for coupling with the flow path (5,7).

4. The slider of claim 1 or any one of the above claims, wherein the flat foil is a multilayer foil, in particular with three layers (103,105), preferred a middle layer (103) and two sealing layers (105), in particular two sealing layers (105) comprising surface modifying material and/or material having a low friction coefficient, preferably Teflon ®.

5. A microfluidic coupling device (63;77;95) comprising at least one port (49;67,69), at least one microfluidic flow path (5,7) coupled to the port (49;67,69), at least one control device, in particular a valve slider (1;35;53;65;79;97) according to claim 1 or any one of the above claims, adapted for controlling the flow within the flow path (5,7), wherein the control device is integrated within the chip.

6. The coupling device the above claim, wherein the control device is integrated between a top layer and a bottom layer of the chip.

7. The coupling device of the above claim, wherein the top layer and the bottom layer are separated by a separating layer having the same thickness as the control device.

8. The coupling device of the above claim, wherein the control device is integrated in a cut-out of the separating layer for sliding and/or rotating at the surfaces of the top layer and the bottom layer.

9. The coupling device of claim 5 or any one of the above claims, wherein the flow path (5) is coupled to a second flow path (7) or to the port (49;67,69) of the microfluidic coupling device (63;77;95) via the control element (3;13).

10. A microfluidic device adapted for processing a microfluidic process comprising a coupling device (63;77;95) according to claim 5 for controlling the microfluidic process.

11. An assembly (82) for handling liquid within a microfluidic device, in particular a microfluidic device according to the above claim, with at least one integrated control device, in particular a coupling device (63;77;95) according to claim 5 with a valve slider (1;35;53;65;79;97) according to claim 1, wherein the microfluidic device comprises at least one port (49;67,69) and at least one microfluidic flow path (5,7) coupled to the port (49;67,69), wherein the flow path (5,7) and/or the port (49;67,69) are flow-controlled by the control device, in particular sealed, switched, or coupled, wherein the assembly (82) comprises an external sealing element (83) adapted for sealing the control device, in particular the flow path (5,7) and/or the port (49;67,69).

12. The assembly of the above claim, wherein the sealing element (83) is put against the microfluidic device, in particular pressed against the microfluidic device by a suited actor element, in particular by a piezoelectric element.

13. The assembly of claim 11 or any one of the above claims, wherein the sealing element (83) comprises an outer actuator (87) and an inner actuator (85) within the outer actuator.

14. A method of controlling a microfluidic process executed with a microfluidic assembly, in particular a microfluidic assembly (82) according to claim 11 or any one of the above claims, with a microfluidic device having a microfluidic coupling device (63;77;95) with a valve slider (1;35;53;65;79;97) comprising the steps of
- releasing an external sealing element (83),
- setting the control element (3;13), in particular moving the valve slider (1;35;53;65;79;97), for controlling the microfluidic flow within the microfluidic device, and
- tightening the sealing element (83).

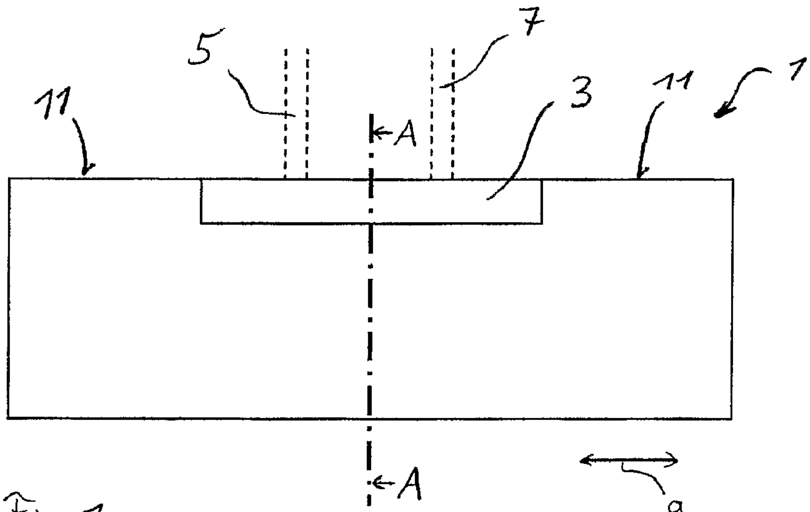

Fig. 1

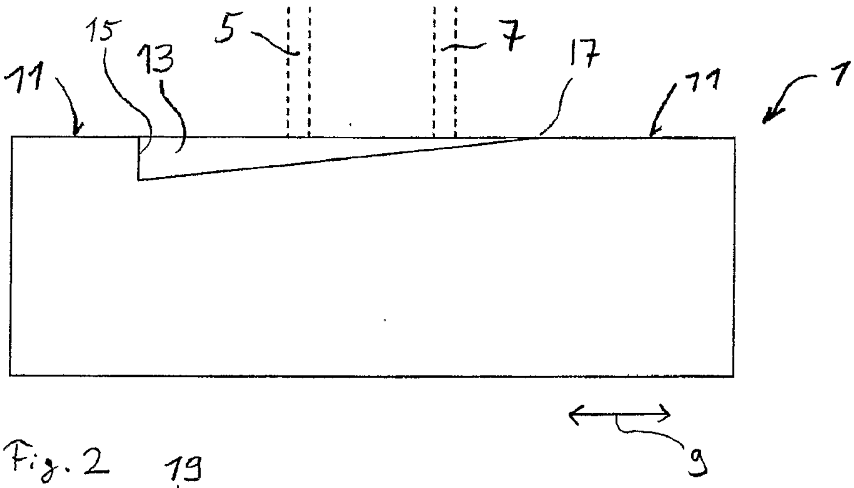

Fig. 2

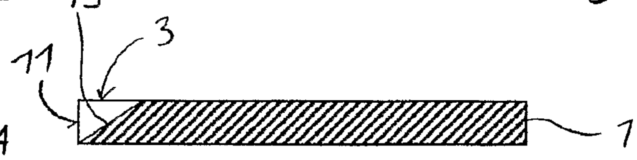

Fig. 3A

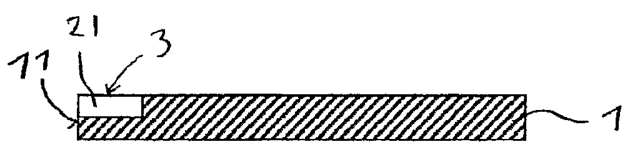

Fig. 3B

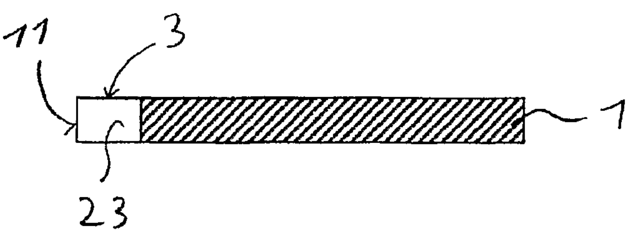

Fig. 3C

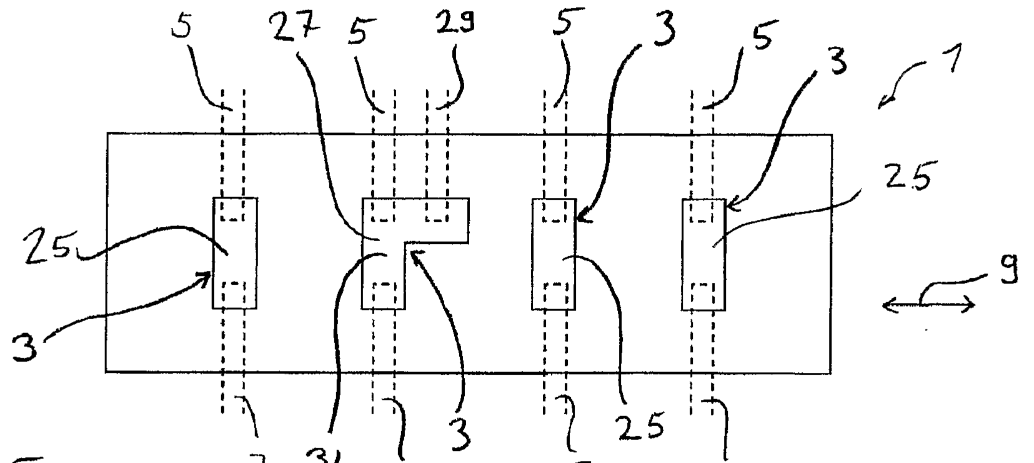

Fig. 4

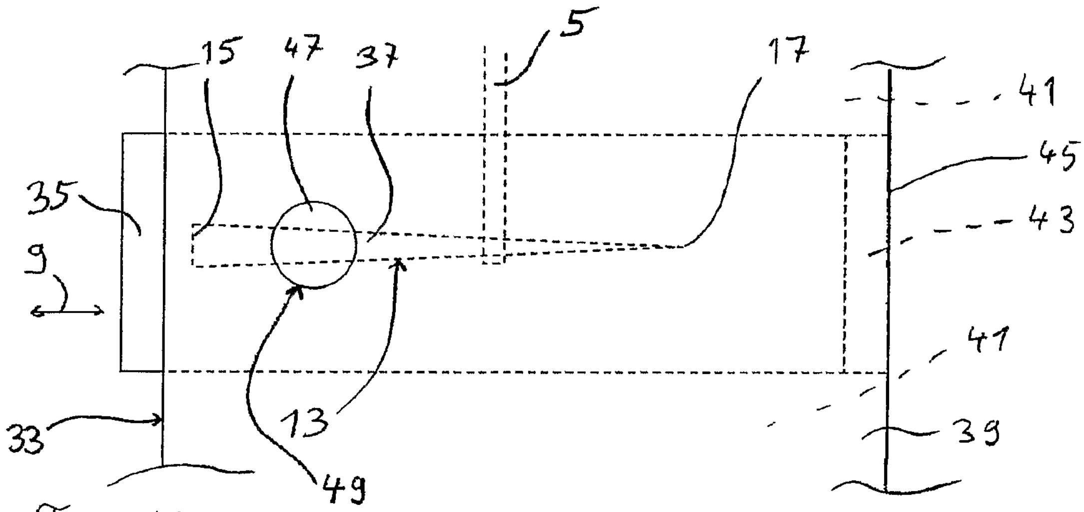

Fig. 5

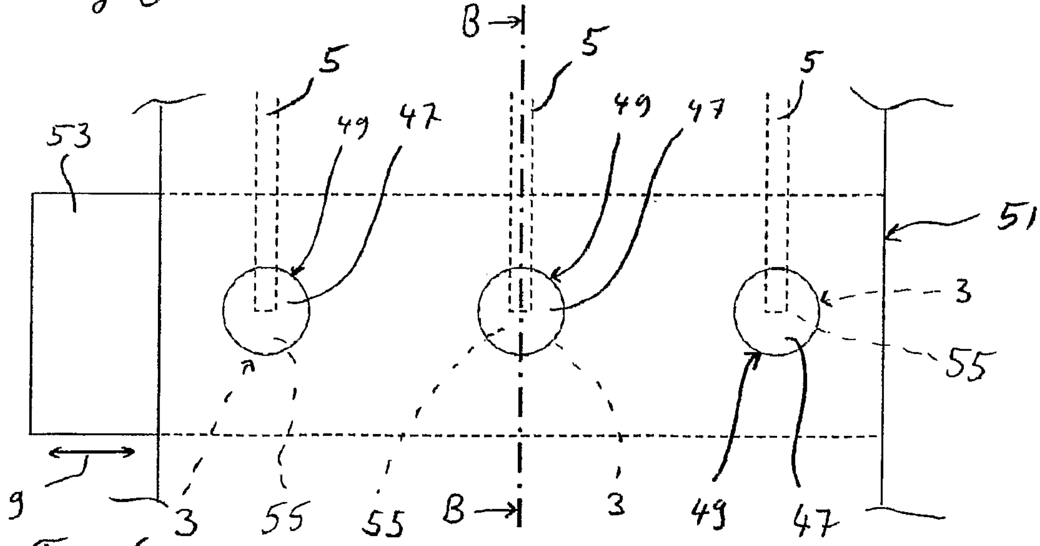

Fig. 6

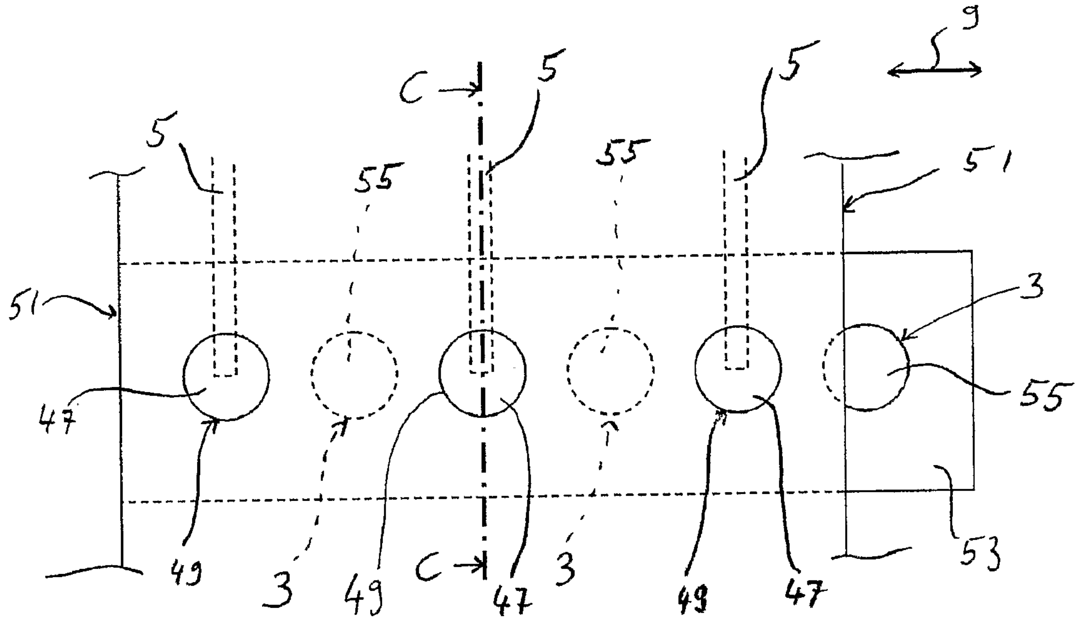

Fig. 7

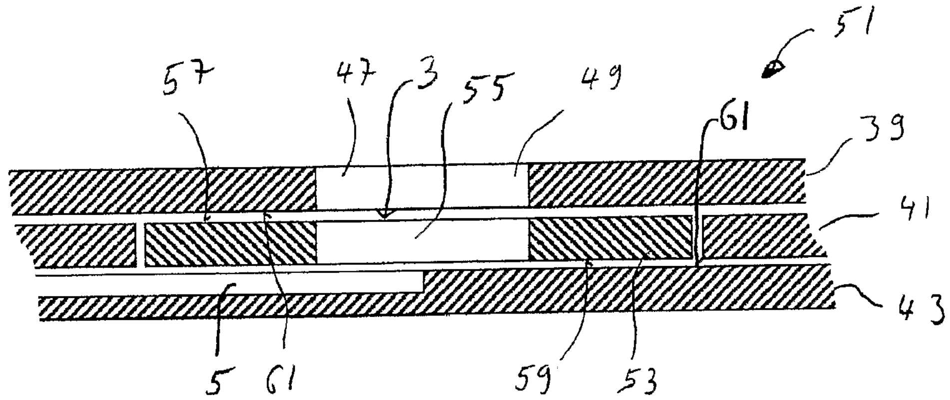

Fig. 8

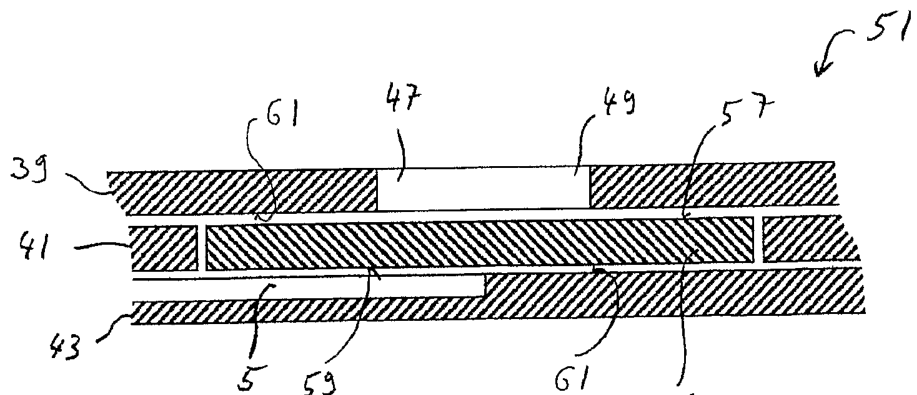

Fig. 9

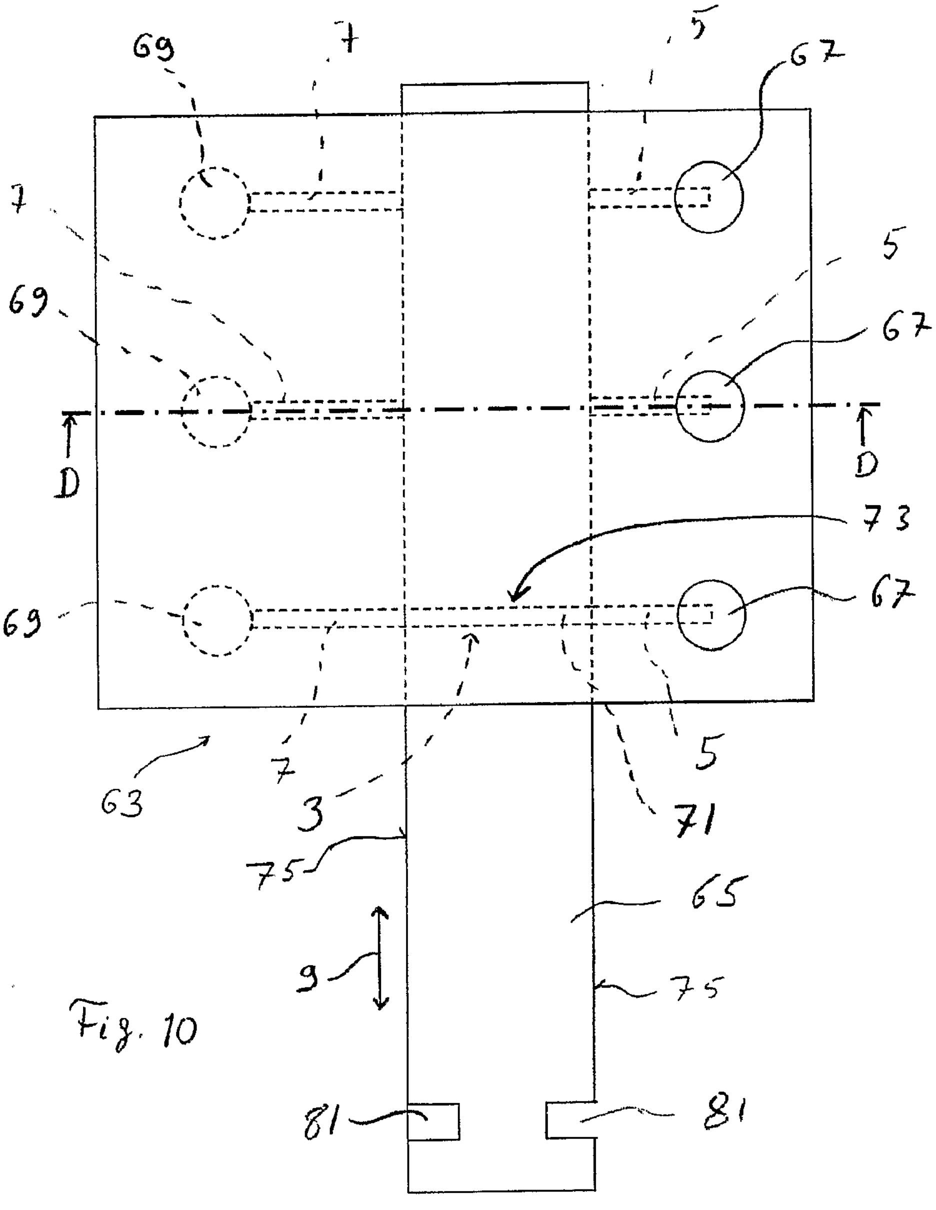
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Fig. 10

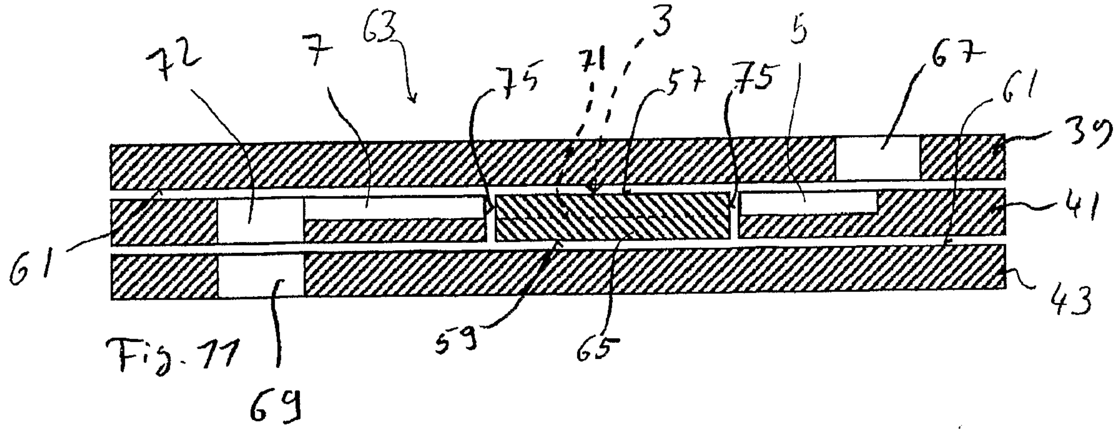
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Fig. 11

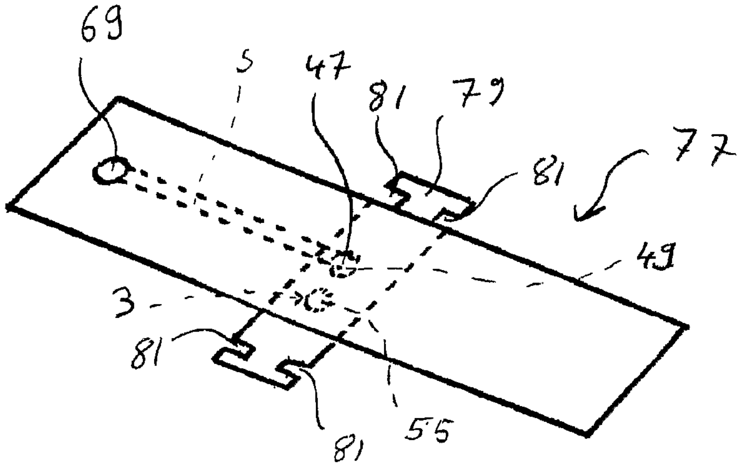
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Fig. 12

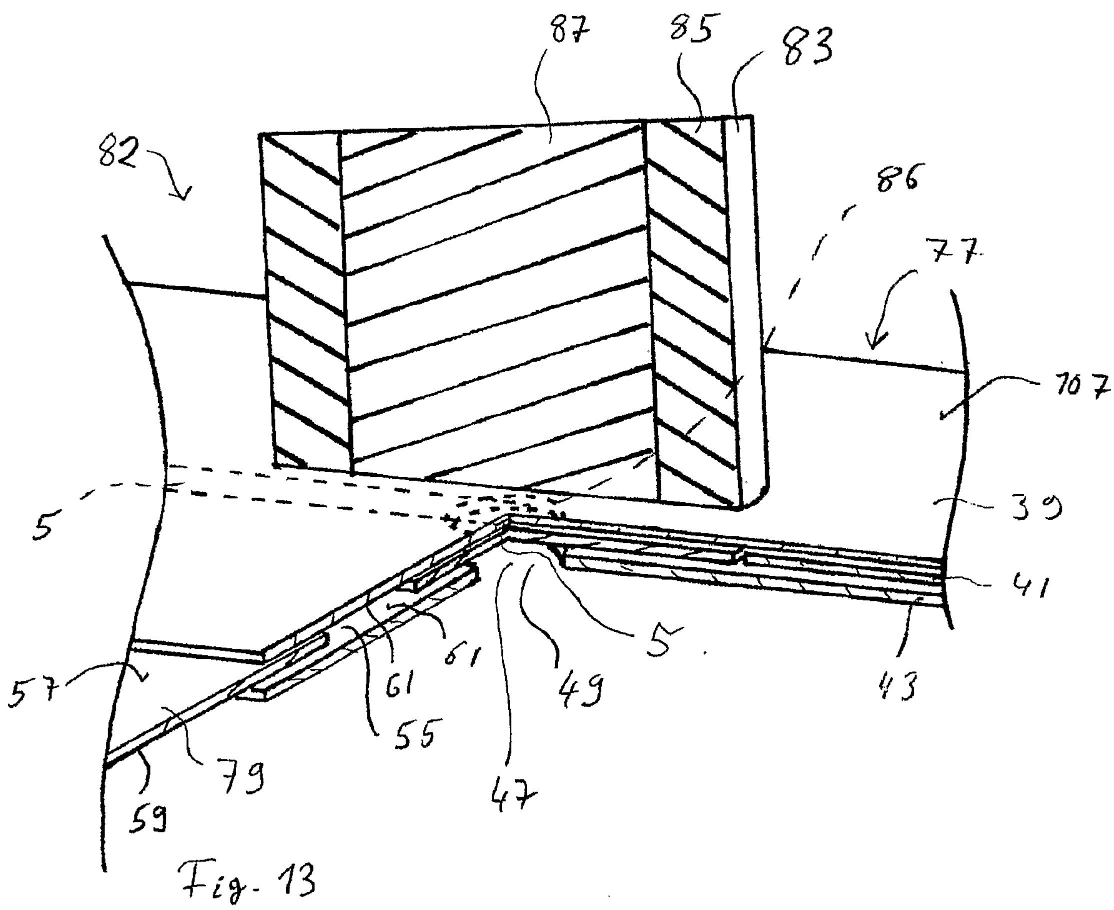
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Fig. 13

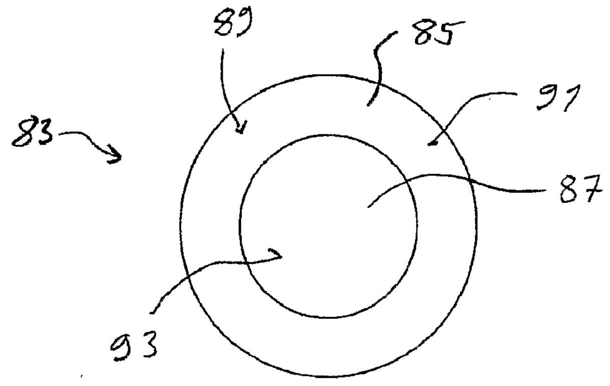

Fig. 14

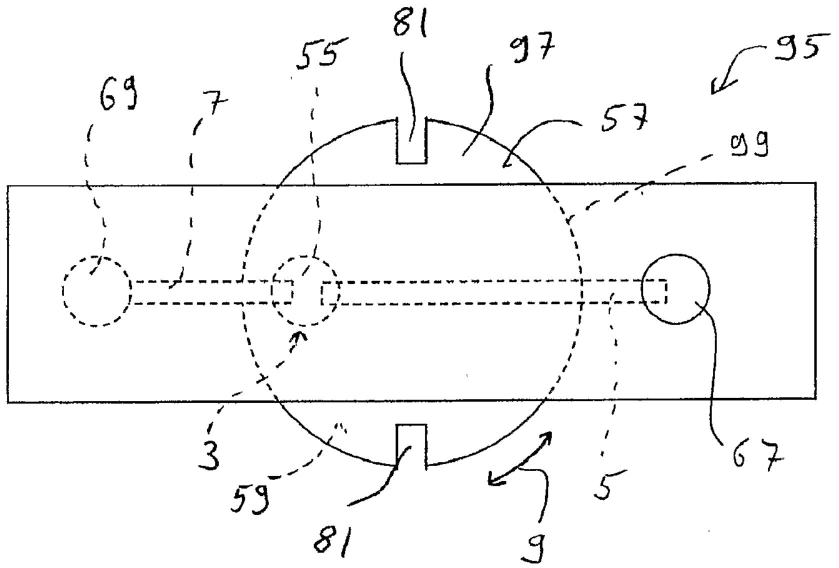

Fig. 15

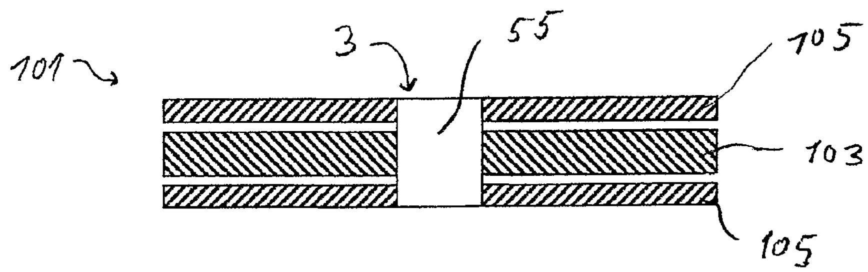

Fig. 16