

DEFENDANT NANOCELLECT'S INVALIDITY CONTENTIONS

EXHIBIT B: Anticipation/Obviousness of U.S. Patent No. 8,623,295

As described in the following claim chart, claims 1-18 of U.S. Patent No. 8,623,295 (“the ’295 patent”) are invalid in view of the following prior art references, alone or in combination with one or more references identified in NanoCollect’s Initial Invalidity Contentions. To the extent any of these references is found not to anticipate one or more of the asserted claims of the ’295 patent, the claims are obvious over any such reference alone or in view of any of the other prior art references disclosed in NanoCollect’s Initial Invalidity Contentions and this claim chart.

The below chart provides examples of prior art that establish that the asserted claims of the ’295 patent are anticipated and/or rendered obvious over the prior art. This case is in the early stages, with most discovery still upcoming, and the close of fact discovery still nine months away on June 26, 2020. The Court has not construed any claims, and expert reports are not due until sometime after the Court’s claim construction order. Further, Plaintiff has only recently disclosed their infringement contentions, but may seek leave to amend their contentions in the future. As a result, NanoCollect reserves the right to supplement and/or amend these charts in response to positions taken by Plaintiff with additional selections from the cited prior art, as well as with additional prior art references. NanoCollect also incorporates by reference the accompanying Invalidity Contentions with respect to the anticipation and obviousness of the other patents in suit, including the prior art descriptions and citations, exemplary prior art combinations, exemplary obviousness rationales and motivations to combine, and commentary on potential objective indicia of nonobviousness described therein. Additionally, NanoCollect incorporates by reference the arguments made in the accompanying Invalidity Contentions with respect to the invalidity of certain of the following claim limitations under 35 U.S.C. §§ 101, 102, 103, and 112.

To the extent that NanoCollect’s Invalidity Contentions rely on or otherwise imply particular constructions of terms or phrases in the asserted claims, NanoCollect is not proposing any such constructions as proper constructions of those terms or phrases. Various positions put forth in this document are predicated on Plaintiff’s incorrect and overly broad interpretation of the asserted claims as evidenced by its initial claim charts, dated August 7, 2019. Those positions are not intended to and do not necessarily reflect NanoCollect’s interpretation of the true and proper scope of the asserted claims, and NanoCollect reserves the right to adopt claim construction positions that differ from, or even conflict with, various positions put forth in this document.

U.S. Patent No. 3,791,517 (“Friedman”) was filed on March 5, 1973, and issued on February 12, 1974. Friedman is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

U.S. Patent No. 4,175,662 (“Zöld 662”) was filed on March 22, 1978, and issued on November 27, 1979. Zöld 662 is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

U.S. Patent No. 4,676,274 (“Brown”) was filed on February 28, 1985, and issued on June 30, 1987. Brown is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

U.S. Patent No. 4,936,465 (“Zöld”) was filed on September 15, 1989, and issued on June 26, 1990. Zöld is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

U.S. Patent No. 5,101,978 (“Marcus”) was filed on November 27, 1989, and issued on April 7, 1992. Marcus is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

U.S. Patent No. 5,171,132 (“Miyazaki”) was filed on December 21, 1990, and issued on December 15, 1992. Miyazaki is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

PCT Publication No. WO 97/02357 (“Anderson”) was filed on June 27, 1996, and published on January 23, 1997. Anderson is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

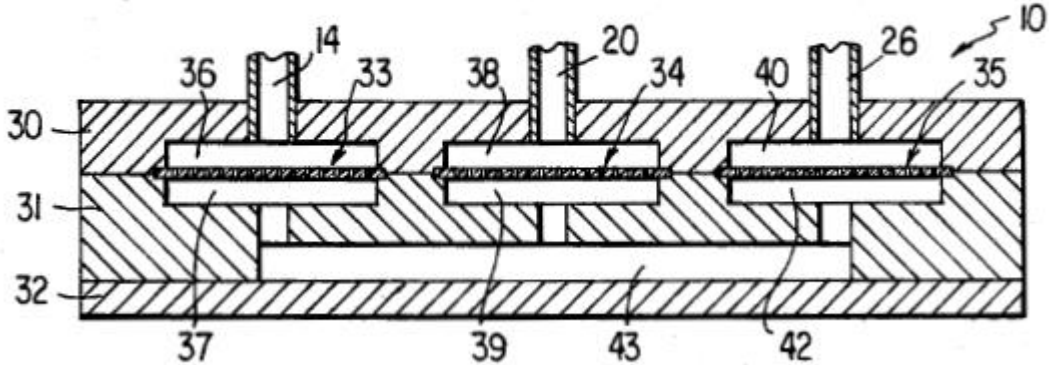
U.S. Patent No. 5,777,649 (“Otsuka”) was filed on August 19, 1996, and issued on July 7, 1998. Otsuka is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

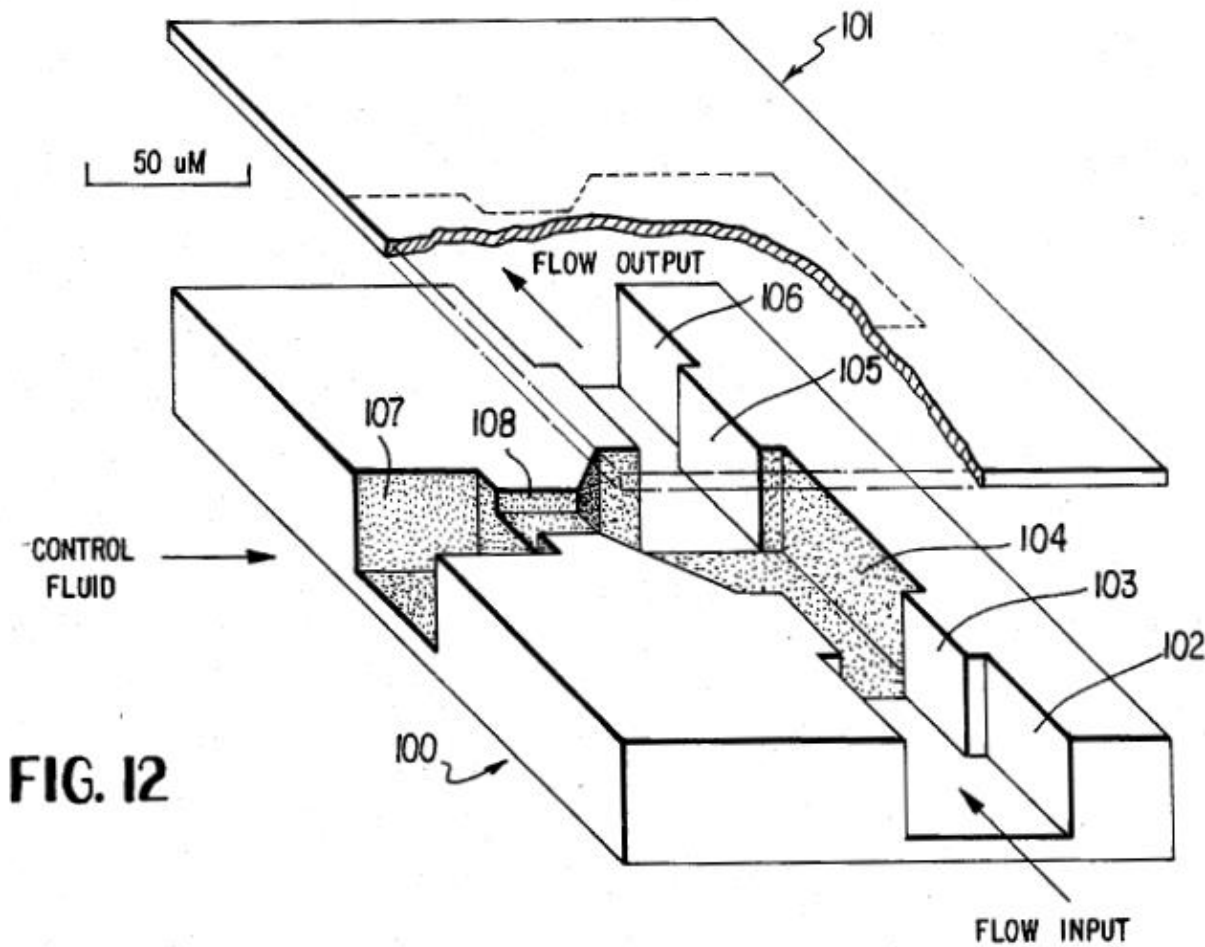
PCT Publication No. WO 00/70080 (“Wada”) was filed on May 11, 2000, and published on November 23, 2000. Wada is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

PCT Publication No. WO 02/29106 (“Chou”) was filed on October 2, 2001, and published on April 11, 2002. Chou is prior art under 35 U.S.C. §§ 102(a), (b), and/or (e).

Asserted Claim Element	Exemplary Prior Art Disclosures
[1] A microfluidic system comprising:	To the extent the preamble of the independent claims are found to be limiting, the following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>For example:</p> <p>Brown</p> <p>Brown discloses a microfluidic device as shown in Figs. 1 and 2 below.</p> <p>FIG. 1</p> <p>The diagram illustrates a microfluidic system. A pump (12) draws fluid from a water reservoir (18) through a tube (16). The fluid is then pumped into a microfluidic chip (10) through a tube (14). The chip (10) has an inlet (20) and an outlet (26). The outlet (26) is connected to a valve (24) and a vent (28). The valve (24) is connected to an air compressor (22) and a gauge (G). The gauge (G) is labeled with an upward arrow and the letter 'G'.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>FIG. 2</p>  <p>“A practical version of a micro flow control valve according to the present invention is illustrated in FIG. 12. In this Figure, the capillary passages involved are formed by suitable etching or other processes in a glass 2 substrate 100 which is provided with the glass cover plate 101. The substrate 100 with its cover plate 101 may form a microscope slide on which an entire controlled flow system for manipulating cells may be formed, as hereinafter more particularly described.” Brown, at 9:22-30; <i>see also</i> Fig. 12 below.</p>

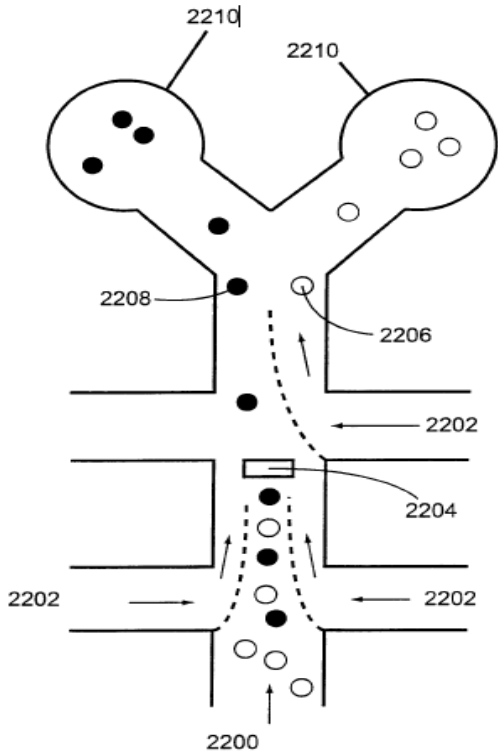
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 12</p> <p>Chou</p> <p>“An embodiment of a microfluidic device in accordance with the present invention comprises pumps, valves, and fluid oscillation dampers.” Chou, at 2:23-24.</p>

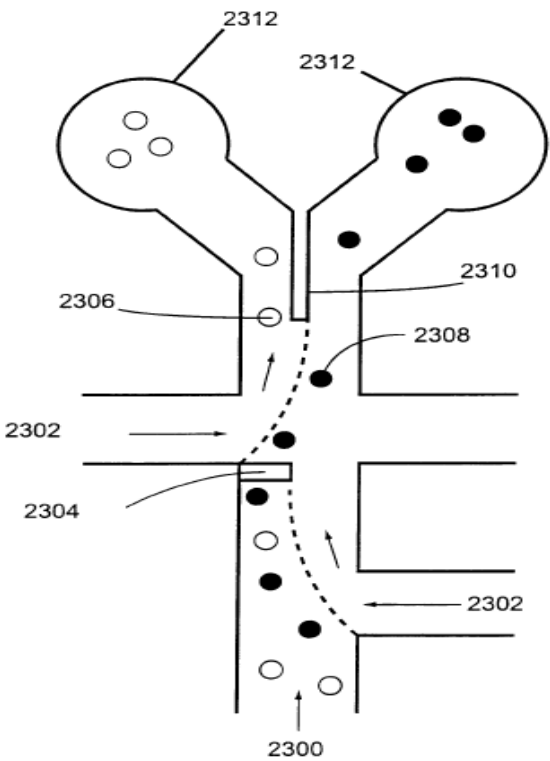
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“An embodiment of a microfluidic device in accordance with the present invention comprises a flow channel, a pump operatively interconnected to said flow channel for moving a fluid in said flow channel, and a damper operatively interconnected to said flow channel for reducing the fluid oscillation in said flow channel.” Chou, at 3:1-4.</p> <p>Wada</p> <p>“The present invention relates to methods of focusing particles in microchannels, e.g., to improve assay throughput, to sort particles, to count particles, or the like.” Wada, at 3:13-15.</p> <p>“In one aspect, the invention provides methods of providing substantially uniform flow velocity to particles flowing in a first microchannel. In the methods, the particles are optionally flowed in the microchannel, e.g., using pressure-based flow, in which the particles flow with a substantially non-uniform flow velocity. Prior to performing the flowing step, the particles are optionally sampled with at least one capillary element, e.g., by dipping the capillary element into a well containing, the particles on a microwell plate and drawing the particles into, e.g., reservoirs, microchannels, or other chambers of the device. The particles (e.g., a cell, a set of cells, a microbead, a set of microbeads, a functionalized microbead, a set of functionalized microbeads, a molecule, a set of molecules, etc.) are optionally focused horizontally and/or vertically in the first microchannel to provide substantially uniform flow velocity to the particles in the first microchannel. Particles are optionally focused using one or more fluid direction components (e.g., a fluid pressure force modulator, an electrokinetic force modulator, a capillary force modulator, a fluid wicking element, or the like). Additional options include sorting, detecting or otherwise manipulating the focused particles.” Wada, at 3:22-4:5.</p> <p>“The subject invention pertains to the dispensing of fluids gases or aerosols in accordance with a preselected program, or the sorting or individual particles, such as cells, of a suspension in accordance with some of their individual physio-chemical properties, such as particle size, DNA and/or protein-content of a cell. Such a method and apparatus, therefore, is useful in cytology, for cell sorting and analysis, i.e., for example, in cancer research or for the dispensing of any fluids and/or gases.” Zöld, at 1:15-24.</p>

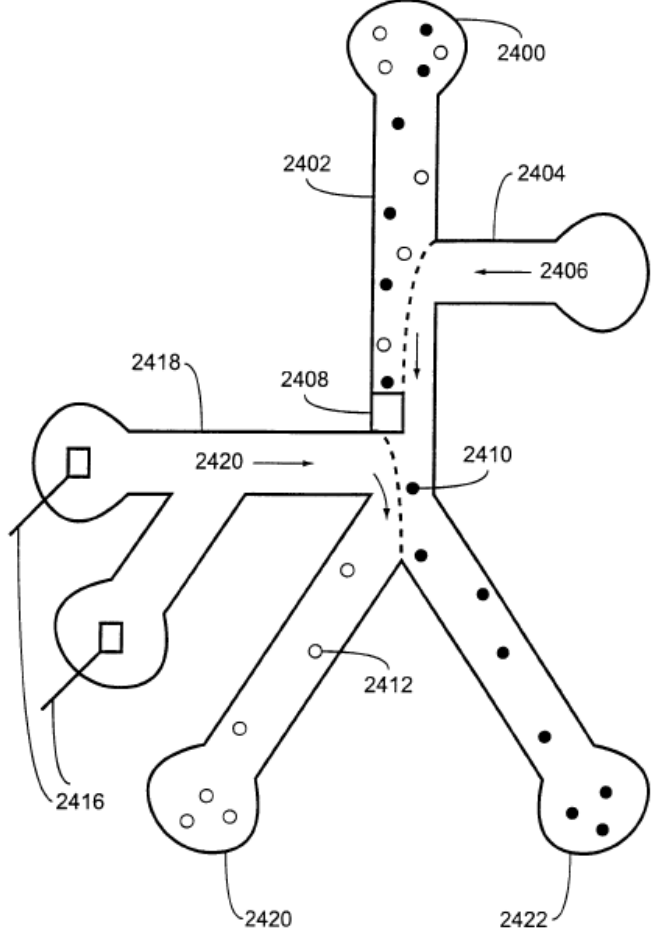
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Zöld</p> <p>“The subject invention pertains to the dispensing of fluids gases or aerosols in accordance with a preselected program, or the sorting or individual particles, such as cells, of a suspension in accordance with some of their individual physio-chemical properties, such as particle size, DNA and/or protein-content of a cell. Such a method and apparatus, therefore, is useful in cytology, for cell sorting and analysis, i.e., for example, in cancer research or for the dispensing of any fluids and/or gases.” Zöld, at 1:15-24.</p> <p>Zöld 662</p> <p>“This invention is concerned with a method and device for the control of motion and especially for the sorting of particles of an electrolytic suspension, where the input flow path can be split up into several output channels leading to respective receptacles. This invention furthermore, is concerned with a sorting device in which by the production of gas particles or cells can be sorted out in accordance with their physical and/or chemical properties such as, particle (cell) size, DNA and/or content.” Zöld 662, at 1:5-14.</p> <p>Marcus</p> <p>“The present invention relates to a fluidic sorting device for the separation of two or more different materials or particles which are suspended in a fluid. The materials or particles to be separated may differ based on shape, texture, color, or any other visually distinctive characteristics. The particles may additionally differ in their visual reaction to an externally applied force, for example an electrostatic or magnetic field. The sorting device of the present invention comprises a fluidic logic element and a machine vision apparatus.” Marcus, at 1:12-22.</p> <p>Friedman</p> <p>“In carrying out the invention there is provided apparatus for sorting small particles such as</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>biological cells while the particles are suspended in a liquid comprising a housing defining a detection chamber, means for moving the particle suspending liquid through said housing in a stream to convey the particles through the stream. A detection means is associated with said detection chamber for detecting differences in particle characteristics and operable to provide electrical signals which vary in accordance with said differences in particle characteristics. A digital fluidic amplifier is provided having an inlet connected to the outlet of said chamber to receive the particle stream, said fluidic amplifier having a switching chamber communicating with said inlet and at least two different outlet ports communicating with said switching chamber, with an electrical transducer coupled to receive electrical signals from said detection means and operable to provide control signals to said fluidic amplifier. Said fluidic amplifier is operable in response to said control signals to switch the liquid particle carrying stream entering the inlet thereof from a first outlet port to a second selected outlet port in response to a predetermined particle characteristic control signal from said transducer.” Friedman, at 1:61-2:16.</p>
<p>(i) a microfluidic flow channel formed in a substrate and adapted to facilitate analysis or processing of a sample having one or more particles suspended in a suspension medium flowing through the flow channel;</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p> <p>Wada</p> <p>“In one aspect, the invention provides methods of providing substantially uniform flow velocity to particles flowing in a first microchannel. In the methods, the particles are optionally flowed in the microchannel, e.g., using pressure-based flow, in which the particles flow with a substantially non-uniform flow velocity.” Wada, at 3:22-26.</p> <p>“Fluid flow streams are optionally "pinched" or "focused" into a narrow region of a microchannel to facilitate single particle or narrow streamline detection using a variety of optical detection schemes (discussed further, below). In one embodiment, particle focusing is achieved</p>

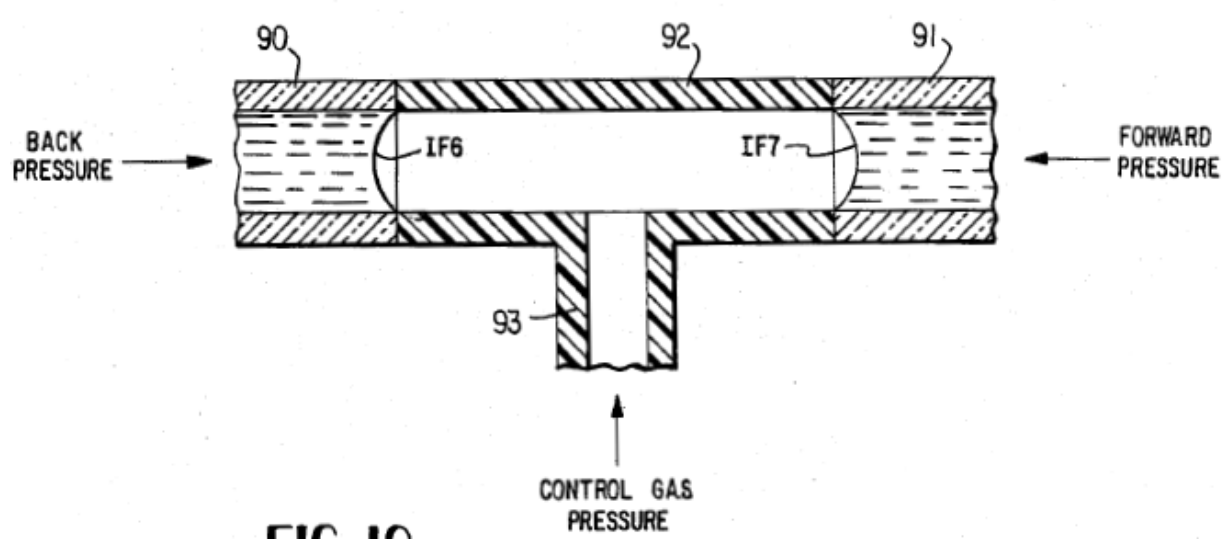
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>electrodynamically (see also, Ramsey et al., "Apparatus and Method for Performing Electrodynamic Focusing on a Microchip." U.S. Pat. No. 5,858,187, issued January 12, 1999). In other preferred embodiments, pressure, Joule heating, and/or other fluid movement methods are used to focus cells or other particles." Wada, at 12:7-14.</p> <p>"As shown, cells 2200 are generally flowed in a main microchannel that includes at least two sets of opposing microchannels for focusing and/or otherwise directing the flow of cells 2200 using hydrodynamic flow 2202 (e.g., cell buffer flow). One set of opposing microchannels is typically located, e.g., upstream from detector 2204 for simultaneously introducing hydrodynamic flow 2202 from both microchannels to focus cells 2200, as described above . . . [a] second set of opposing microchannels is typically located downstream from detector 2204 for introducing at least one hydrodynamic flow 2202 so as to direct selected cells 2208 (e.g., fluorescently-labeled cells) and non-selected cells 2206 into, in this case, one of two microchannels, each terminating in particular collection wells 2210." Wada, at 19:24-20:2; <i>see also</i> Fig. 22 below.</p>

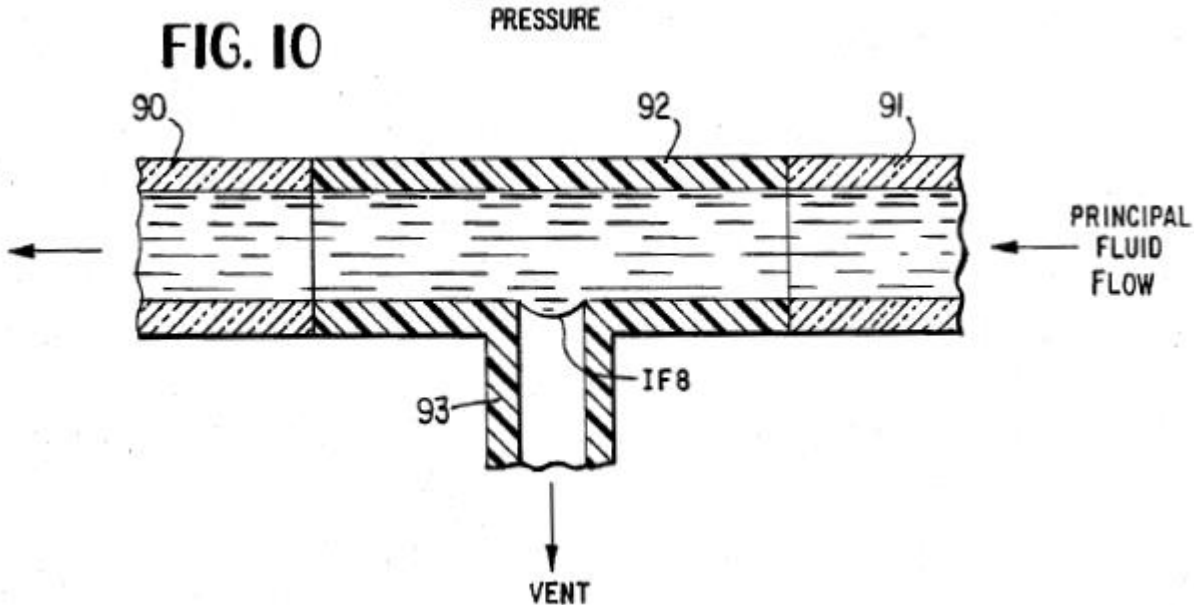
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>Fig. 22</p> <p>“In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304.” Wada, at 20:4-6; <i>see also</i> Fig. 23 below.</p>

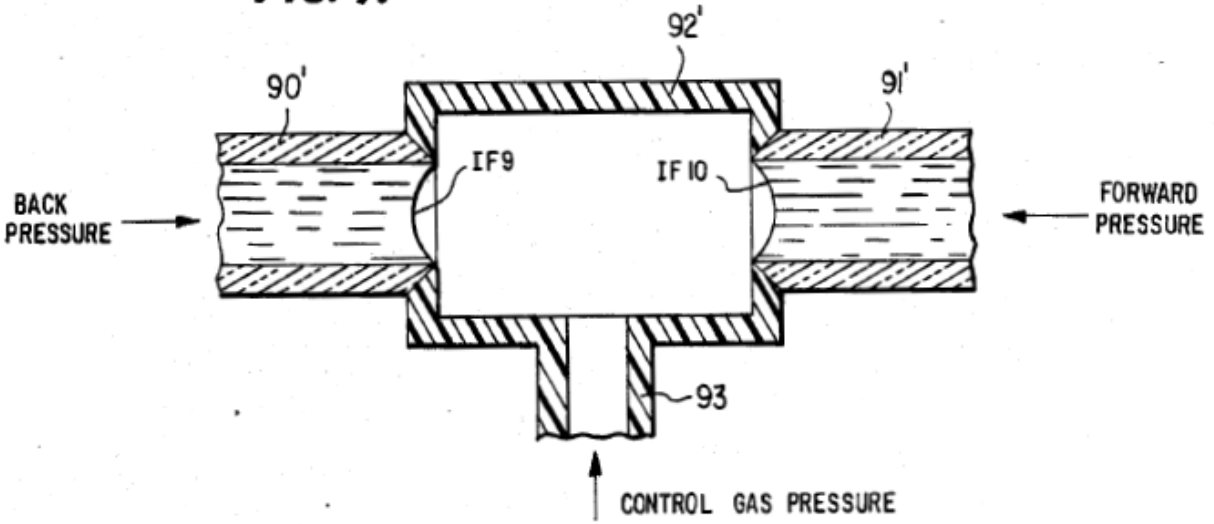
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>Marcus</p> <p>“FIG. 1 generally teaches the apparatus and concept of the present invention. In said figure, element 1 broadly depicts the fluidic logic element. Said fluidic logic element 1 comprises input flow port 2 through which a suspension containing particulate matter is forced. Fluidic logic element 1 further</p>

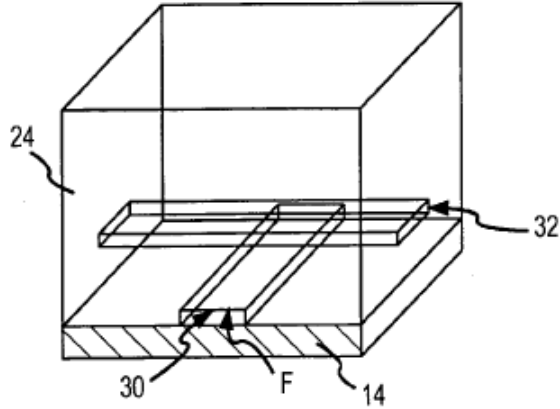
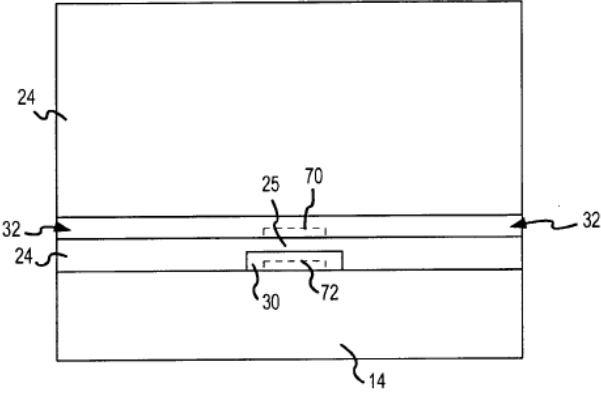
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>comprises control Port and control port B, 4 and 3, respectively; and output port A and output port B, 5 and 6, respectively.” Marcus, at 3:28-36; <i>see also</i> Fig. 1 below.</p> <div> </div> <p>FIG. 1</p> <p>“A suspension containing at least two visually different particulate matter is forced through input flow port 2. The suspension contains particle type A, 8, particle type B, 7, and a fluid carrier 15.” Marcus, 3:49-51.</p> <p>Brown</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Brown shows a microfluidic device comprising a microchannel (label 90 in Figs. 9-11) having an interior bounded by a sidewall (label 90). <i>See Brown, Figs. 9-11 below.</i></p> <p style="text-align: center;">FIG. 9</p>  <p style="text-align: center;">FIG. 10</p>

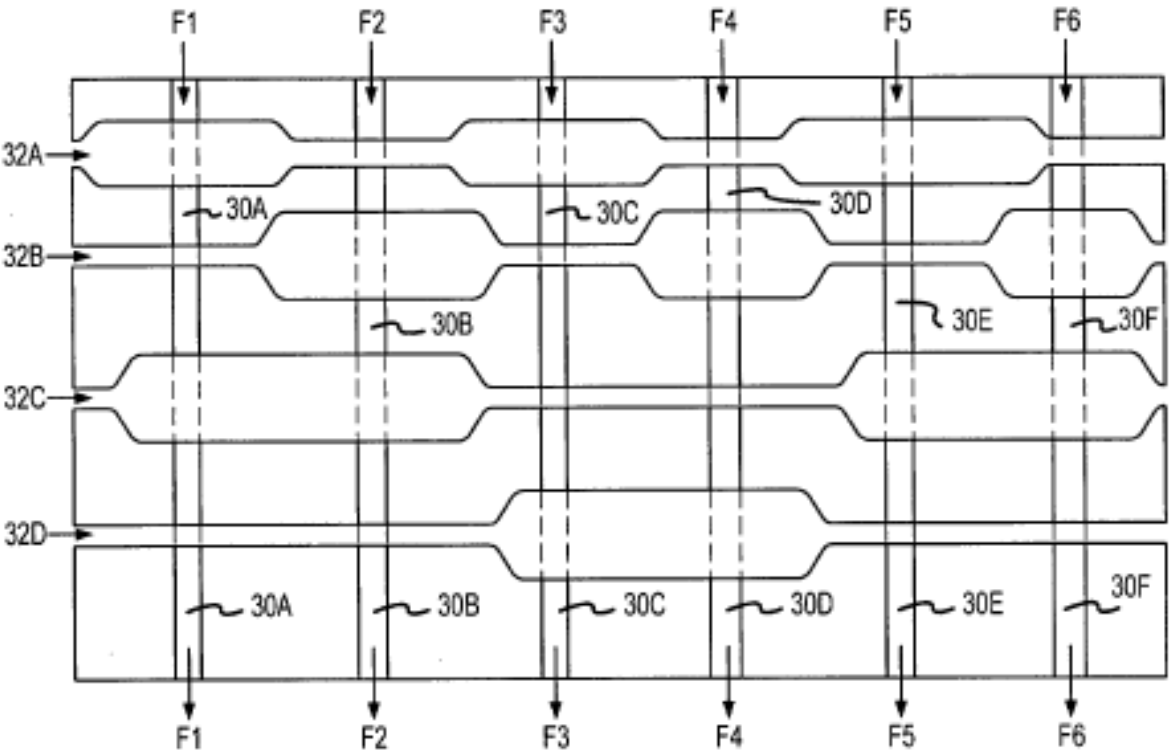
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>FIG. 10</p>  <p>The diagram shows a cross-section of a device with a central horizontal channel. The channel is bounded by upper and lower walls, labeled 90 and 91 respectively. A central portion of the channel is labeled 92. A side vent, labeled 93, is located on the bottom wall of the channel. The vent is a vertical passage that leads to a 'VENT' at the bottom. The vent is labeled IF8. Arrows indicate 'PRINCIPAL FLUID FLOW' from right to left through the channel. A 'PRESSURE' label is positioned above the channel. A downward arrow points from the vent to the 'VENT' label.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p style="text-align: center;">FIG. 11</p>  <p>“In a particular embodiment of the invention, a device relates to capillary flow control and in particular to controlling such flow with respect to extremely small volumes of a principal fluid. By extremely small volumes of principal fluid, as used herein, is meant volumes which may be as small as in the order of one picoliter.” Brown, at 3:45-50.</p> <p>“FIGS. 9 and 10 show a control valve construction which is functionally equivalent to those shown in FIGS. 1-6, although, the principal fluid flow rate in this case is extremely small because all of the passages illustrated in FIGS. 9 and 10 are of capillary size.” Brown, at 8:33-37.</p> <p>Friedman</p> <p>“Referring more particularly to FIG. 1, there is shown an optical chamber formed by a glass tube member 10 which is clamped by means not shown to a digital fluidic switch chamber housing</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>member 14, the two members being sealed together by a liquid-tight annular seal 18. The liquid 19 containing the particles to be observed enters the apparatus through a tube 20 centrally disposed within the funnel-shaped entrance portion 24 of the cylindrical central bore 26 of the member 10. Another liquid 23 also enters the mouth 24 of the central bore 26 and forms a sheath of liquid for the liquid 19 containing the particles.” Friedman, at 2:30-41; <i>see also</i> Fig. 1 below.</p> <p>FIG. 1</p> <p>Chou</p> <p>“An embodiment of a microfluidic device in accordance with the present invention comprises a flow channel, a pump operatively interconnected to said flow channel for moving a fluid in said flow channel, and a damper operatively interconnected to said flow channel for reducing the fluid oscillation in said flow channel. An embodiment of a microfluidic sorting device comprises</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>a first flow channel formed in a first layer of elastomer material, a first end of the first flow channel in fluid communication with a collection pool and a second end of the first flow channel in fluid communication with a waste pool.” Chou, at 3:1-8; <i>see also</i> Figs. 7A and 7B below.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div> <p style="text-align: center;">FIG. 7A FIG. 7B</p> <p>“As will be explained, the preferred method of Figs. 1 to 7B involves using pre-cured elastomer layers which are assembled and bonded. In an alternative method, each layer of elastomer may be cured "in place". In the following description "channel" refers to a recess in the elastomeric structure which can contain a flow of fluid or gas.” Chou, at 8:18-21.</p> <p>“As can be seen in Fig. 7A and 7B, flow channels 30 and 32 are preferably disposed at an angle to one another with a small membrane 25 of substrate 24 separating the top of flow channel 30 from the bottom of flow channel 32.” Chou, at 9:20-22.</p> <p>“Figs. 7B and 7H together show the closing of a first flow channel by pressurizing a second flow channel, with Fig. 7B (a front sectional view cutting through flow channel 32 in corresponding Fig. 7A), showing an open first flow channel 30; with Fig. 7H showing first flow channel 30 closed by pressurization of the second flow channel 32. Referring to Fig. 7B, first flow channel</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position)." Chou, at 19:1-16; <i>see also</i> Fig. 16 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 16</p> <p>Zöld</p> <p>“In particular, the object of this invention is to provide a method for the fast and reliable sorting of individual particles in suspension in accordance with one or more of their physio-chemical properties, or for the fast and reliable dispensing of any kind of fluid, gas, or aerosol in</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>accordance with a preselected program, wherein the substance flows through a closed or hole-like flow system, regardless of whether or not the same rate of the fluid or suspension exists in all of the outlets of the system.” Zöld, at 5:34-43.</p> <p>“Accordingly, a method is described for the control of the flow of fluid substances, such as fluids, gases, aerosols and individual particles (cells) of a suspension, either in accordance with a preselected dispensing program, in one mode of operation, or in accordance with one or more individual physio-chemical properties of these particles, in another mode of operation, where the substance flows through a closed, or hole-like, and environmentally friendly, duct system under the effect of a pressure difference, created between the inlets and the outlets of the system, and where a combined compensating process assures fast and reliable achievement of each preselected flow configuration, defined by the distribution of the flow of the substance to be dispensed and the flow of the injected control substance, a fluid or gas, in the outlet ducts, and the return of the flow to its steady state flow configuration after each dispensing flow configuration during the whole operation of the system. The method includes transporting said fluid substance in one or more streams in at least one transporting duct towards a duct branching volume; analyzing the individual particles in said transporting duct in accordance with one or more of their physio-chemical properties in the sorting mode of the operation;” Zöld, at 5:53-6:8.</p> <p>“The combination of the center stream 5, called earlier as the very thin stream, enveloped by the sheath stream 6, is generated in the nozzle chamber 7a where the fluid of the center stream 5, and hence the particles to be processed, flow into the nozzle chamber 7a through the nozzle 7b where the sheath stream 6 fluid envelopes it under the suction effect of a vacuum (system) pump, attached to the outlets of the flow system.” Zöld, at 15:30-37.</p> <p>“After leaving the orifice 9, the particles pass through the delay channel 11, being still inside of the center stream 5, where the former extends from the orifice 9 to the entrance of the channel branching volume 12, where the latter is defined as the volume delimited by the cross-sections of the six channels which either end or begin there, by the bottom part of the channel system, and by the lower side of the cover glass. After this traversal, and depending on the sorting conditions,</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the particles either continue their linear flow into the middle dispenser channel 13, where this flow configuration defines also the steady flow state of the suspension and that of the particles too, or they are deflected into one of the side dispensing channels 14 or 15 through the deflecting process, described below. Subsequently, the suspension is filtered either by the inside located filtering/collector cavity (not shown) or by the outside filter/collector bottle of FIG. 5.” Zöld, at 16:3-21.</p> <p>“These partial streams are delimited by the two physically real sides of the transporting channel, which is the combination of the connecting channel 8 and of the delay channel 11, and partly by the virtual planes, imagined to be laid on the stream lines from 30a to 30d and are directed perpendicularly to the bottom of the transporting channel, i.e., to the sheet of the paper of FIG. 2. The extreme side streams 6a and 6b flow into the left and right only control channels 17 and 16, respectively. The amount of the electrolyte, that flows in these two streams, has to be as large as possible because through these two streams is achieved the generation of the already described asymmetry of the flow in the channel branching volume 12, shown in FIG. 1, and hence, the deflection of the center stream 5, and that of the particles too, into one of the only-dispenser channels 14 or 15. The middle side streams 6c and 6d, delimited by the vertical planes laid on the stream lines 30a and 30c, and 30b and 30d, respectively, flow into the side exit only-dispenser channels 15 and 14, flowing at first against the slightly pointed ends of the separating wall pair 33 and being deflected thereby into these channels.” Zöld, at 18:4-26.</p> <p>“It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels.” Zöld, at 23:66-24:7.</p> <p>Zöld 662</p> <p>“The operation of the known method and device is as follows: In a flow chamber with a capillary</p>

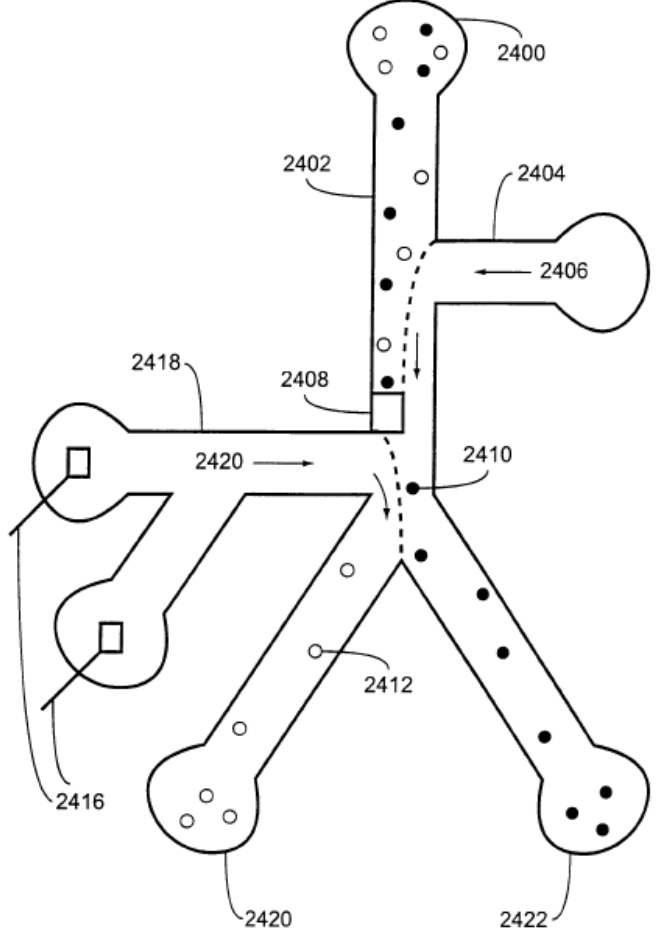
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>exit of very small diameter a very thin (cca. 25 micron diameter) stream of the suspension is produced.” Zöld 662, at 1:24-28.</p> <p>“Therefore, it is one object of the invention to provide a method and a device for controlling the flow of an electrolyte in closed channels of capillary size in order to make possible the sorting of at least one but rather two kinds of particles (cells) from a mixture . . . this problem is solved in such a manner that the electrolyte flowing in a channel can be split into at least two side channels and that the thin suspension stream can be deflected completely into at least one of the side channels from the entrance channel or middle channel by producing a sudden and short electrolysis gas impulse in that side channel lying opposite to the side channel in which the suspension stream is to be deflected. This method of sorting is based on the direct changing of the electrolyte flow path while the suspended particles are deflected only indirectly by this change of the electrolyte flow.” Zöld 662, at 1:57-2:8.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control</p>

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	<p>electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p> <p>“In another embodiment of the invention the middle channel is branched into three narrower</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture." Zöld 662, at 4:55-5:10.</p> <p>"In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance." Zöld 662, at 5:54-6:11.</p> <p>"FIG. 1, that the suspension flowing from container 38 through the entrance channel 34 and the</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>orifice 28 continues to flow in the relatively narrow capillary exit channel 12 after mixing with pure electrolyte from container 40 and another entrance channel 36, thus making possible the lining-up of the particles for further analysis or sorting.” Zöld 662, at 7:2-8.</p> <p>“The operation of the T-sorter is as follows: Under the suction effect of the pump (not shown) connected to the tube 26 suspension and pure electrolyte flow from containers 38 and 40 through the entrance channels 34 and 36, respectively, towards the orifice 28 into the exit channel 12 and then through the side channels 14 and 16 into the containers 22 and 24, respectively.” Zöld 662, at 7:33-39.</p> <p>“In this version, as can be seen in FIG. 2, the suspension is injected into the counter through a very thin capillary tube 44 which ends in a nozzle 46 and is located substantially coaxially inside the entrance channel 42; the pure electrolyte flowing in the entrance channel 42 focuses the suspension into a very thin stream at the upstream side of the orifice 28 concentrically with the orifice from where the suspension further flows into the exit channel or middle channel 50 of the sorter device. Adjacent the orifice 28 pure electrolyte enters laminarly at both sides of the suspension stream 60 through the side entrance channels 36 and 37 to keep the suspension stream 60 at the center of the middle channel 50 and to direct the suspension and thus, the particles, right against the tip 56 of the branching of the middle channel 50 into the two side channels 52 and 54. The pairs 18 and 20 of control electrodes are provided at a small distance before the branching of the middle channel 50 on the inner side walls of the middle channel. Alternatively, the pairs of control electrodes can also be provided in the side channels 52 and 54 in the manner shown in FIG. 1. The deflection of the suspension stream 60 into one side channel, say into channel 52, is achieved by producing a sufficiently large amount of gas by the control electrodes 18; the control electrodes 20 would, clearly, produce the deflection of the suspension stream into the side channel 54. It is an advantage of this embodiment that the deflection of the very thin suspension stream 60 is simpler and faster than in the T-sorter and as a result faster operation can be achieved with the Y-sorter than with the T-sorter.” Zöld 662, at 8:14-46.</p> <p>“FIG. 7 shows the channel arrangement of a device which in accordance with the invention is capable to reduce the interparticle spacing of particles suspended in a suspension stream in a capillary channel. The particles flow through a channel counter 68, 78 and 80 into a main</p>

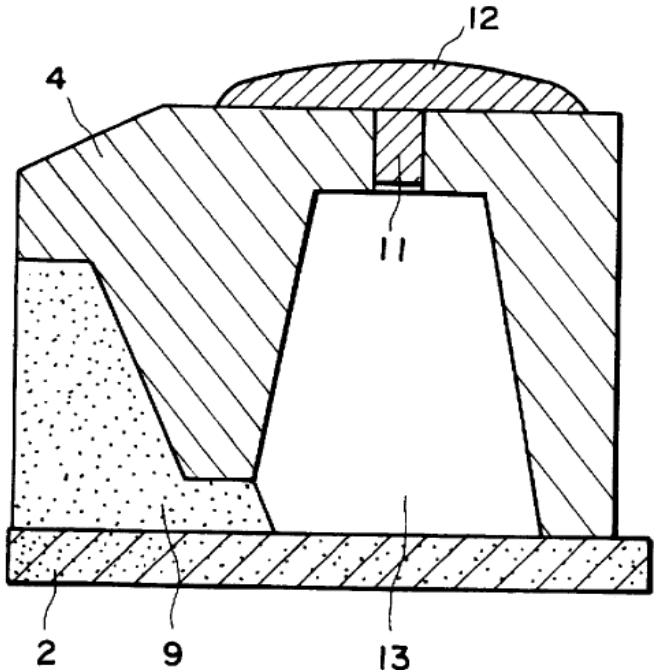
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channel 70 of capillary cross-section from which two side channels 72 and 74 branch out symmetrically each of which being provided with a valve-electrode pair 82 and 84, respectively. The valve-electrode pairs 82 and 84 are programmed by an electronic system (not shown) such that the amount of the electrolyte and hence the spacing between two particles in the main channel is reduced to a desired value at those intervals during which no particle passes across the entrance of the side channels. With the reduction of the interparticle spacing the operation of another analyser such as an impulse cyto-photometer 76 can be improved since the through-put of the particles through the analyzer will be somewhat increased. It should be understood that the programming of the system should be such that the suction effect exerted from the side channels should be zero when a particle passes these channels.” Zöld 662, at 9:1-22.</p>
<p>(ii) a first reservoir operatively associated with the flow channel and adapted for dampening or absorbing a pressure pulse propagated across the flow channel; and</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p> <p>Wada</p> <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>“In some instances, electrokinetic material transport systems are used to direct one or more of the flow of cell suspensions, the injection of test compounds, and other material movement parameters. In such cases, the overall system used in performing the assay will typically include an appropriate controller and interface for controlling such electrokinetic material transport. Typically, such transport systems include one or more electrical power supplies that are operably coupled to the termini of the channels in a microfluidic device, e.g., as described in greater detail below. The connection of the power supply(ies) with the channels is typically accomplished via electrodes placed into reservoirs at the termini of the channels, which electrodes are coupled to the power supply(ies). The power supply(ies) then deliver(s) appropriate voltage levels to the various electrodes to yield a desired flow pattern within the channels of the device, e.g., flowing the cell suspension and periodically injecting a test compound.” Wada, at 36:20-32.</p> <p>Marcus</p> <p>“FIG. 1 generally teaches the apparatus and concept of the present invention. In said figure, element 1 broadly depicts the fluidic logic element. Said fluidic logic element 1 comprises input flow port 2 through which a suspension containing particulate matter is forced. Fluidic logic element 1 further comprises control port A and control port B, 4 and 3, respectively; and output port A and output port B, 5 and 6, respectively.” Marcus, at 3:28-36.</p> <p>“A suspension containing at least two visually different particulate matter is forced through input flow port 2. The suspension contains particle type A, 8, particle type B, 7, and a fluid carrier 15. Machine vision camera lens 9 reads the appearance of said particles 7 and 8. It transmits what is read to an image capture device 10 which forwards what it sees to an image interpretation device 11 which is able to interpret and register a distinction between particles 7 and 8. This distinction is then transmitted to a control decision device 12 which signals a fluidic controller device 14 to instruct control ports A and B, 4 and 3 respectively; to separate out said particles 7 and 8. These particles 7</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>and 8 are then sorted through output port A and output port B, 5 and 6.” Marcus, at 3:49-62.</p> <p style="text-align: center;">FIG. 1</p> <p>Otsuka</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving of the ejection energy generating elements propagate, the buffering chamber containing a gas for attenuating the pressure wave.” Otsuka, at Abstract.</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving</p>

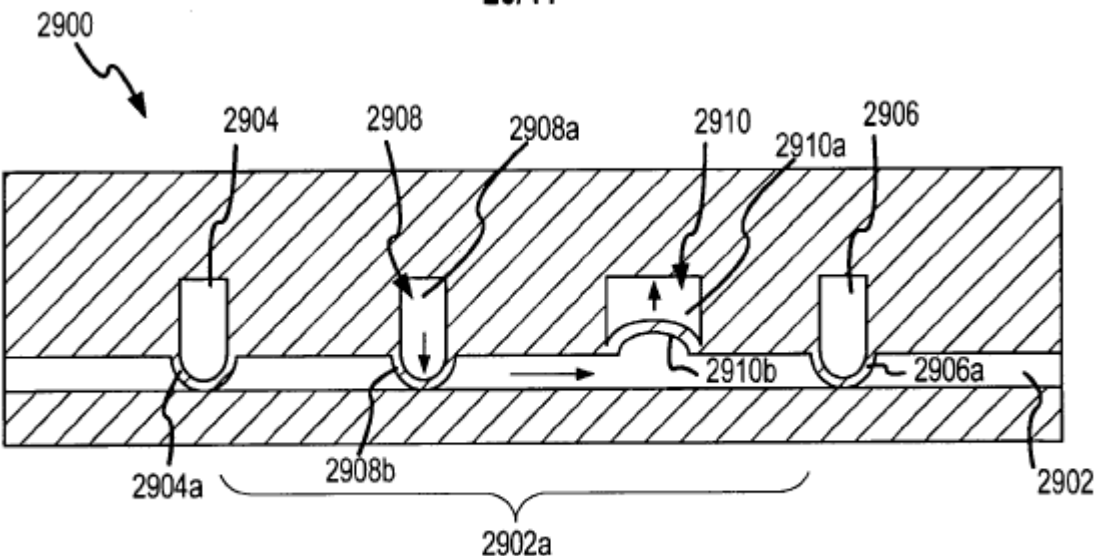
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>of the ejection energy generating elements propagate, the buffering chamber containing a gas for attenuating the pressure wave, wherein a part of a wall constituting the buffering chamber has a gas transmitting property.” Otsuka, at 4:34-41.</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving of the ejection energy generating elements propagate. the buffering chamber containing a gas for attenuating the pressure wave, wherein a part of a wall constituting the buffering chamber has a gas transmitting property; and driving signal supply means for supplying a driving signal for ejecting the ejecting energy generating elements.” Otsuka, at 4:49-57; <i>see also</i> Fig. 1 below.</p> <div> </div> <p style="text-align: center;">FIG. 1</p> <p>“FIG. 2 shows an enlarged buffer chamber 13 according to an embodiment of this invention. As shown, the buffering chamber 13 filled with the gases partly communicates with the common liquid</p>

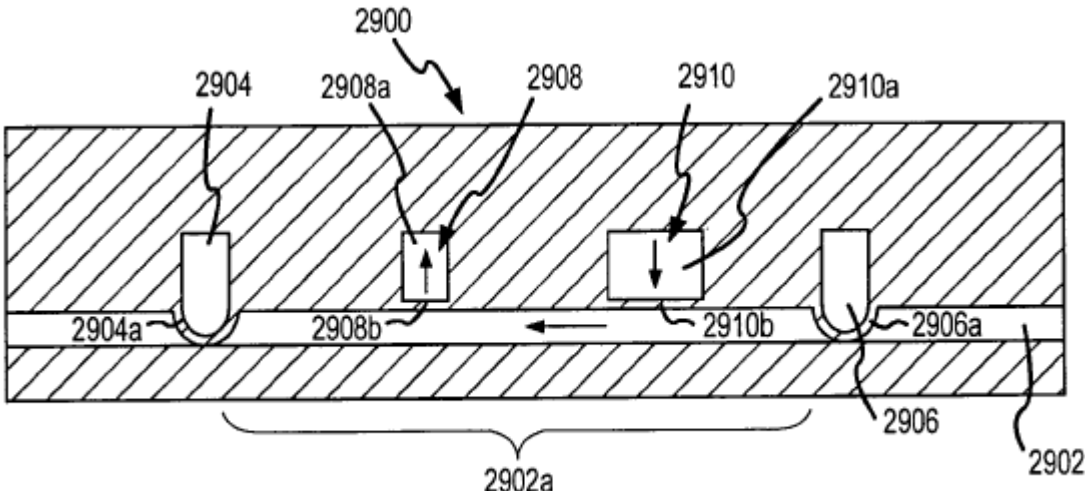
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>chamber 9. and the gases function to absorb the pressure wave.” Otsuka, at 6:34-38; <i>see also</i> Fig. 2 below.</p>  <p style="text-align: center;">FIG. 2</p> <p>Brown</p> <p>“In order to pump out the volumetric chamber 117, exogenous control fluid pressure is introduced as is indicated in FIG. 14 through the capillary passage 125 while the control valve 119 is opened by venting its capillary passage 127 as indicated. Both of these capillaries 125 and 127 are connected with suitable sources of control fluid having pressure control means</p>

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	<p>associated therewith. It will be noted that in this embodiment, the capillary 126 is always vented to permit proper operation during filling so that it, in effect, is a passive element whose presence is nevertheless essential. The control fluid introduced at 125 forms a stabilized interface 128 at the downstream end of the necked down portion 115 and thereby prevents backflow of the control fluid therebeyond, i.e., a valving action is effected. The interface 130 is already present at the mouth of the capillary 126 where it joins the pump chamber so that as the principal fluid is being expelled from the pump chamber by the travelling interface 129, the only flow path for the principal fluid is through the necked down portion 118.” Brown, at 10:44-64; <i>see also</i> Fig. 14 below.</p> <div> </div> <p>Chou</p> <p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p> <p>“Figure 27 shows a cross-sectional view of yet another embodiment of a damper structure in accordance with the present invention, wherein damper structure 2700 comprises portion 2702a</p>

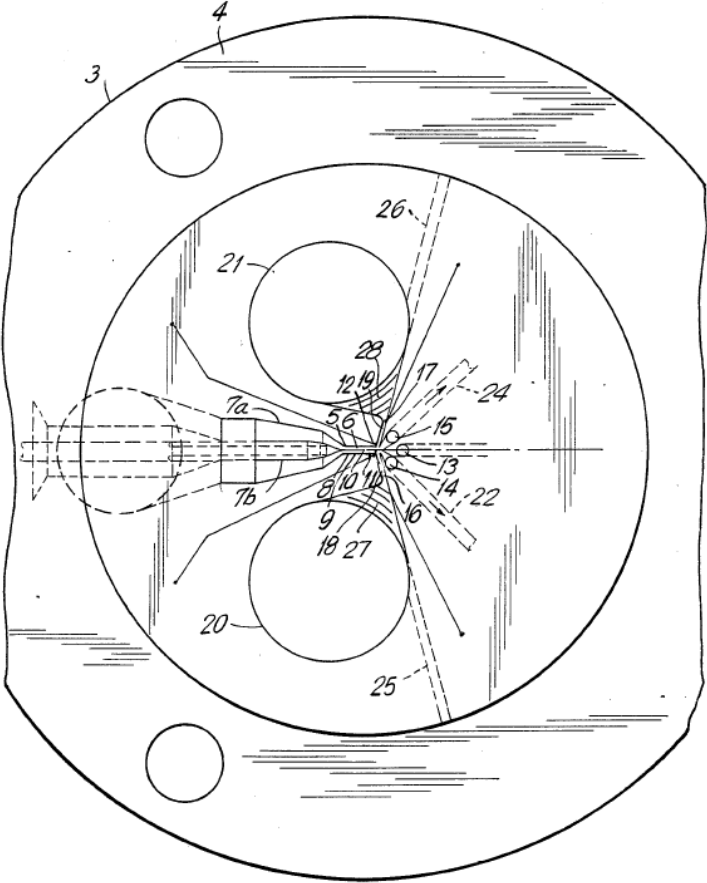
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>of flow channel 2702 having a larger cross-section, an upper region of portion 2702 being filled with air or some other type of fluid 2704. As material 2706 flowing through channel 2702 experiences pressure oscillations 2708 and eventually encounters damper 2700, energy is expended as material 2706 pushes against fluid 2704. This expenditure of energy serves to reduce the amplitude of energy of oscillation of material in the flow channel.” Chou, at 41:5-12; <i>see also</i> Fig. 27 below.</p> <div> </div> <p style="text-align: center;">FIG.27</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactivated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure</p>

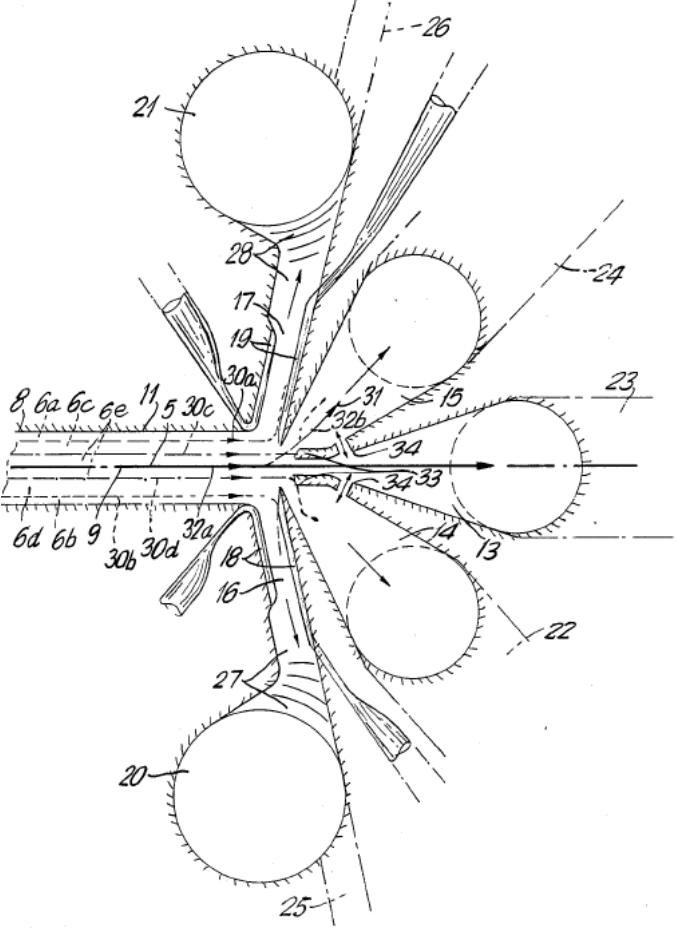
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>  <p style="text-align: center;">FIG. 29A</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Zöld</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 1</p> <p>The diagram shows a circular device with an outer ring (3) and an inner circular region (4). Inside the inner region, there are two large circles (21 and 20) and a central area (26). A complex network of lines and points is shown, with labels 1 through 28. A dashed line (25) is also present. The diagram is a technical drawing of a device, likely a medical or scientific instrument, with various components and features labeled for identification.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“Furthermore, the suction stabilization is achieved through the use of the buffer cavities, which are large holes 20 and 21, drilled into the body 1 of the device quasi perpendicularly into its top surface 4, as shown in FIGS. 1 and 2, and most of their volume is free of an electrolyte, from where their stabilization characteristic follows. Their outlet holes are connected through flexible tubes (not shown) to a waste bottle of very large volume in such a manner that both the electrolyte and the generated gas can flow parallel to each other without blocking each other's flow into the bottle. On the other hand, the outlet holes of the only-dispenser channels 13, 14 and 15 are connected through flexible tubes to the filtering/collector bottles of very large volume where the already processed suspension is filtered, after flowing through the two-position multiple-tube valve, which, in this case, is a triple-tube valve.” Zöld, at 20:41-57.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels,</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p> <p>“It is important to note that buffer devices are often applied at other branches of the modern techniques, too. For instance, the storage elements, at the interface between the central processing unit of a computer and the attached peripheral unit, such as a keyboard, are a build-screen, functions in the same manner by permitting fast operation of the extremely fast central processing unit in spite of the quoted slowly functioning peripheral units. From the above description, it is also clear that for fast and reliable sorting, as is defined above, the use of the buffer cavities are of paramount importance both for the stabilization of the vacuum and for the decoupling of the very fast fluctuating suspension to be dispensed in the dispenser channels from the very slowly flowing, and the large amount of the processed substance of the connecting tubes. The fact that in these cavities the gas is also separated from the suspension, as the result of the known buoyancy, provides yet a third use of these cavities; this third type of cavities are used, however, only in such devices where the control and dispensing process takes place in the same channel or duct.” Zöld, at 21:60-22:13.</p> <p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p>

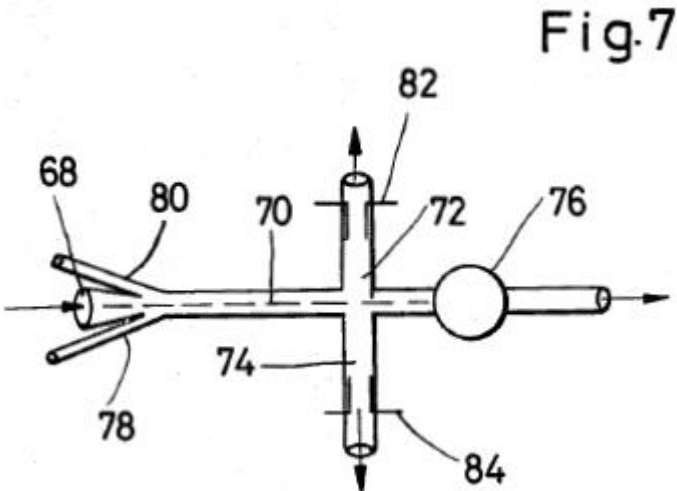
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p> <p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side</p>

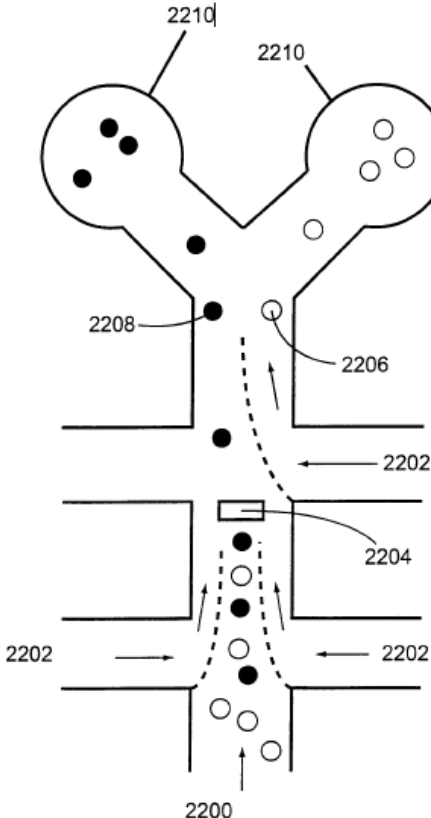
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p> <p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig1</p>

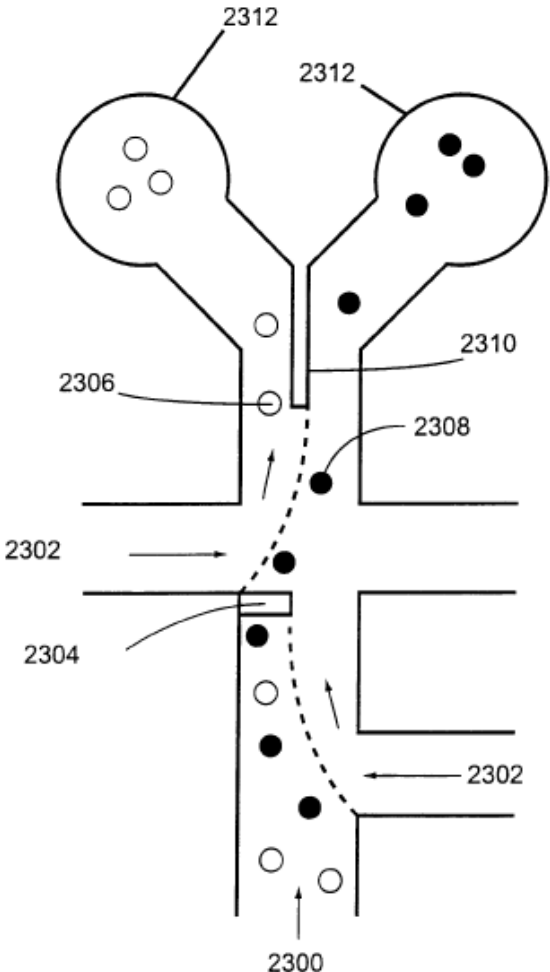
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig. 2</p> <p>“FIG. 7 shows the channel arrangement of a device which in accordance with the invention is capable to reduce the interparticle spacing of particles suspended in a suspension stream in a capillary channel. The particles flow through a channel counter 68, 78 and 80 into a main channel 70 of capillary cross-section from which two side channels 72 and 74 branch out symmetrically each of which being provided with a valve-electrode pair 82 and 84, respectively. The valve-electrode pairs 82 and 84 are programmed by an electronic system (not shown) such</p>

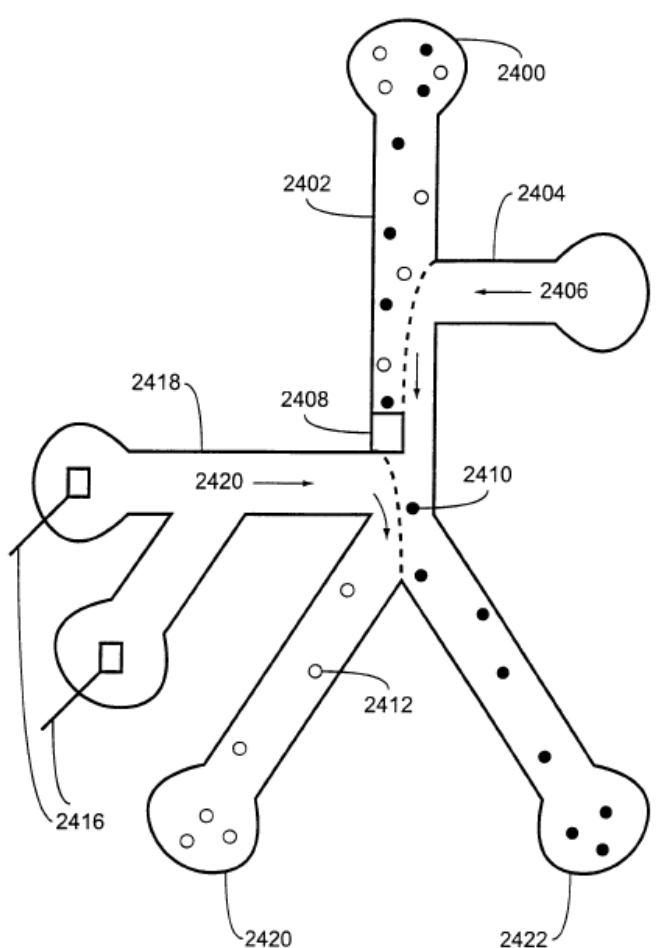
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>that the amount of the electrolyte and hence the spacing between two particles in the main channel is reduced to a desired value at those intervals during which no particle passes across the entrance of the side channels. With the reduction of the interparticle spacing the operation of another analyser such as an impulse cyto-photometer 76 can be improved since the through-put of the particles through the analyzer will be somewhat increased. It should be understood that the programming of the system should be such that the suction effect exerted from the side channels should be zero when a particle passes these channels.” Zöld 662, at 9:1-22; <i>see also</i> Fig. 7 below.</p>  <p style="text-align: right;">Fig.7</p>
(iii) a second reservoir operatively associated with the flow channel and adapted for generating the pressure pulse based on a change in volume or pressure in the	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
second reservoir;	<p>Wada</p> <p>“Optionally, the instruction set directs individual or simultaneous fluid flow from the third and sixth microchannels by individually or simultaneously activating at least one heating element (e.g., a Joule heating electrode, a conductively coated microchannel portion, or the like) disposed within each of the third and sixth microchannels or within at least one well that fluidly communicates with each of the third and sixth microchannels.” Wada, at 8:18-23.</p> <p>“As shown, cells 2200 are generally flowed in a main microchannel that includes at least two sets of opposing microchannels for focusing and/or otherwise directing the flow of cells 2200 using hydrodynamic flow 2202 (e.g., cell buffer flow). One set of opposing microchannels is typically located, e.g., upstream from detector 2204 for simultaneously introducing hydrodynamic flow 2202 from both microchannels to focus cells 2200, as described above . . . [a] second set of opposing microchannels is typically located downstream from detector 2204 for introducing at least one hydrodynamic flow 2202 so as to direct selected cells 2208 (e.g., fluorescently-labeled cells) and non-selected cells 2206 into, in this case, one of two microchannels, each terminating in particular collection wells 2210.” Wada, at 19:24-20:2; <i>see also</i> Fig. 22 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>Fig. 22</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>  <p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle</p>

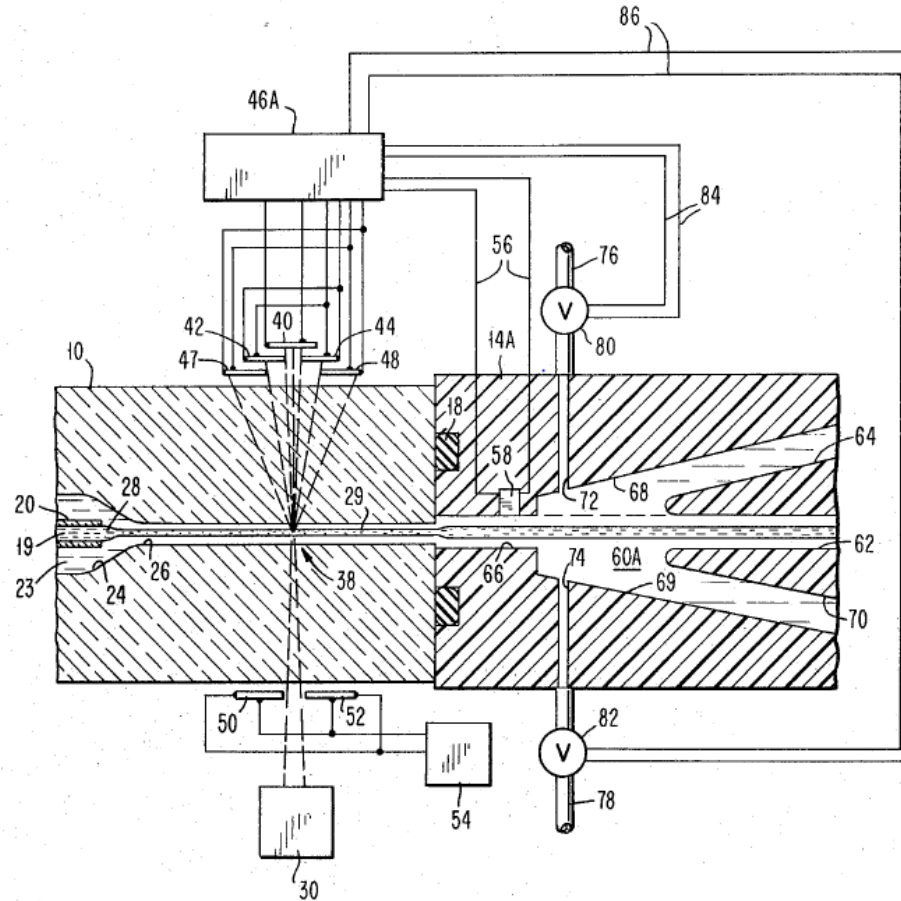
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Marcus</p> <p>“FIG. 1 generally teaches the apparatus and concept of the present invention. In said figure, element 1 broadly depicts the fluidic logic element. Said fluidic logic element 1 comprises input flow port 2 through which a suspension containing particulate matter is forced. Fluidic logic element 1 further comprises control port A and control port B, 4 and 3, respectively; and output port A and output port B, 5 and 6, respectively.” Marcus, at 3:28-36.</p> <p>“A suspension containing at least two visually different particulate matter is forced through input flow port 2. The suspension contains particle type A, 8, particle type B, 7, and a fluid carrier 15. Machine vision camera lens 9 reads the appearance of said particles 7 and 8. It transmits what is read to an image capture device 10 which forwards what it sees to an image interpretation device 11 which is able to interpret and register a distinction between particles 7 and 8. This distinction is then transmitted to a control decision device 12 which signals a fluidic controller device 14 to instruct control ports A and B, 4 and 3 respectively; to separate out said particles 7 and 8. These particles 7 and 8 are then sorted through output port A and output port B, 5 and 6.” Marcus, at 3:49-62.</p>

Asserted Claim Element

Exemplary Prior Art Disclosures

82.” Friedman, at 8:53-67; *see also* Fig. 2 below.

FIG. 2

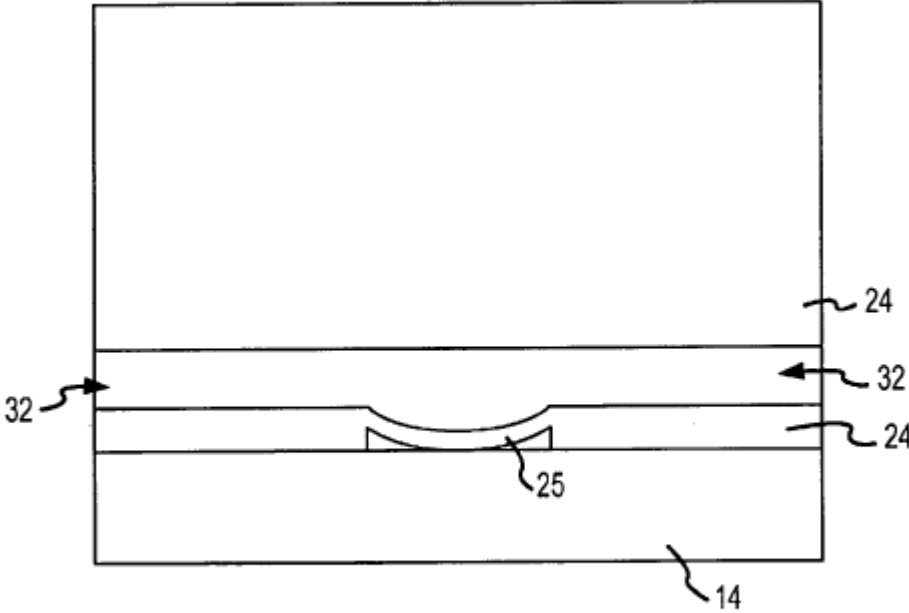


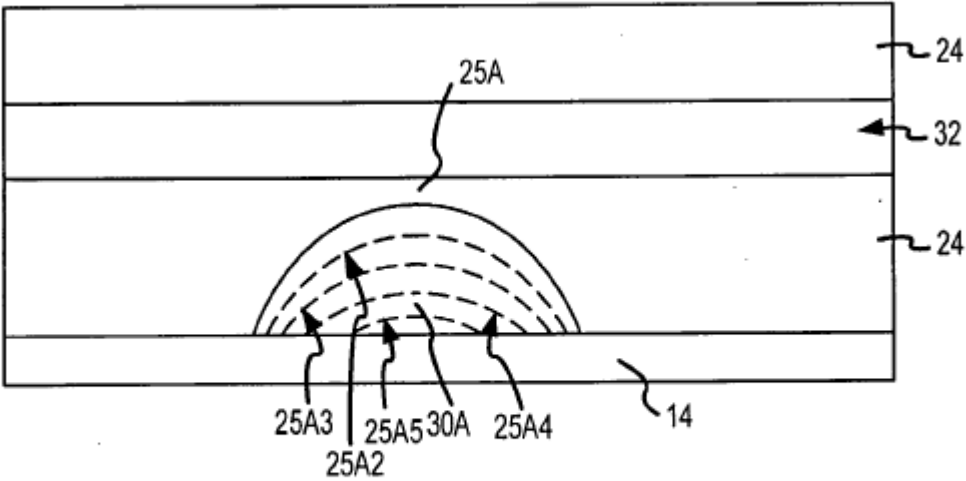
“As illustrated in the drawing, the opposite walls 68 and 69 of the switching chamber 60A are essentially equidistant from the nozzle formed by the inlet 66. Accordingly, they are equally capable

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>of displaying the wall attachment effect in the presence of turbulence in the liquid stream, as previously described above. Thus, just as the wall attachment effect to wall 68 directs the liquid stream to outlet port 64, the wall attachment effect at wall 69 leads the fluid stream to the outlet port 70. Once established at one wall, the wall attachment effect will be maintained and will hold the stream to one of these two walls, and thus direct the stream to one of these two outlet ports, as long as turbulence continues. In order to determine which direction the stream will take, a signal must be supplied from one of the control ports 72 or 74. If the signal takes the form of a supply of control fluid under pressure, it has the effect of shifting the stream away from the wall adjacent to the control port and over to the opposite wall. Thus, if control fluid is supplied to the switching chamber 68 through the control port 74, the supply of fluid destroys the low pressure bubble at the wall 69, causing the stream to shift to the opposite wall 68. A similar, but opposite effect is available if a vacuum is applied at the control port 74. This reduces the pressure at the wall 69, tending to increase the wall attachment at the wall 69 and to switch the device so that the liquid stream is pulled away from the wall 68 and to the wall 69 and to the port 70. The embodiment of FIG. 2 is capable of several different alternative modes of operation. For instance, if the switching chamber 60A is fabricated in an asymmetrical form such that the wall 68 is substantially closer to the nozzle formed by the inlet 66 than the wall 69, then without any control signals at the control ports 72 and 74, the switching action will be identical to that described above for the embodiment of FIG. 1. Thus, if a signal is supplied to the transducer 58, the resulting turbulence will cause the stream to attach to the wall 68 and to be directed to port 64. In the absence of a signal at transducer 58, the laminar flow will continue, and the stream will be directed through the outlet port 62.” Friedman, at 9:3-45.</p> <p>“The switching fluid used at the ports 72 and 74 should be compatible with the liquid in the main stream, but it need not be identical to that liquid. Thus, where the liquid in the main stream is water, the switching fluid may be water, or air, or some other compatible fluid.” Friedman, at 10:45-50.</p> <p>“As illustrated in the simplified schematic diagram of FIG. 3, additional fluidic amplifier switches may be employed downstream from the fluidic amplifier switch of the system of FIG. 1, or in that of FIG. 2. This provides the possibility of still further sorting and segregation of particles on a single pass through the apparatus. The downstream fluidic amplifiers may also be connected to receive control signals from circuits 46. FIG. 3, at the left side, illustrates in simplified schematic form an apparatus corresponding to the apparatus of FIG. 2, with corresponding parts correspondingly numbered. The main stream outlet port 62 is connected to a second fluidic amplifier switch housing</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>114 which may correspond exactly in structure and operation with the fluidic switch contained within the housing 14 and described above in connection with FIG. 1. The fluidic switch 114 responds to a signal from circuits 46 on a connection indicated at 146 through a delay circuit 149 and a gate circuit 151 to control a signal from an oscillator 153 to a transducer within the switch housing 114. By this means, particles which were not sorted and segregated in the first fluidic amplifier within housing 14, and diverted to the outlet port 64, continue on through the port connection 62, through the switch 114, and may be sorted and segregated according to a second particle characteristic into an outlet port 164. If the particles are not so segregated, they continue on in the main stream outlet port 162 from the housing 114. Thus, FIG. 3 illustrates the principle that a plurality of fluidic amplifier switches may be controlled to accomplish several sorting operations based on signals obtained from a single optical chamber 10.” Friedman, at 11:33-65; <i>see also</i> Fig. 3 below.</p> <p style="text-align: center;">FIG. 3</p> <p>Otsuka</p> <p>“The consideration will be made as to the case in which all of the ejection nozzles are continuously actuated by the ejection heater 3 being actuated.” Otsuka, at 2:28-30.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Chou</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

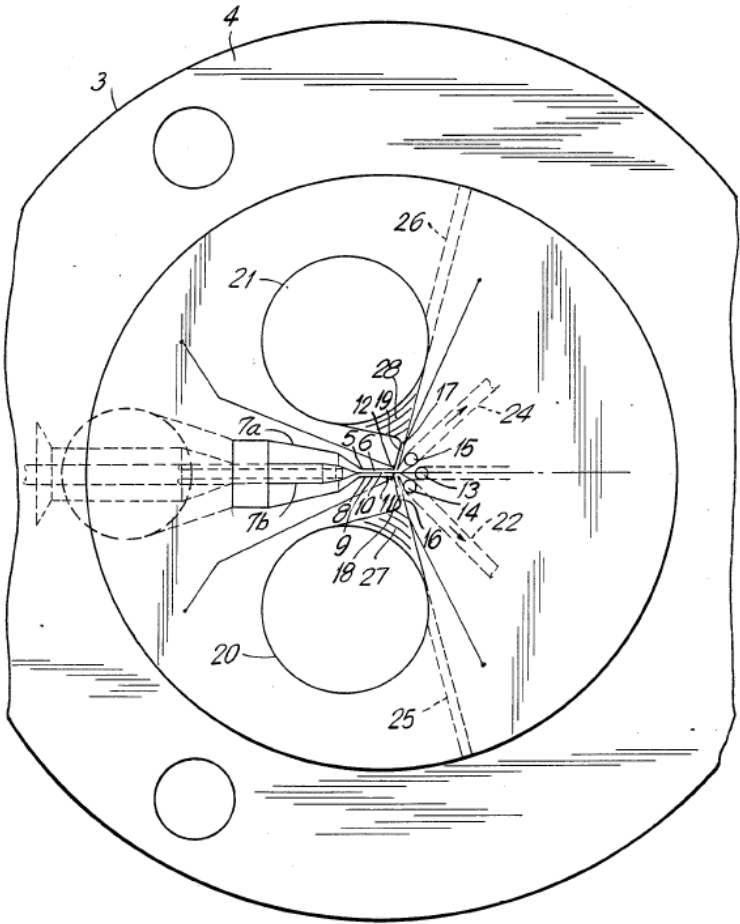
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 7H</p> <p>“In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in</p>

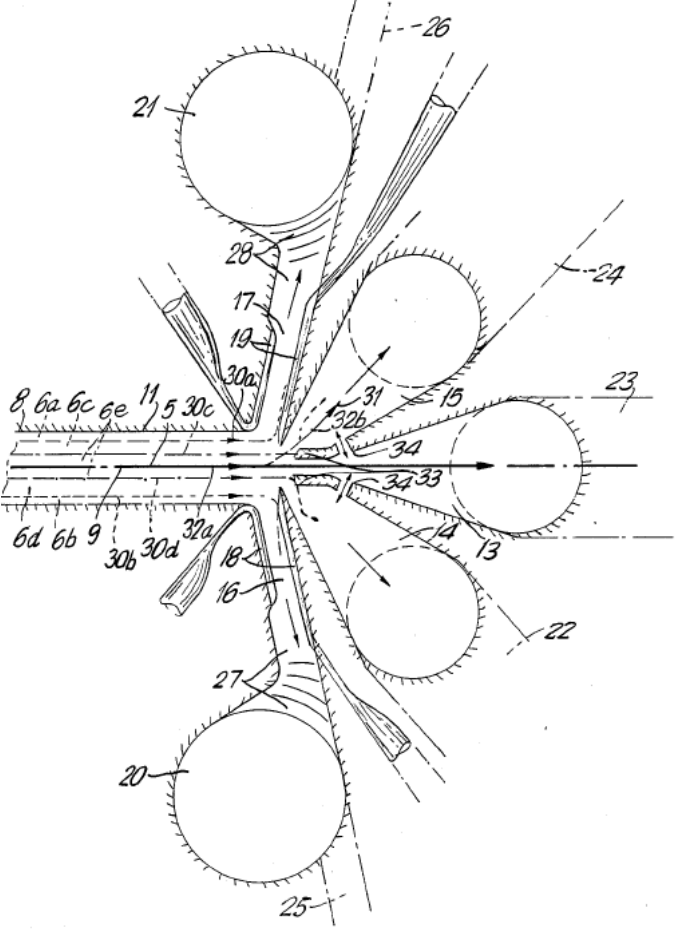
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

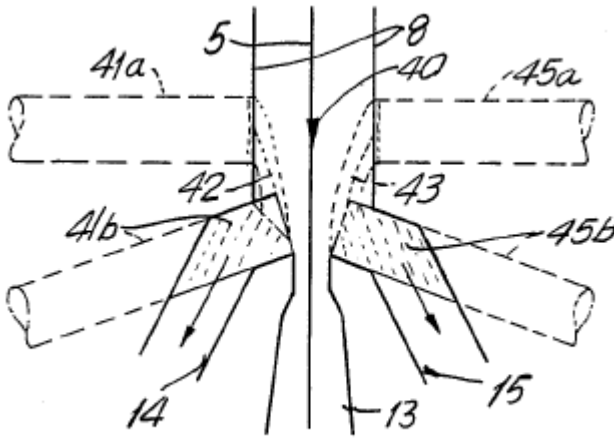
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Zöld</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value</p>

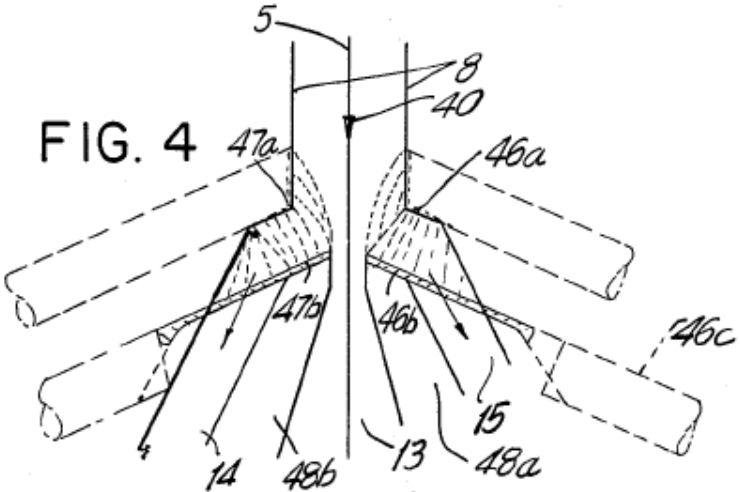
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p> <p>The diagram shows a circular device with an outer boundary 3. Inside, there are two large circular regions, 21 (top) and 20 (bottom). A central horizontal axis features a component 7a on the left and 7b on the right. Various other components are labeled with numbers: 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 26, 27, and 28. Dashed lines indicate internal structures and connections between these components.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>FIG. 4</p>  <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

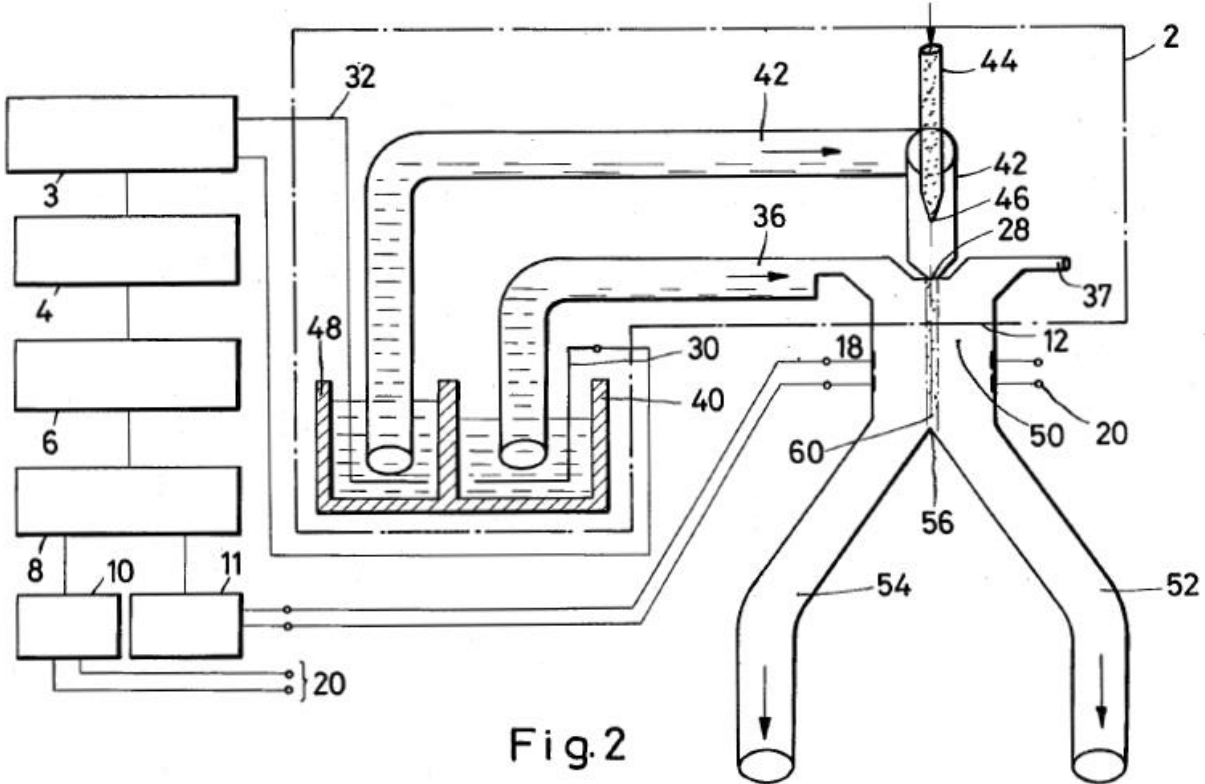
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p> <p>“In another embodiment of the invention the middle channel is branched into three narrower</p>

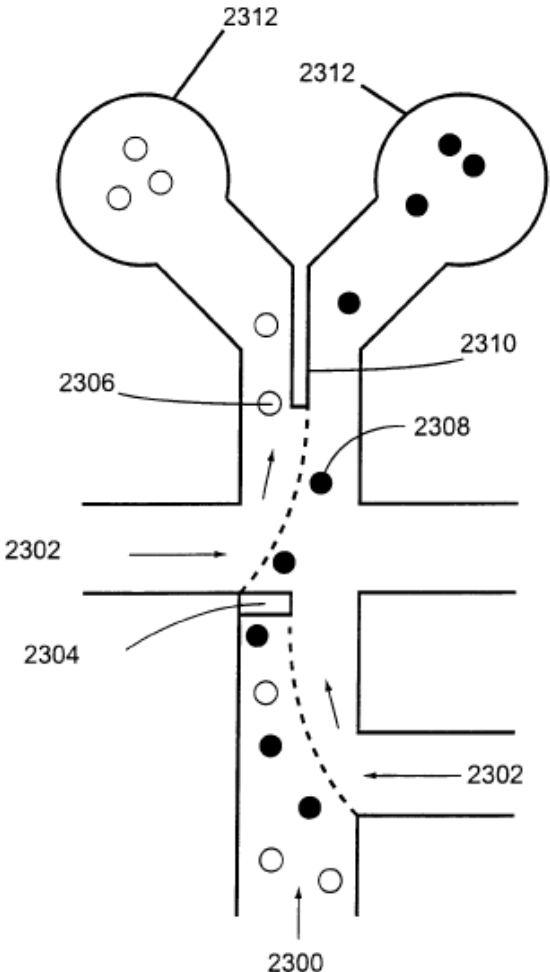
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture." Zöld 662, at 4:55-5:10.</p> <p>"In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance." Zöld 662, at 5:54-6:11.</p> <p>"FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter</p>

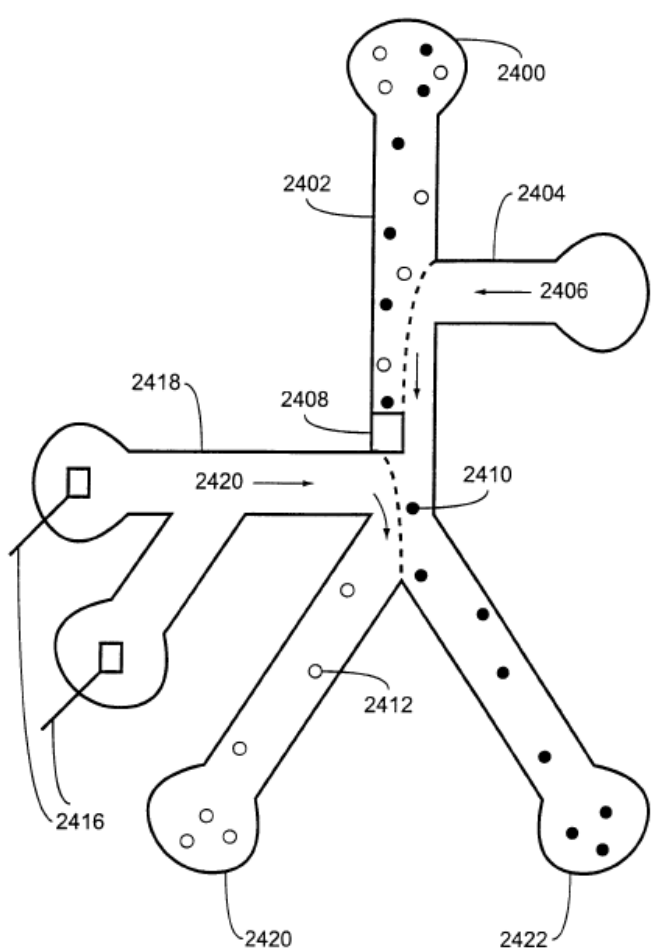
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig.1</p>

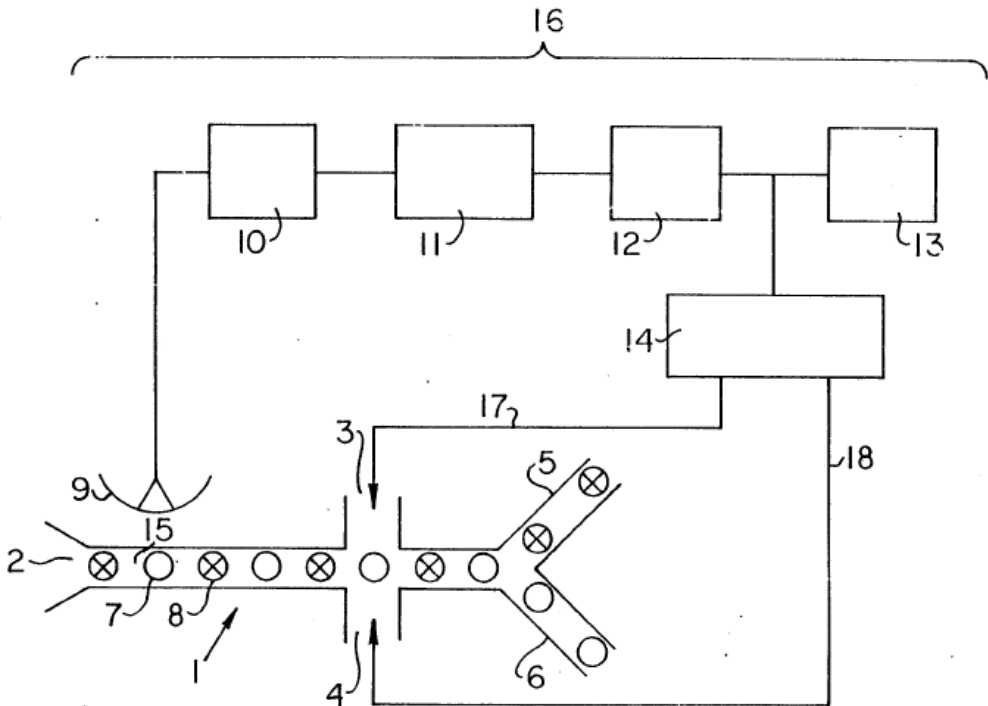
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>(iv) wherein the flow channel defines a first aperture for connecting the flow channel relative to the first reservoir and a second aperture for connecting the flow channel</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
relative to the second reservoir, wherein the first aperture is substantially opposite the second aperture.	<p>Wada</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300 pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

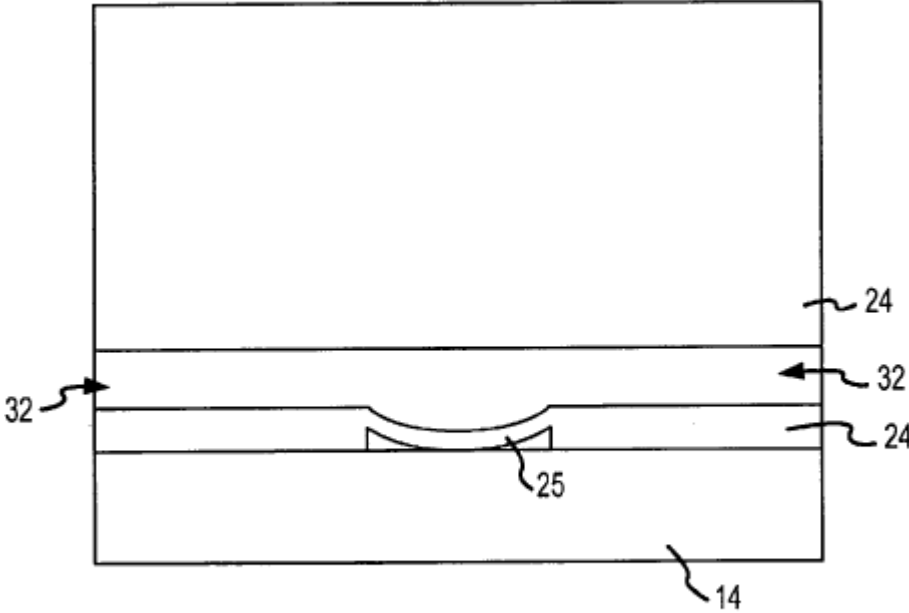
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

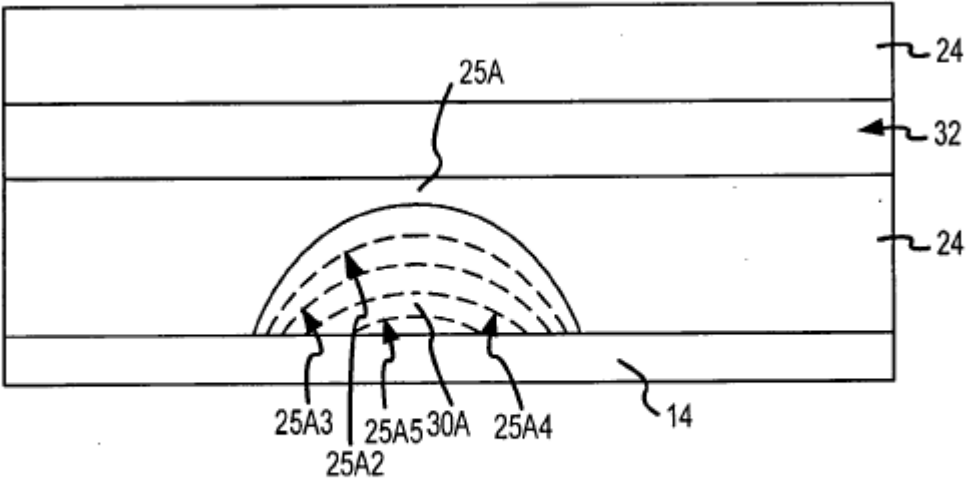
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>  <p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Marcus</p> <p>“FIG. 1 generally teaches the apparatus and concept of the present invention. In said figure, element 1 broadly depicts the fluidic logic element. Said fluidic logic element 1 comprises input flow port 2 through which a suspension containing particulate matter is forced. Fluidic logic element 1 further comprises control port A and control port B, 4 and 3, respectively; and output port A and output port B, 5 and 6, respectively.” Marcus, at 3:28-36.</p> <p>“A suspension containing at least two visually different particulate matter is forced through input flow port 2. The suspension contains particle type A, 8, particle type B, 7, and a fluid carrier 15. Machine vision camera lens 9 reads the appearance of said particles 7 and 8. It transmits what is read to an image capture device 10 which forwards what it sees to an image interpretation device 11 which is able to interpret and register a distinction between particles 7 and 8. This distinction is then transmitted to a control decision device 12 which signals a fluidic controller device 14 to instruct control ports A and B, 4 and 3 respectively; to separate out said particles 7 and 8. These particles 7 and 8 are then sorted through output port A and output port B, 5 and 6.” Marcus, at 3:49-62.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 1</p> <p>Chou</p> <p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of</p>

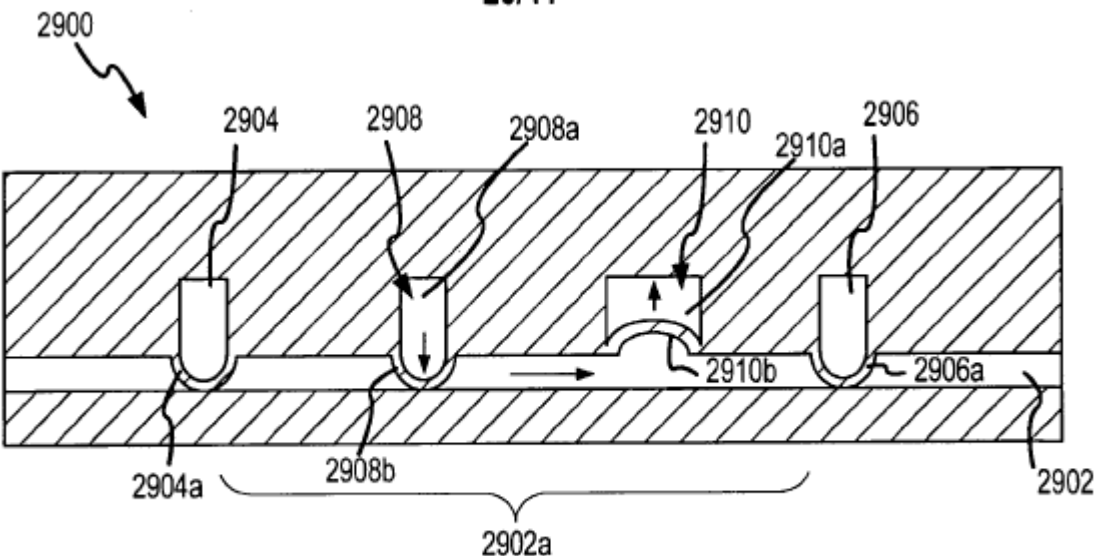
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

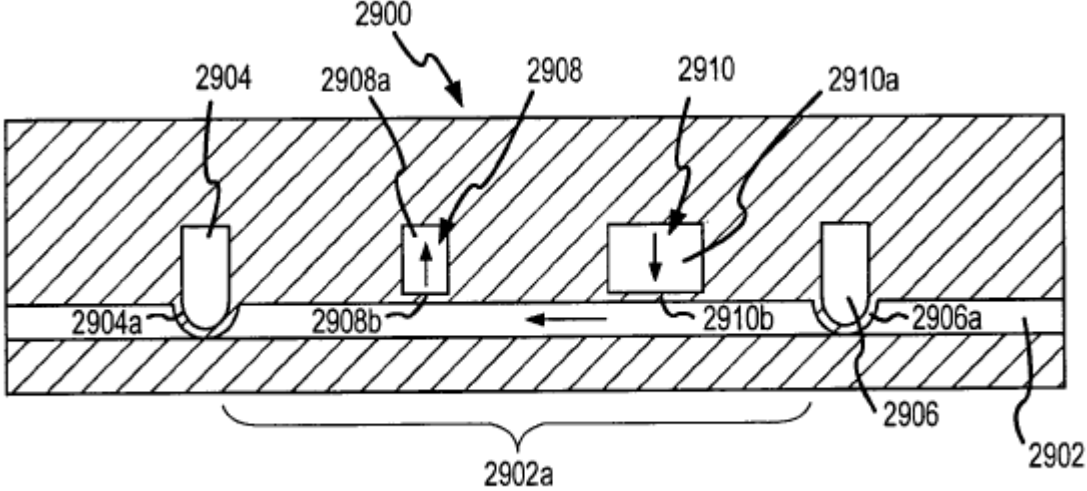
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 7H</p> <p>“In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

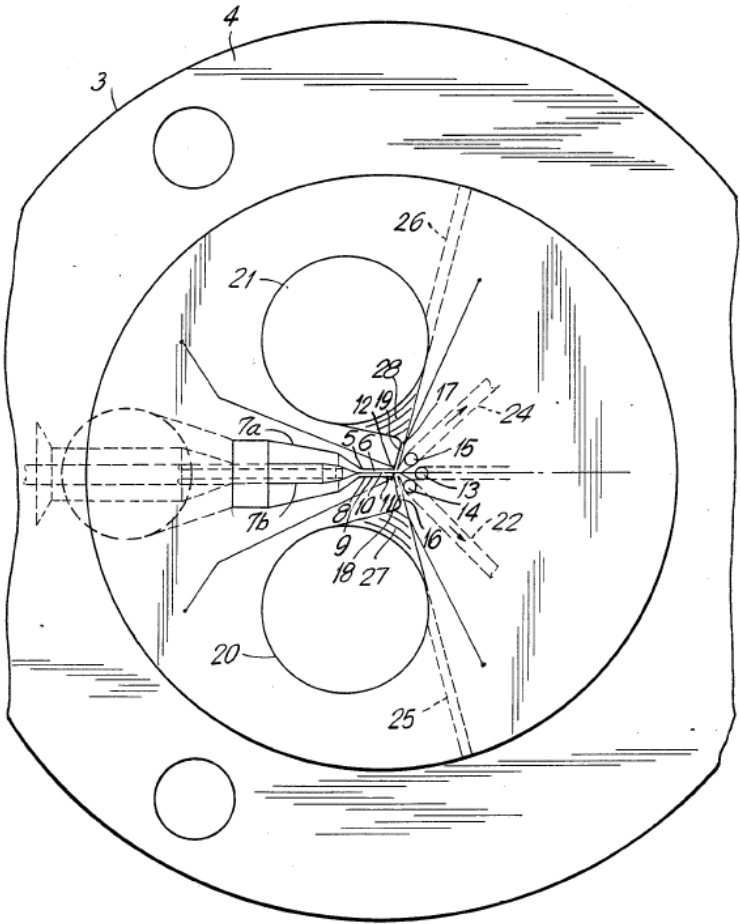
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactuated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>  <p style="text-align: center;">FIG. 29A</p>

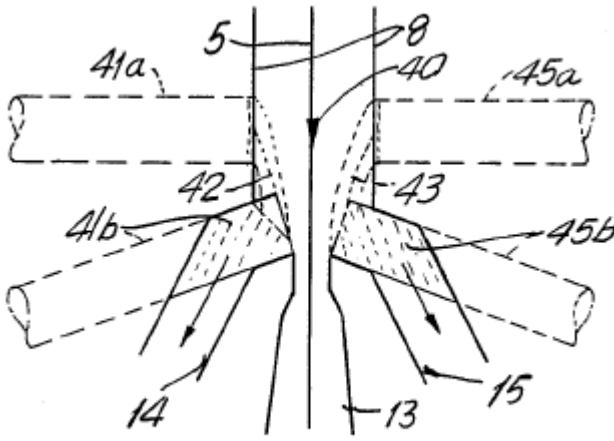
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Zöld</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous</p>

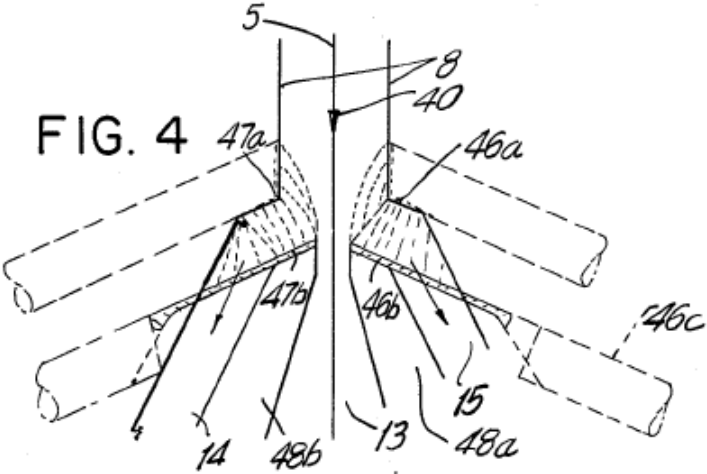
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I is a schematic diagram of a circular device, possibly a lens or a sensor, showing internal components and numbered labels. The device has an outer boundary (3) and an inner circular region (4). Inside the inner region, there are two large circular elements (21 and 20) and a central area (28) with various sub-components (12, 19, 17, 15, 13, 14, 22, 18, 27, 9, 10, 11, 8, 5, 6, 7a, 7b). Dashed lines (26, 25) indicate optical paths or fields of view. The diagram is labeled FIG. I at the bottom.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

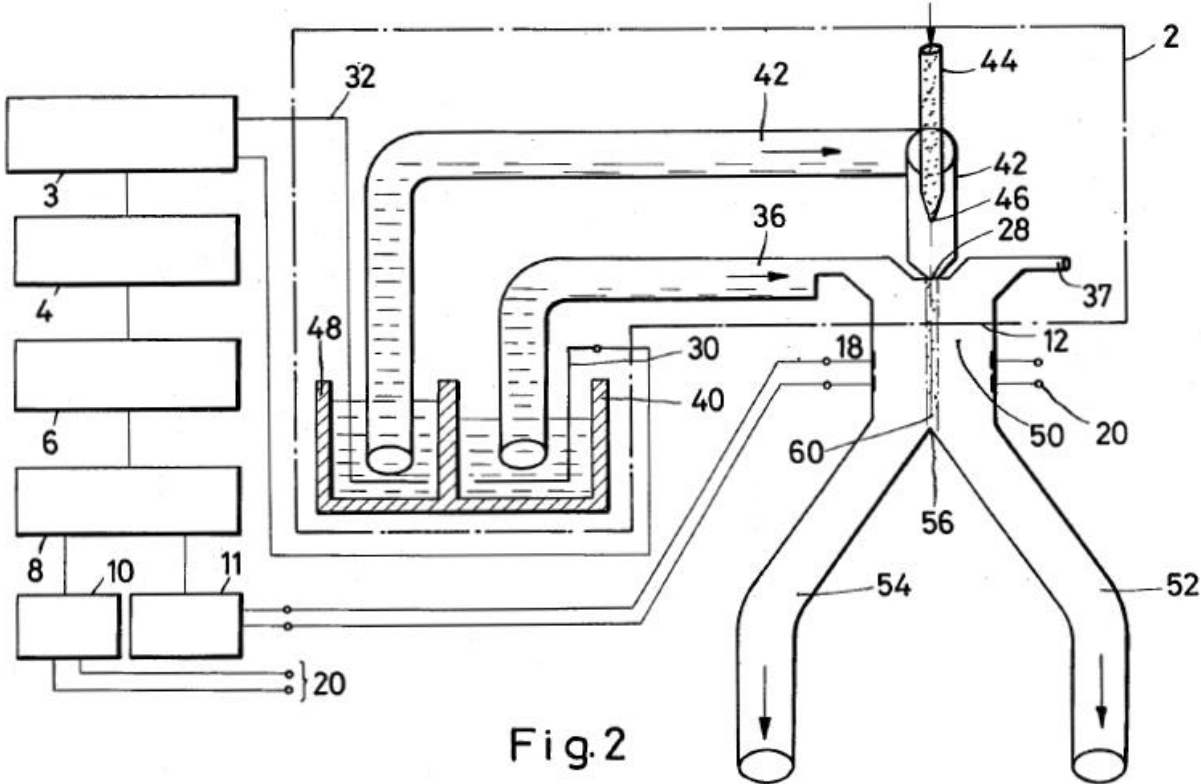
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 4</p> <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control</p>

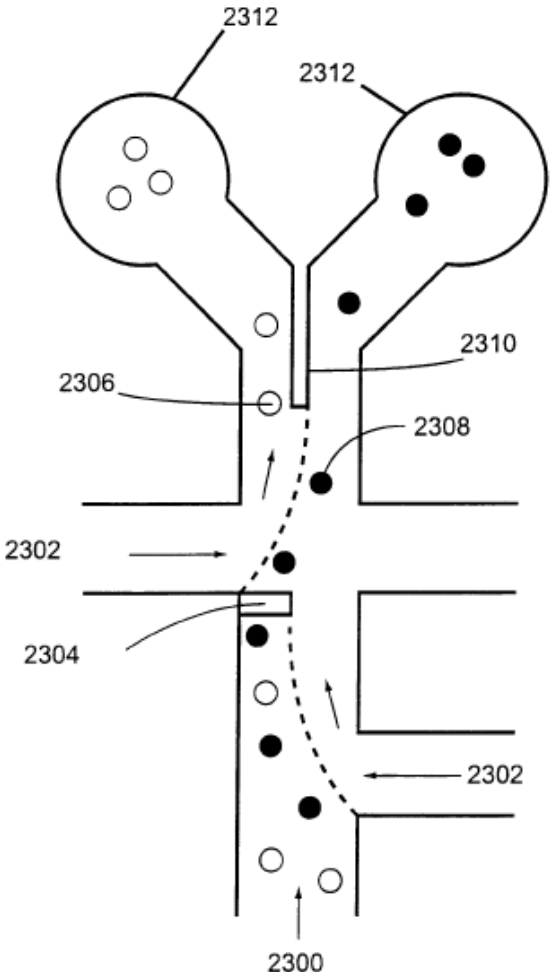
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p> <p>“In another embodiment of the invention the middle channel is branched into three narrower</p>

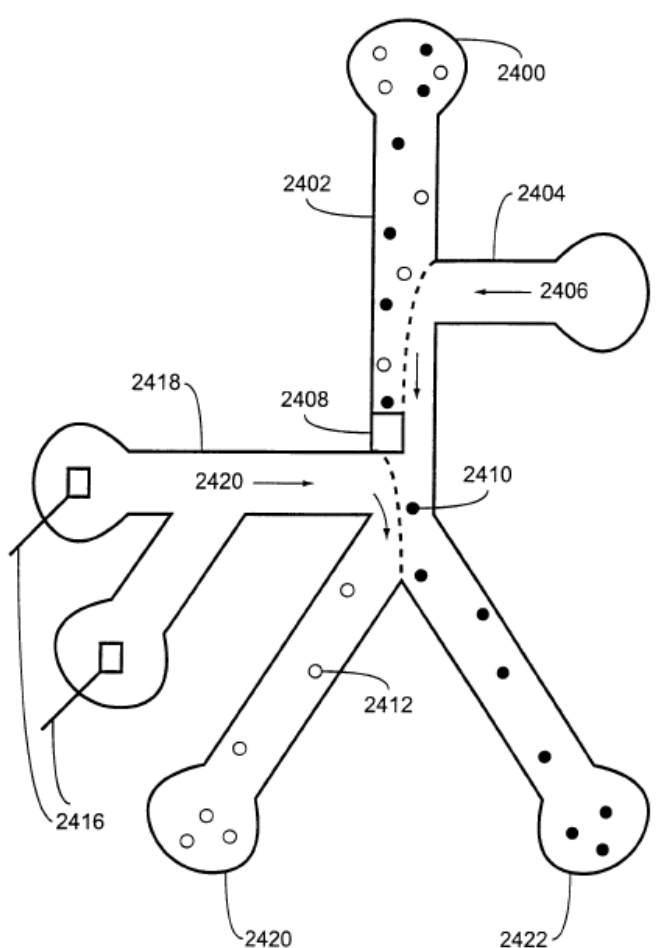
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture." Zöld 662, at 4:55-5:10.</p> <p>"In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance." Zöld 662, at 5:54-6:11.</p> <p>"FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

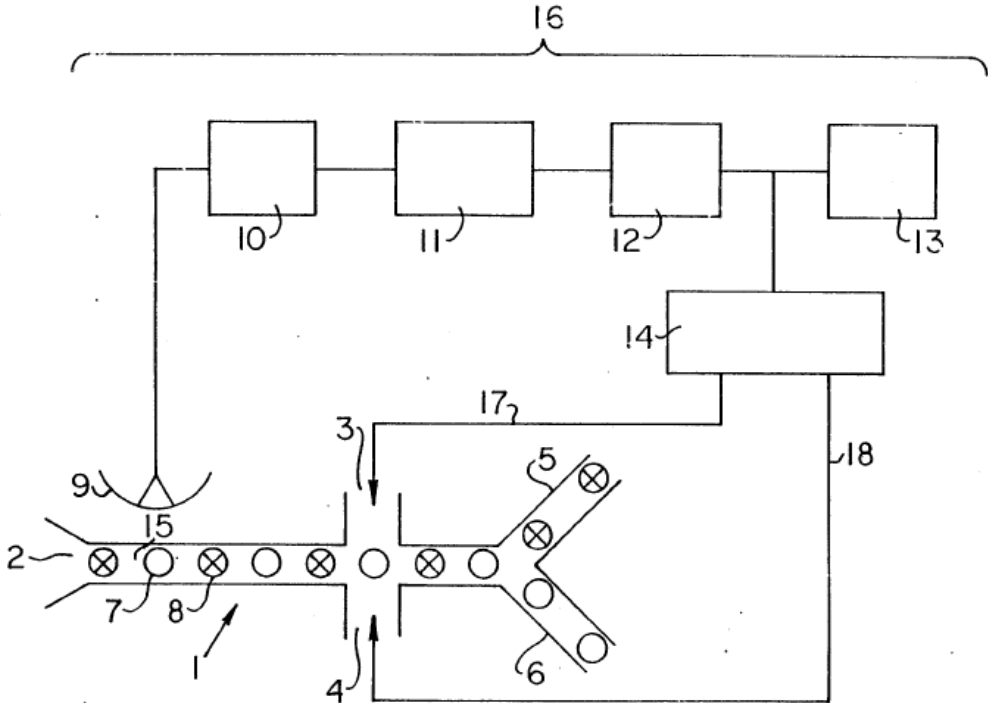
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[2] The system of claim 1 further comprising an actuator or pressurizer operatively associated with the second reservoir and adapted for generating the pressure pulse</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
by varying the volume or pressure in the second reservoir.	<p>Wada</p> <p>The Wada disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“Optionally, the instruction set directs individual or simultaneous fluid flow from the third and sixth microchannels by individually or simultaneously activating at least one heating element (e.g., a Joule heating electrode, a conductively coated microchannel portion, or the like) disposed within each of the third and sixth microchannels or within at least one well that fluidly communicates with each of the third and sixth microchannels.” Wada, at 8:18-23.</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300 pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

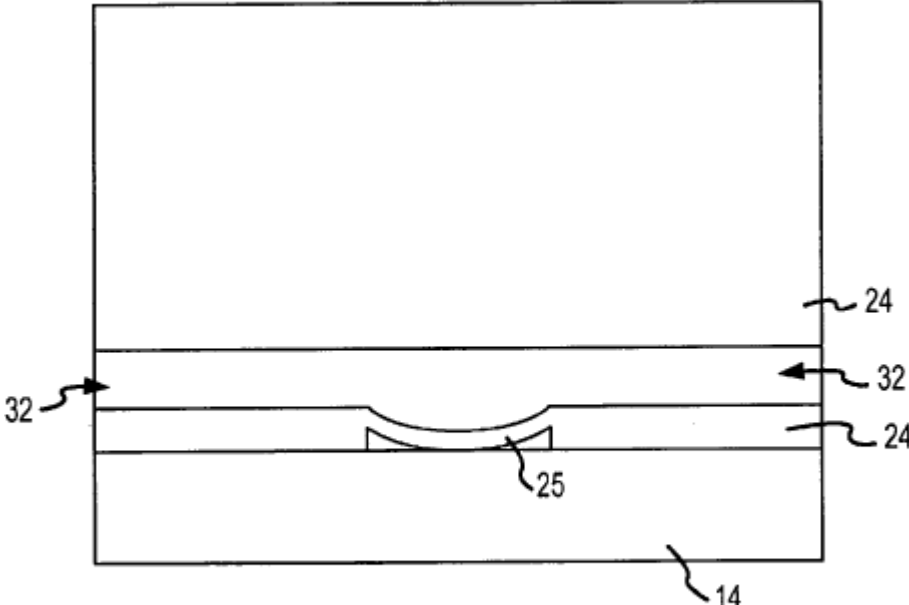
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

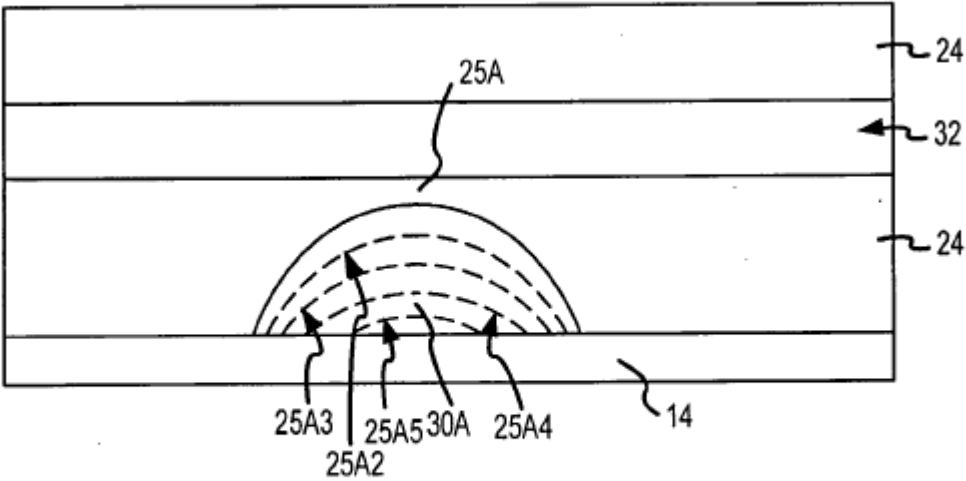
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>  <p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Otsuka</p> <p>The Otsuka disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“The consideration will be made as to the case in which all of the ejection nozzles are continuously actuated by the ejection heater 3 being actuated.” Otsuka, at 2:28-30.</p> <p>Marcus</p> <p>The Marcus disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“FIG. 1 generally teaches the apparatus and concept of the present invention. In said figure, element 1 broadly depicts the fluidic logic element. Said fluidic logic element 1 comprises input flow port 2 through which a suspension containing particulate matter is forced. Fluidic logic element 1 further comprises control port A and control port B, 4 and 3, respectively; and output port A and output port B, 5 and 6, respectively.” Marcus, at 3:28-36.</p> <p>“A suspension containing at least two visually different particulate matter is forced through input flow port 2. The suspension contains particle type A, 8, particle type B, 7, and a fluid carrier 15. Machine vision camera lens 9 reads the appearance of said particles 7 and 8. It transmits what is read to an image capture device 10 which forwards what it sees to an image interpretation device 11 which is able to interpret and register a distinction between particles 7 and 8. This distinction is then transmitted to a control decision device 12 which signals a fluidic controller device 14 to instruct</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>control ports A and B, 4 and 3 respectively; to separate out said particles 7 and 8. These particles 7 and 8 are then sorted through output port A and output port B, 5 and 6.” Marcus, at 3:49-62.</p>  <p style="text-align: center;">FIG. 1</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL." Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

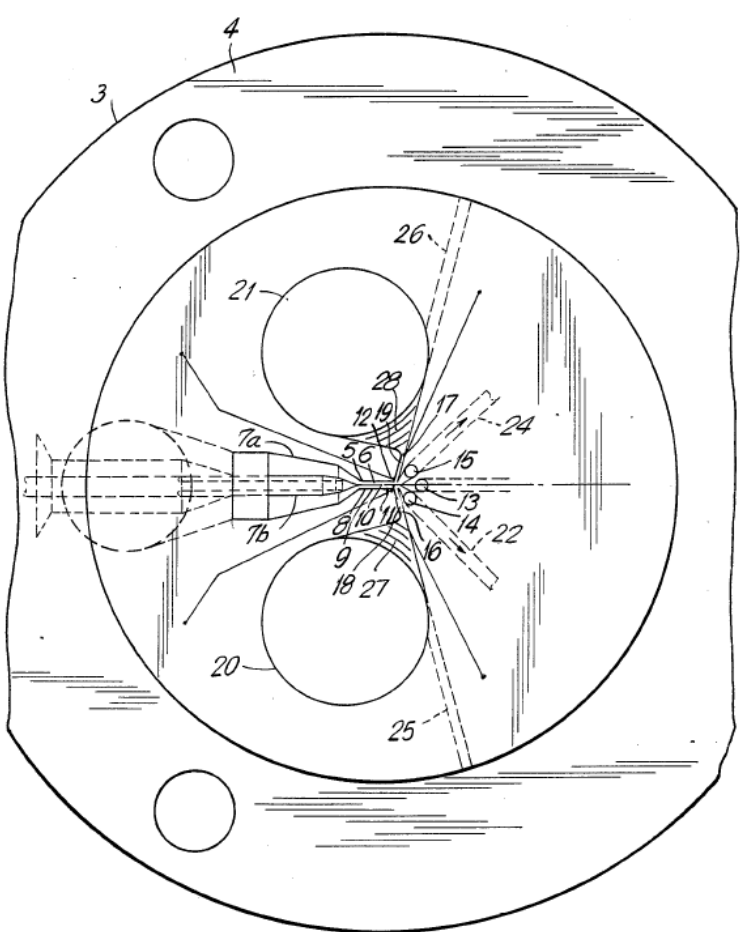
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 7H</p> <p>“In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in</p>

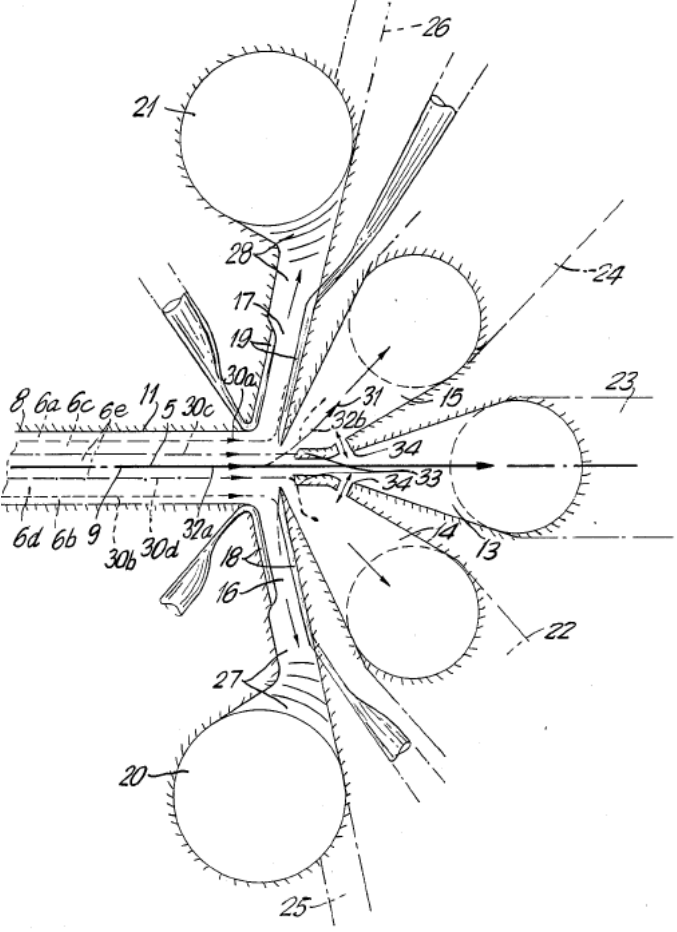
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

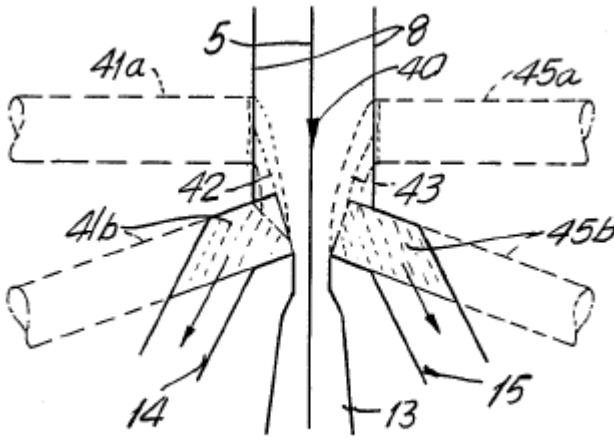
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 1</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

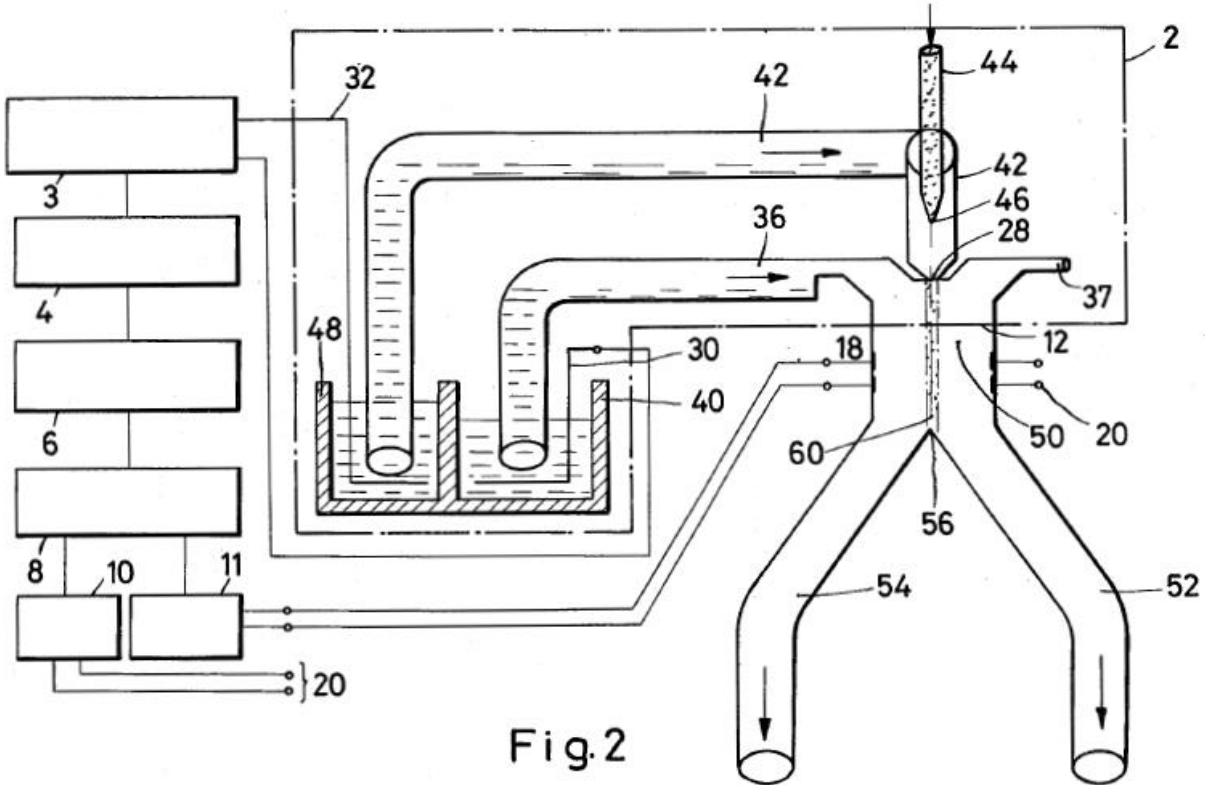
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p> “In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12. </p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

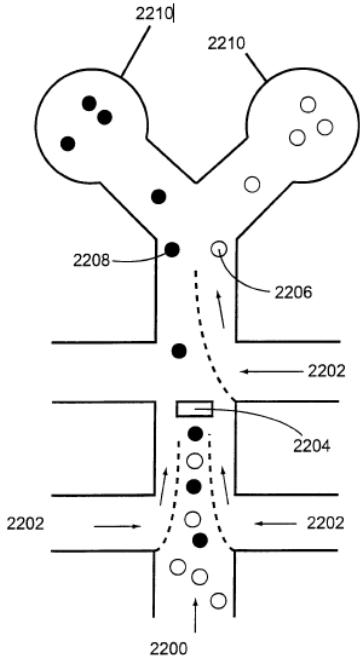
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

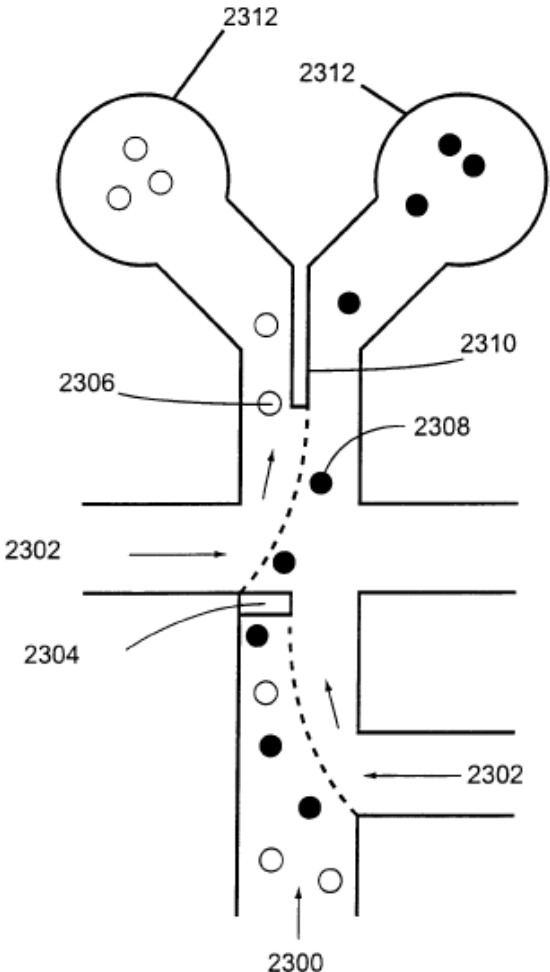
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

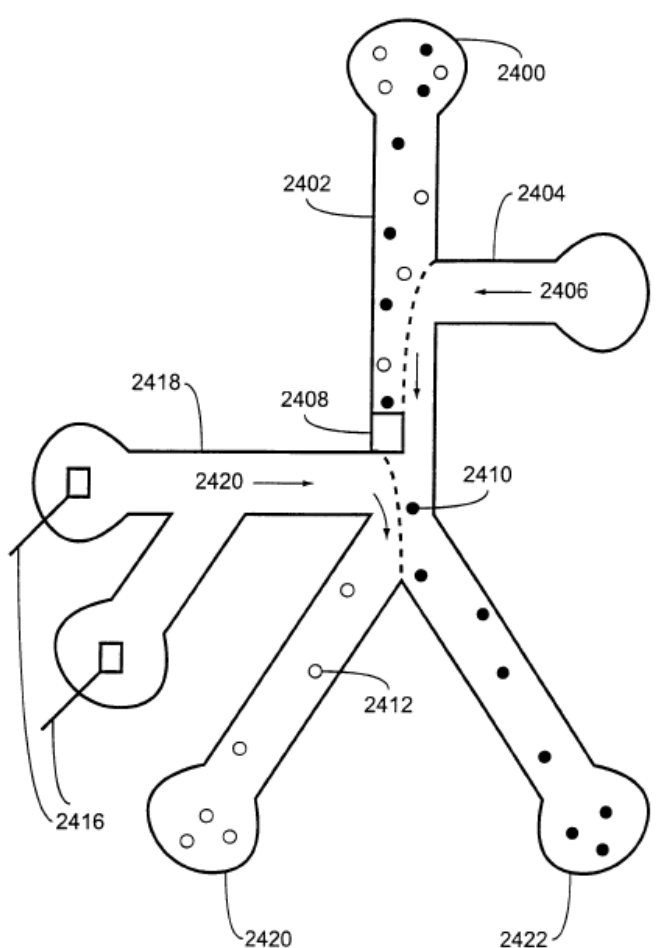
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[3] The system of claim 1, wherein the flow channel includes a branched portion, wherein the pressure pulse is used to sort one or more particles into a selected branch of the branched</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
portion.	<p>Wada</p> <p>The Wada disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“In one aspect, the invention provides methods of providing substantially uniform flow velocity to particles flowing in a first microchannel. In the methods, the particles are optionally flowed in the microchannel, e.g., using pressure-based flow, in which the particles flow with a substantially non-uniform flow velocity.” Wada, at 3:22-26.</p> <p>“The system also optionally includes at least a second microchannel that intersects the first microchannel for introducing at least one fluid into the first microchannel to horizontally or vertically focus the members of the at least one particle population in the first microchannel.” Wada, at 5:22-25.</p> <p>“In this particle sorting embodiment, the computer is optionally operably linked to the first or other fluid direction component(s), the flow control regulator, and the signal detector. Additionally, the instruction set typically directs simultaneous introduction of the at least one fluid from the third microchannel into the first microchannel to horizontally or vertically focus the selected member of the particle population such that the selected member is directed into the fourth microchannel in response to the detectable signal produced by the selected member.” Wada, at 7:18-24.</p> <p>“Optionally, the instruction set directs individual or simultaneous fluid flow from the third and sixth microchannels by individually or simultaneously activating at least one heating element (e.g., a Joule heating electrode, a conductively coated microchannel portion, or the like) disposed within each of the third and sixth microchannels or within at least one well that fluidly communicates with each of the third and sixth microchannels.” Wada, at 8:18-23.</p> <p>“Figure 22 schematically illustrates one particle sorting configuration utilizing these methods. As shown, cells 2200 are generally flowed in a main microchannel that includes at least two sets of opposing microchannels for focusing and/or otherwise directing the flow of cells 2200 using</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>hydrodynamic flow 2202 (e.g., cell buffer flow). One set of opposing microchannels is typically located, e.g., upstream from detector 2204 for simultaneously introducing hydrodynamic flow 2202 from both microchannels to focus cells 2200, as described above. A second set of opposing microchannels is typically located downstream from detector 2204 for introducing at least one hydrodynamic flow 2202 so as to direct selected cells (e.g., fluorescently-labeled cells) and non-selected cells 2206 into, in this case, one of two microchannels, each terminating in particular collection wells 2210.” Wada, at 19:23-20:2; <i>see also</i> Fig. 22 below.</p>  <p style="text-align: center;">Fig. 22</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of</p>

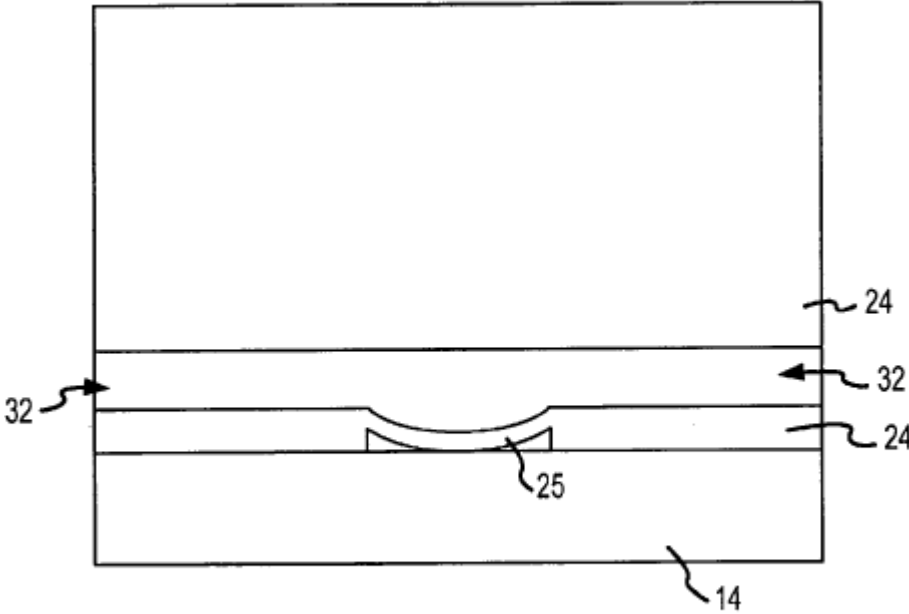
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300 pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

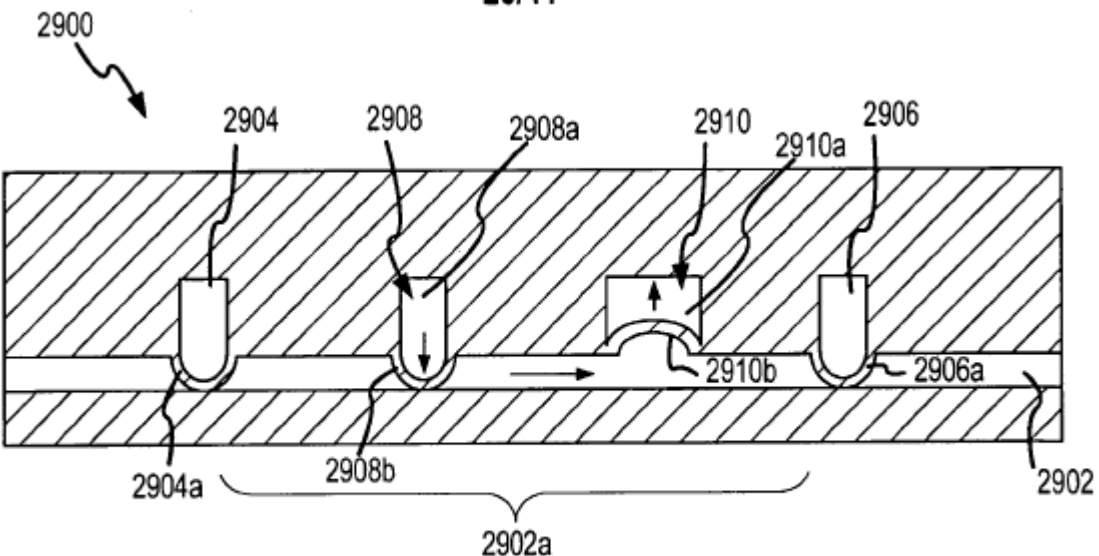
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>  <p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle</p>

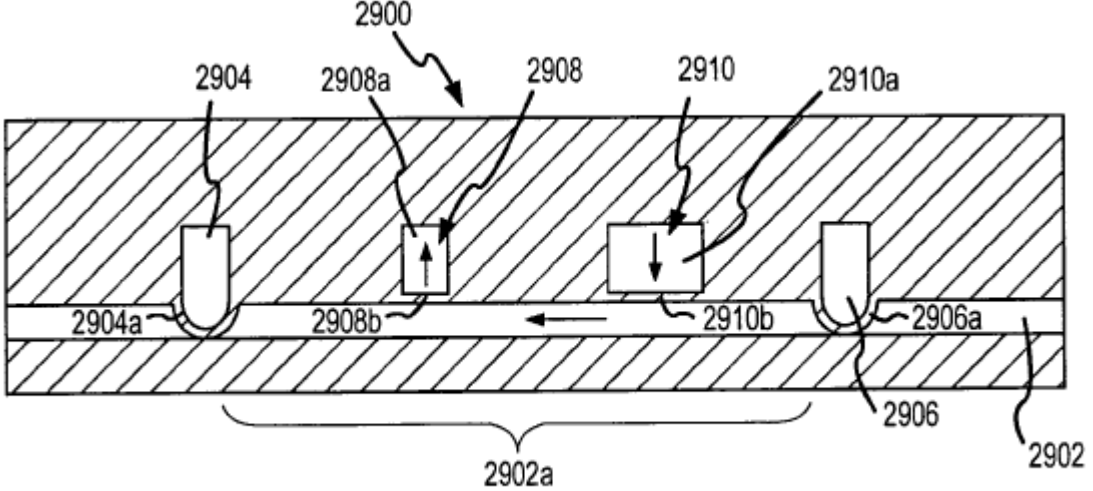
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL." Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 7H</p> <p>“Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc.” Chou, at 28:27-33.</p> <p>“As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will</p>

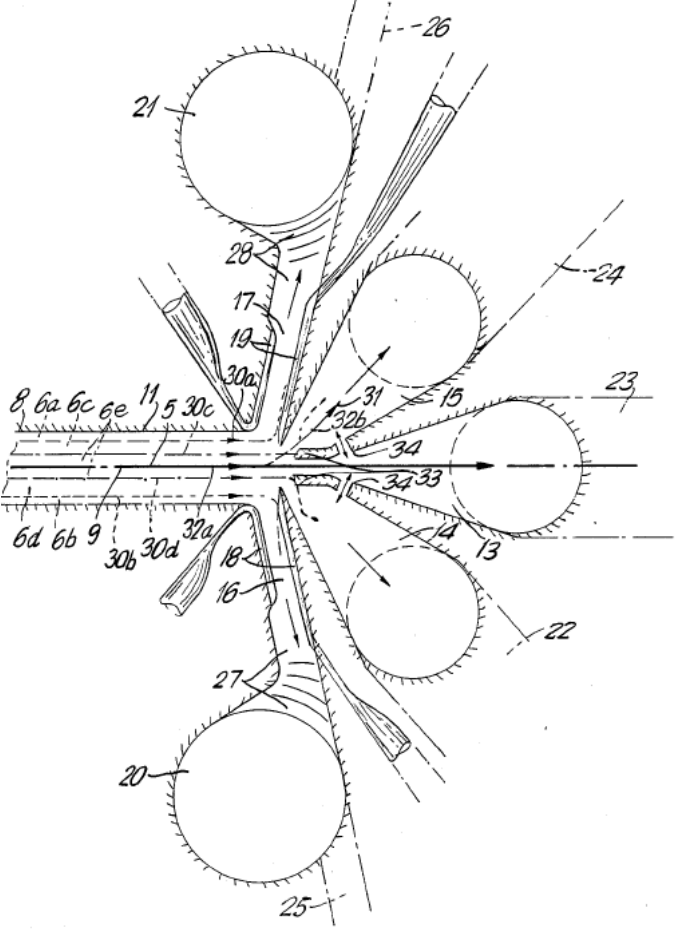
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30.” Chou, at 31:13-20.</p> <p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactuated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>  <p style="text-align: center;">FIG. 29A</p>

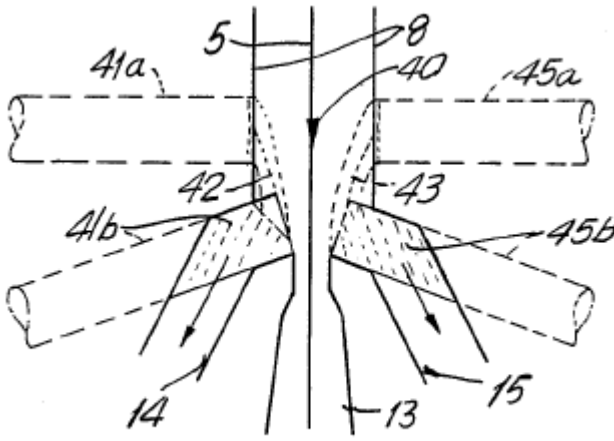
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis,</p>

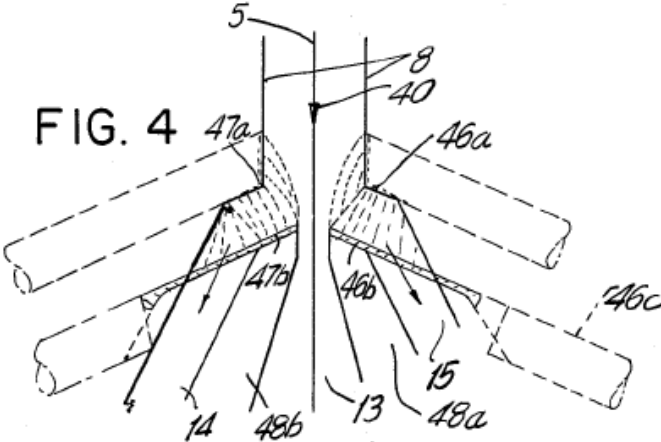
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 4</p> <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p> <p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to the middle channel. In the quiescent state the electrolyte and therefore also the particle are</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

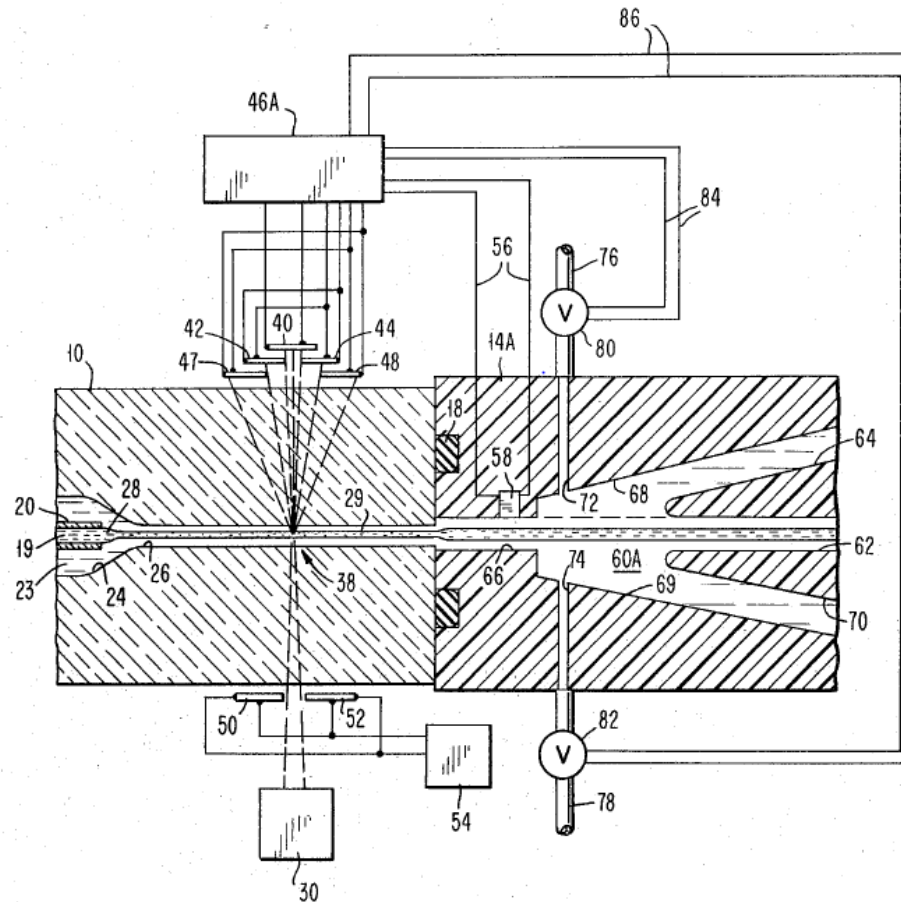
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p style="text-align: center;">Fig. 2</p>
<p>[4] The system of claim 1, wherein the first reservoir includes a gas pocket, wherein compression of the gas facilitates the dampening or absorbing of the pressure pulse.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Friedman</p> <p>The Friedman disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“For instance, in FIG. 2, three outlet ports are provided from the switching chamber and it will be understood that photoelectric sort detectors, such as elements 69 and 83, may be employed for each of those three outlet ports. FIG. 2 illustrates an alternative embodiment of the invention in which the switching chamber 60 is modified as shown at 60A, in a modified fluidic amplifier housing 14A, to provide an additional outlet port 70 and added control ports 72 and 74. A control fluid under pressure may be supplied to the switching chamber 60A through the control ports 72 and 74 through the respective supply lines 76 and 78 under the control of electromagnetically operated valves 80 and 82.” Friedman, at 8:53-67; <i>see also</i> Fig. 2 below.</p>

Asserted Claim Element

Exemplary Prior Art Disclosures

FIG. 2

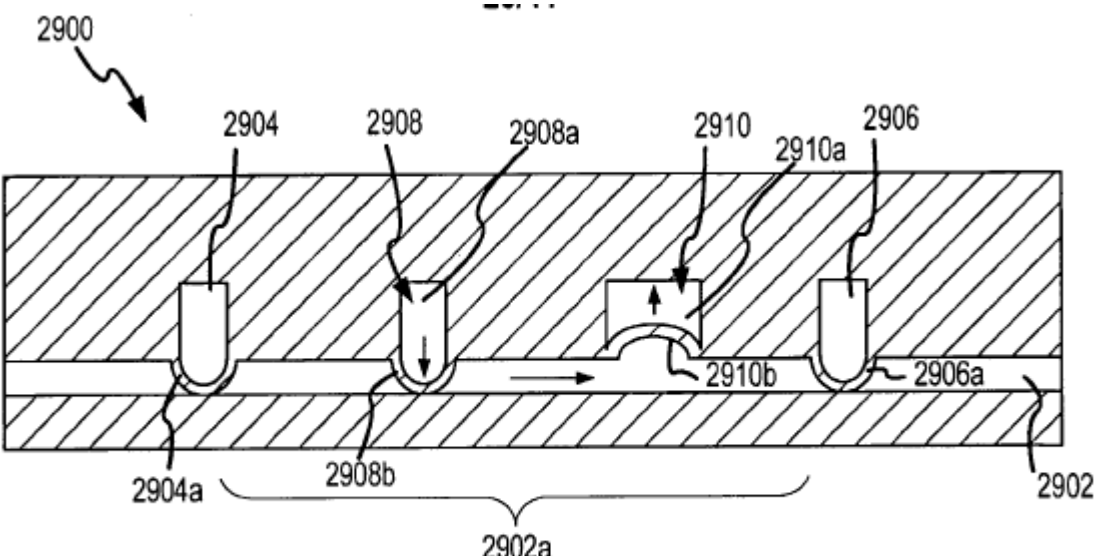


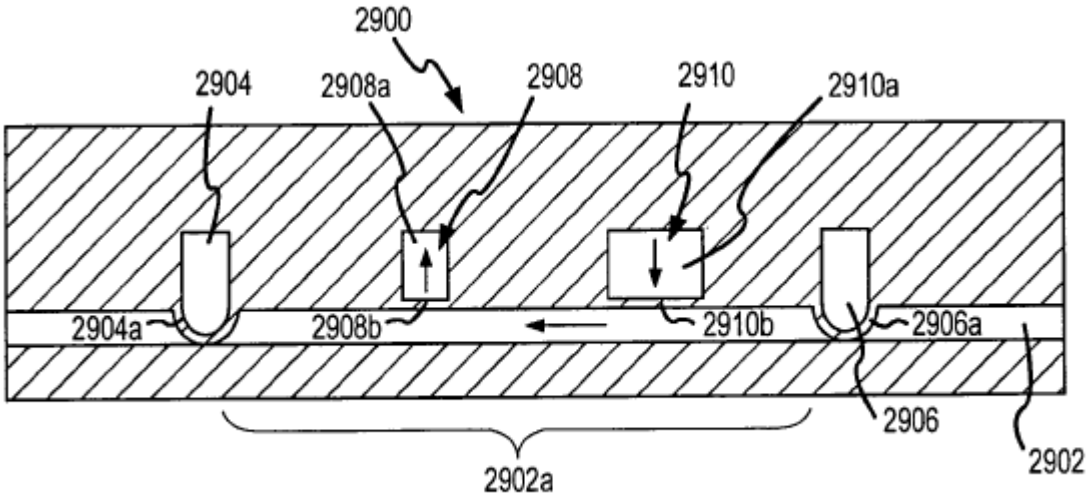
“As illustrated in the drawing, the opposite walls 68 and 69 of the switching chamber 60A are essentially equidistant from the nozzle formed by the inlet 66. Accordingly, they are equally capable of displaying the wall attachment effect in the presence of turbulence in the liquid stream, as

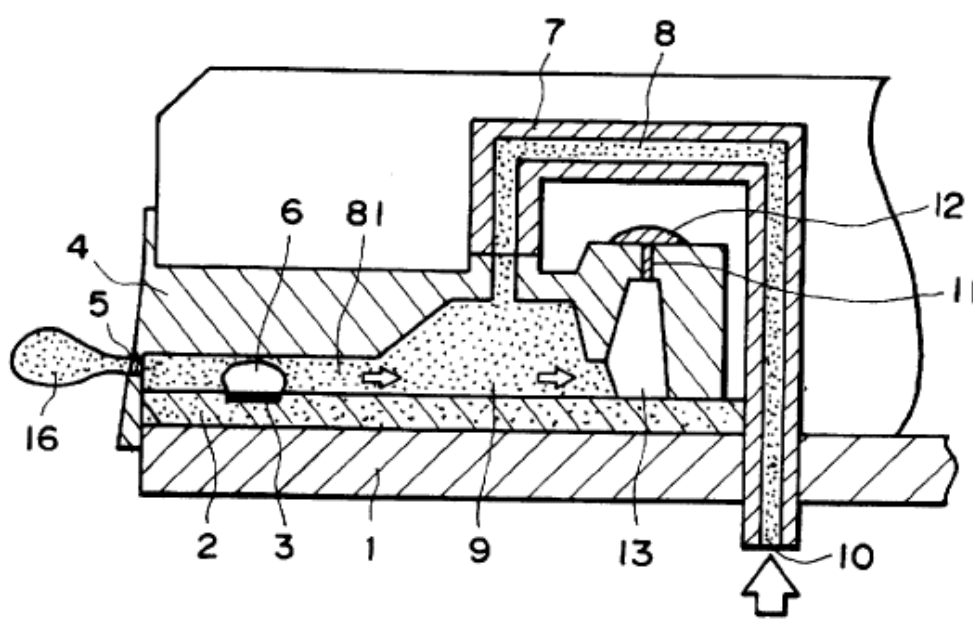
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>previously described above. Thus, just as the wall attachment effect to wall 68 directs the liquid stream to outlet port 64, the wall attachment effect at wall 69 leads the fluid stream to the outlet port 70. Once established at one wall, the wall attachment effect will be maintained and will hold the stream to one of these two walls, and thus direct the stream to one of these two outlet ports, as long as turbulence continues. In order to determine which direction the stream will take, a signal must be supplied from one of the control ports 72 or 74. If the signal takes the form of a supply of control fluid under pressure, it has the effect of shifting the stream away from the wall adjacent to the control port and over to the opposite wall. Thus, if control fluid is supplied to the switching chamber 68 through the control port 74, the supply of fluid destroys the low pressure bubble at the wall 69, causing the stream to shift to the opposite wall 68. A similar, but opposite effect is available if a vacuum is applied at the control port 74. This reduces the pressure at the wall 69, tending to increase the wall attachment at the wall 69 and to switch the device so that the liquid stream is pulled away from the wall 68 and to the wall 69 and to the port 70. The embodiment of FIG. 2 is capable of several different alternative modes of operation. For instance, if the switching chamber 60A is fabricated in an asymmetrical form such that the wall 68 is substantially closer to the nozzle formed by the inlet 66 than the wall 69, then without any control signals at the control ports 72 and 74, the switching action will be identical to that described above for the embodiment of FIG. 1. Thus, if a signal is supplied to the transducer 58, the resulting turbulence will cause the stream to attach to the wall 68 and to be directed to port 64. In the absence of a signal at transducer 58, the laminar flow will continue, and the stream will be directed through the outlet port 62.” Friedman, at 9:3-45.</p> <p>“The switching fluid used at the ports 72 and 74 should be compatible with the liquid in the main stream, but it need not be identical to that liquid. Thus, where the liquid in the main stream is water, the switching fluid may be water, or air, or some other compatible fluid.” Friedman, at 10:45-50.</p> <p>“As illustrated in the simplified schematic diagram of FIG. 3, additional fluidic amplifier switches may be employed downstream from the fluidic amplifier switch of the system of FIG. 1, or in that of FIG. 2. This provides the possibility of still further sorting and segregation of particles on a single pass through the apparatus. The downstream fluidic amplifiers may also be connected to receive control signals from circuits 46. FIG. 3, at the left side, illustrates in simplified schematic form an apparatus corresponding to the apparatus of FIG. 2, with corresponding parts correspondingly numbered. The main stream outlet port 62 is connected to a second fluidic amplifier switch housing 114 which may correspond exactly in structure and operation with the fluidic switch contained within</p>

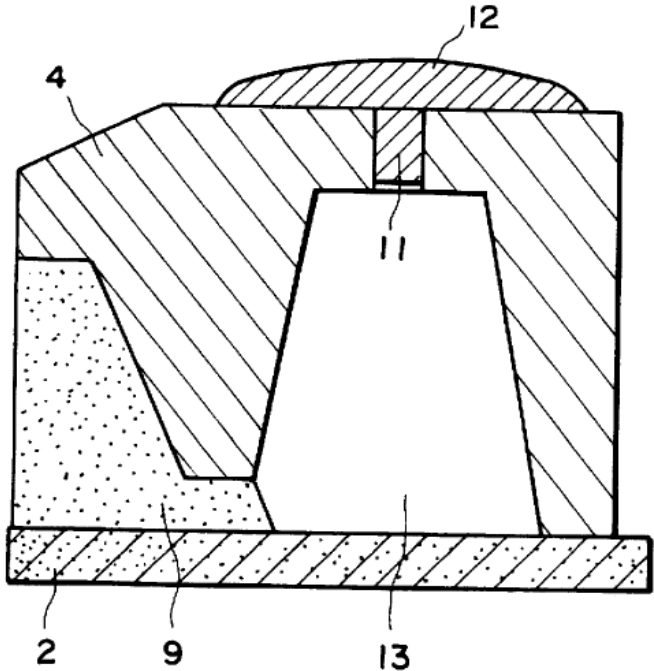
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the housing 14 and described above in connection with FIG. 1. The fluidic switch 114 responds to a signal from circuits 46 on a connection indicated at 146 through a delay circuit 149 and a gate circuit 151 to control a signal from an oscillator 153 to a transducer within the switch housing 114. By this means, particles which were not sorted and segregated in the first fluidic amplifier within housing 14, and diverted to the outlet port 64, continue on through the port connection 62, through the switch 114, and may be sorted and segregated according to a second particle characteristic into an outlet port 164. If the particles are not so segregated, they continue on in the main stream outlet port 162 from the housing 114. Thus, FIG. 3 illustrates the principle that a plurality of fluidic amplifier switches may be controlled to accomplish several sorting operations based on signals obtained from a single optical chamber 10.” Friedman, at 11:33-65; <i>see also</i> Fig. 3 below.</p> <p style="text-align: center;">FIG. 3</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper.” Chou, at 39:25-33.</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908</p>

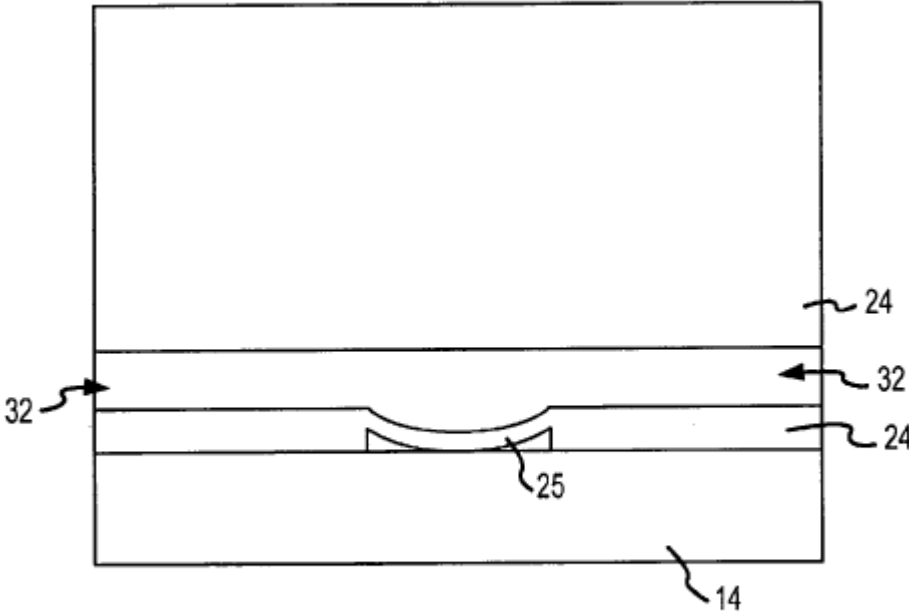
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactivated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>  <p style="text-align: center;">FIG. 29A</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>Otsuka</p> <p>The Otsuka disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving of the ejection energy generating elements propagate, the buffering chamber containing a gas for attenuating the pressure wave.” Otsuka, at Abstract.</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving of the ejection energy generating elements propagate, the buffering chamber containing a gas for attenuating the pressure wave, wherein a part of a wall constituting the buffering chamber has a gas transmitting property.” Otsuka, at 4:34-41.</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving of the ejection energy generating elements propagate. the buffering chamber containing a gas for</p>

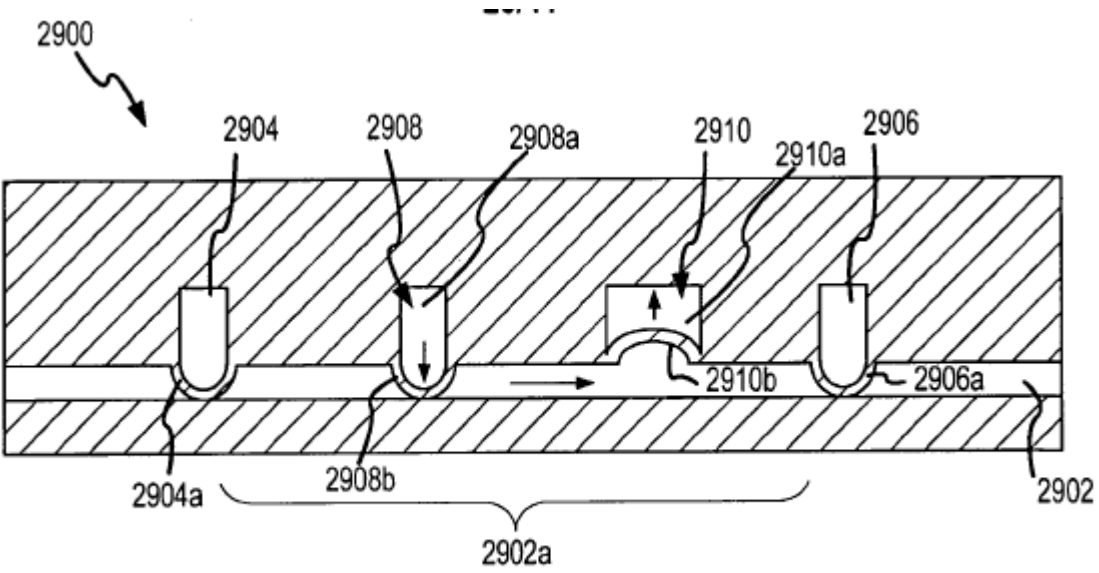
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>attenuating the pressure wave, wherein a part of a wall constituting the buffering chamber has a gas transmitting property; and driving signal supply means for supplying a driving signal for ejecting the ejecting energy generating elements.” Otsuka, at 4:49-57; <i>see also</i> Fig. 1 below.</p>  <p style="text-align: center;">FIG. 1</p> <p>“FIG. 2 shows an enlarged buffer chamber 13 according to an embodiment of this invention. As shown, the buffering chamber 13 filled with the gases partly communicates with the common liquid chamber 9. and the gases function to absorb the pressure wave.” Otsuka, at 6:34-38; <i>see also</i> Fig. 2 below.</p>

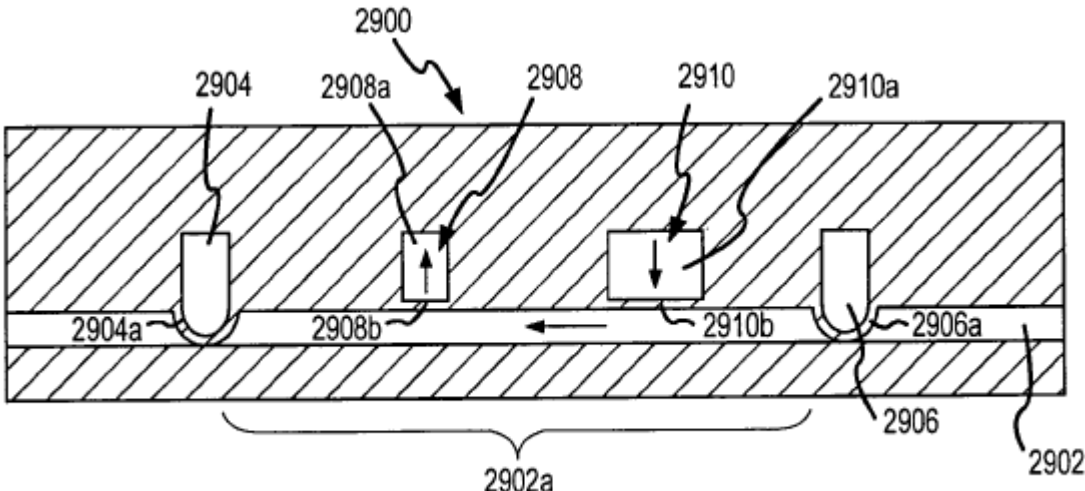
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 2</p>
<p>[5] The system of claim 4, further comprising a fluid filled region interfacing with the flow channel and the gas pocket.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p> <p>Chou</p> <p>The Zöld disclosures in each limitation of claim 4 are incorporated by reference.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 IL to 1 nL,</p>

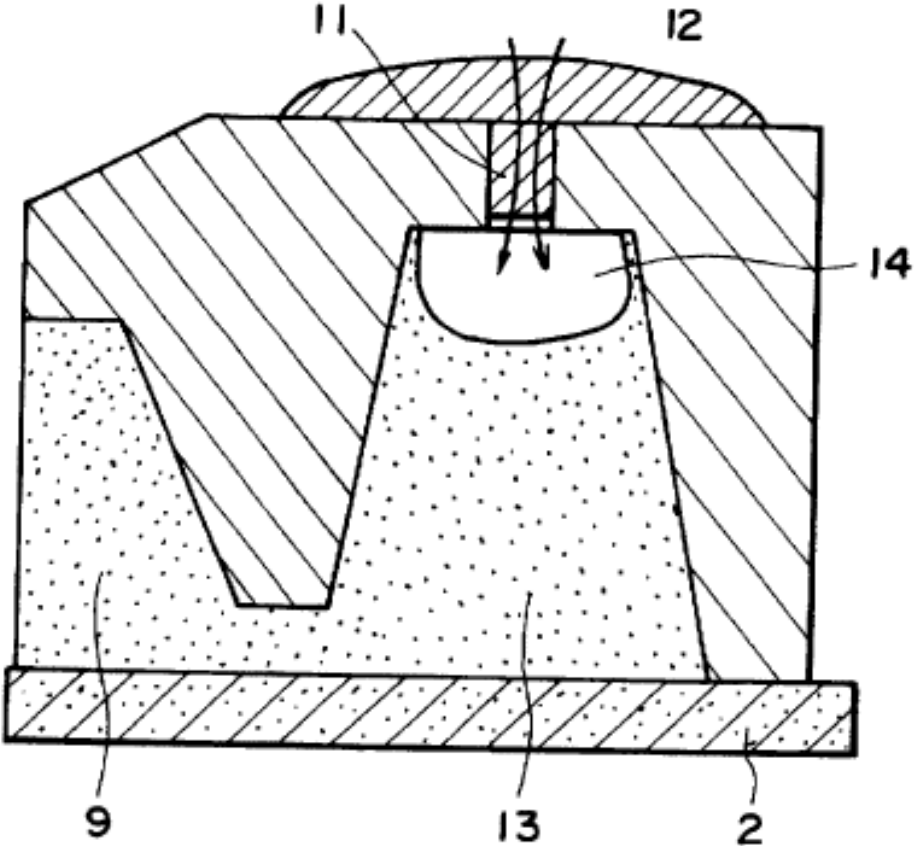
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>  <p style="text-align: center;">FIG. 7H</p> <p>“Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc.” Chou, at 28:27-33.</p> <p>“As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30.” Chou, at 31:13-20.</p> <p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to</p>

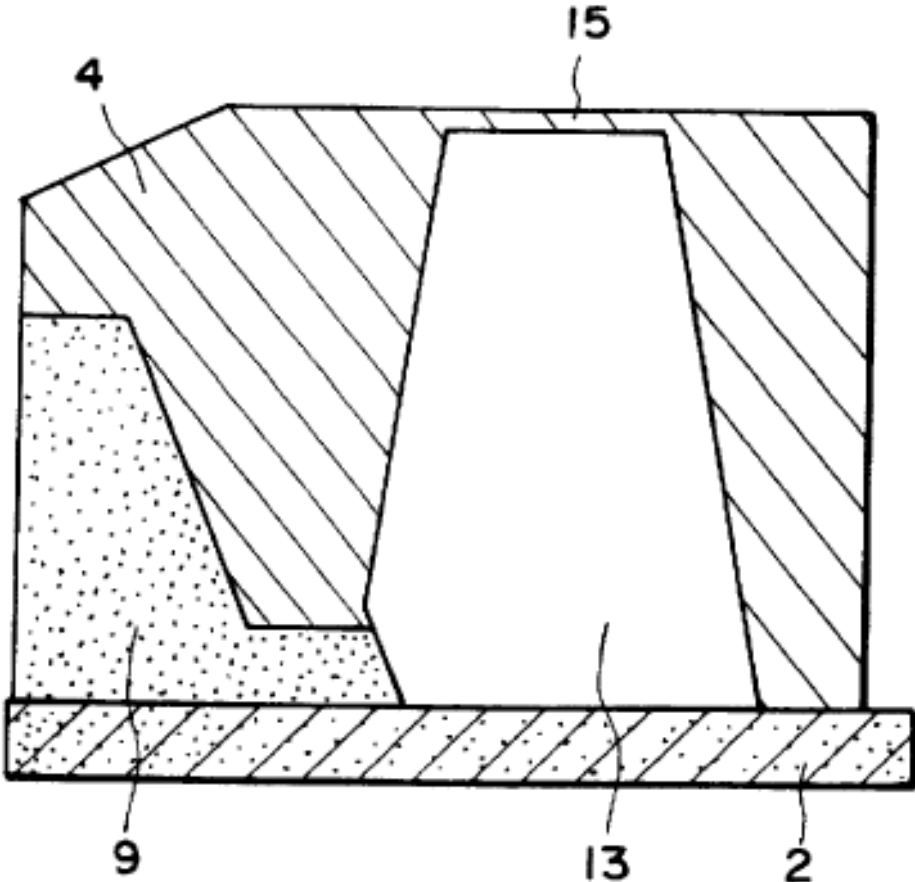
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p> permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactivated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B. </p>  <p style="text-align: center;">FIG. 29A</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Otsuka</p> <p>The Otsuka disclosures in each limitation of claim 4 are incorporated by reference.</p> <p>“In order to efficiently absorb the pressure wave, it is desirable that, as shown in FIG. 1, an opening to the common liquid chamber is provided in the buffering chamber 13 at a position faced to each nozzle (passage).” Otsuka, at 6:39-42.</p>

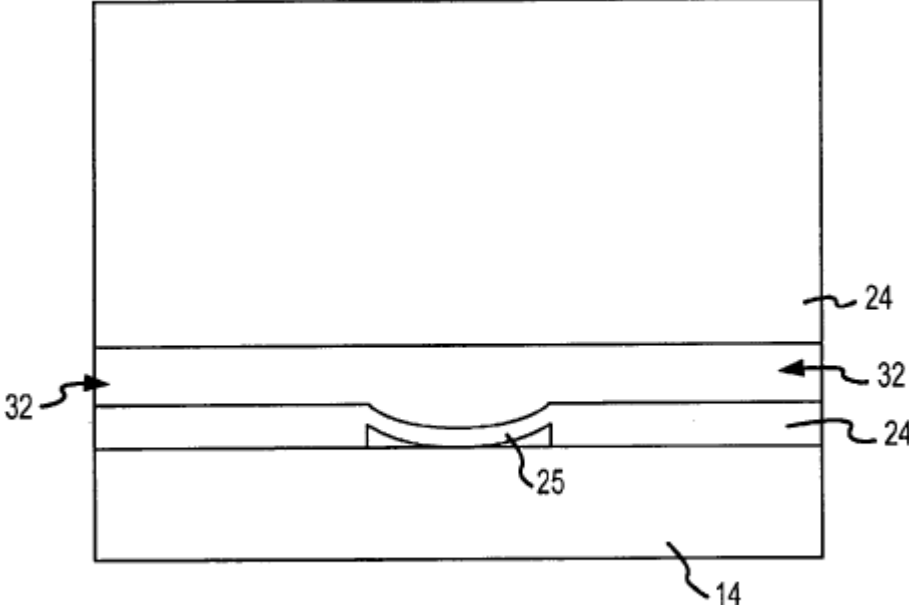
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“However, in this invention, the buffering chamber is provided with a portion (gas transmitting portion) which relatively easily permits the gases to enter the buffering chamber. Therefore, the gases (air) is external of the print head are supplied into the buffering chamber, as shown in FIG. 4. For this reason, even if the gases in the buffering chamber are reduced, the gases are refilled. In this-manner, the ink vibration can be suppressed for a long period of time, thus stabilizing the printing operation. In the structure in which an opening 11 is formed in a part of a wall constituting a buffering chamber, and it is sealed by a gas transmitting scaling material, it is desirable that the practical properly is provided by controlling the gas transmitting speed of the sealing member.” Otsuka, at 6:55-7:2.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 4</p> <p>“FIG. 11 shows another embodiment. The buffering chamber 13 of this embodiment is similar to that of the foregoing embodiment. However, it is different structurally therefrom in that there is no separate member for the gas transmission. In the structure of this embodiment, the thickness</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>of the wall at the rearmost position of the pressure buffering chamber 13 is made very thin, as compared with the other portion of the wall, so that the intended advantage of the present invention is provided. This embodiment uses the property that the amount of the gas transmission increases with decrease of the thickness of the member. By reducing the thickness to the significant extent, the rearmost position of the pressure buffering chamber 14 permits the gas transmission selectively at the position. Thus, the ink entered into the pressure buffering chamber 13 can be pushed out.” Otsuka, at 8:23-38.</p>

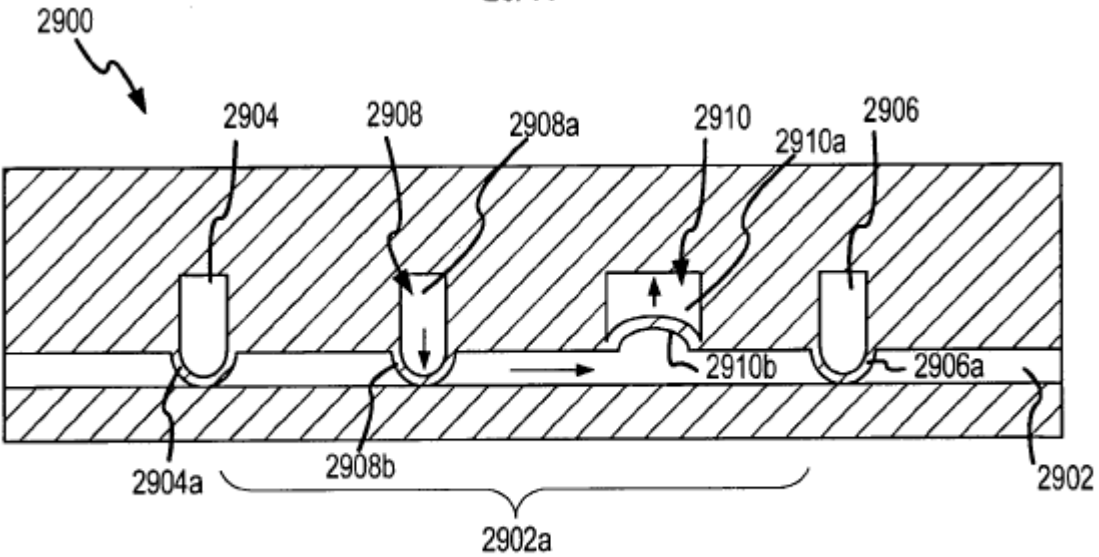
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 11</p>
[6] The system of claim 5,	The following exemplary citations to prior art references establish that this claim limitation is

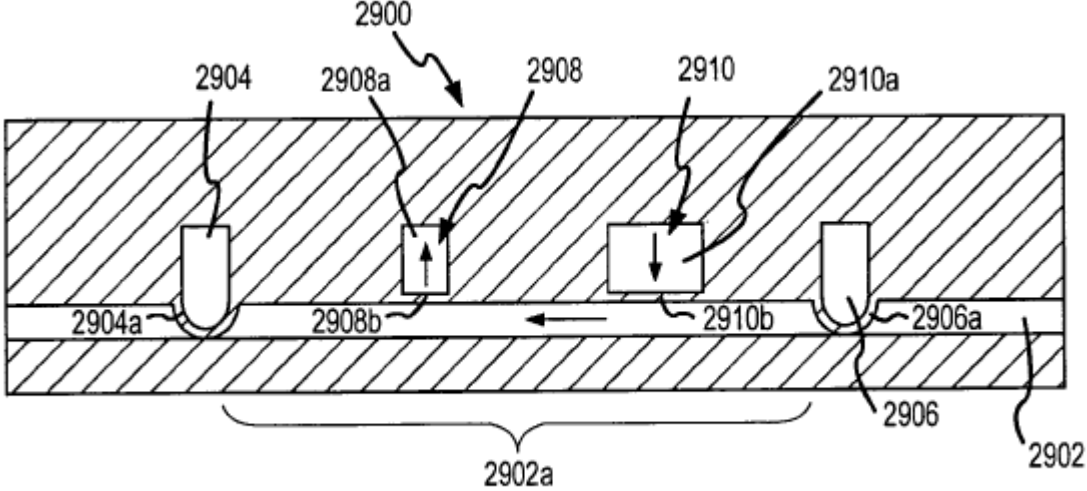
Asserted Claim Element	Exemplary Prior Art Disclosures
<p>wherein the fluid filled region includes a portion of the first reservoir.</p>	<p>taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 5 are incorporated by reference.</p> <p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is “open”. As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>(For illustration purposes only, channel 30 in Fig. 7G is shown in a “mostly closed” position, rather than a “fully closed” position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>  <p style="text-align: center;">FIG. 7H</p>

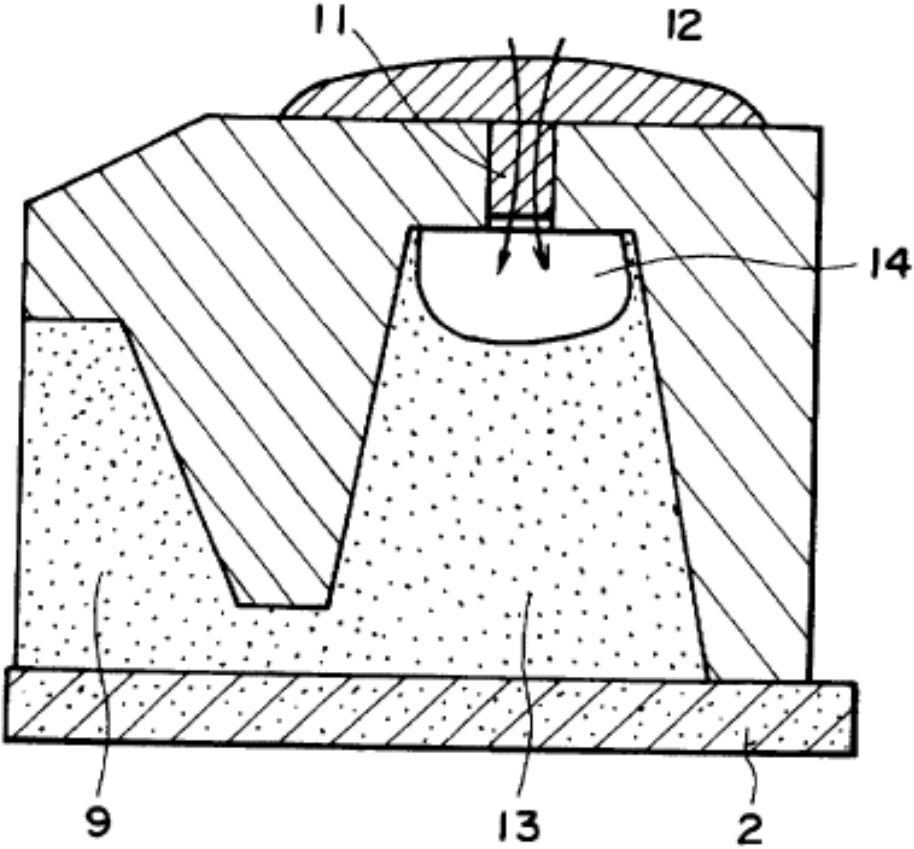
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc.” Chou, at 28:27-33.</p> <p>“As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30.” Chou, at 31:13-20.</p> <p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactuated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>

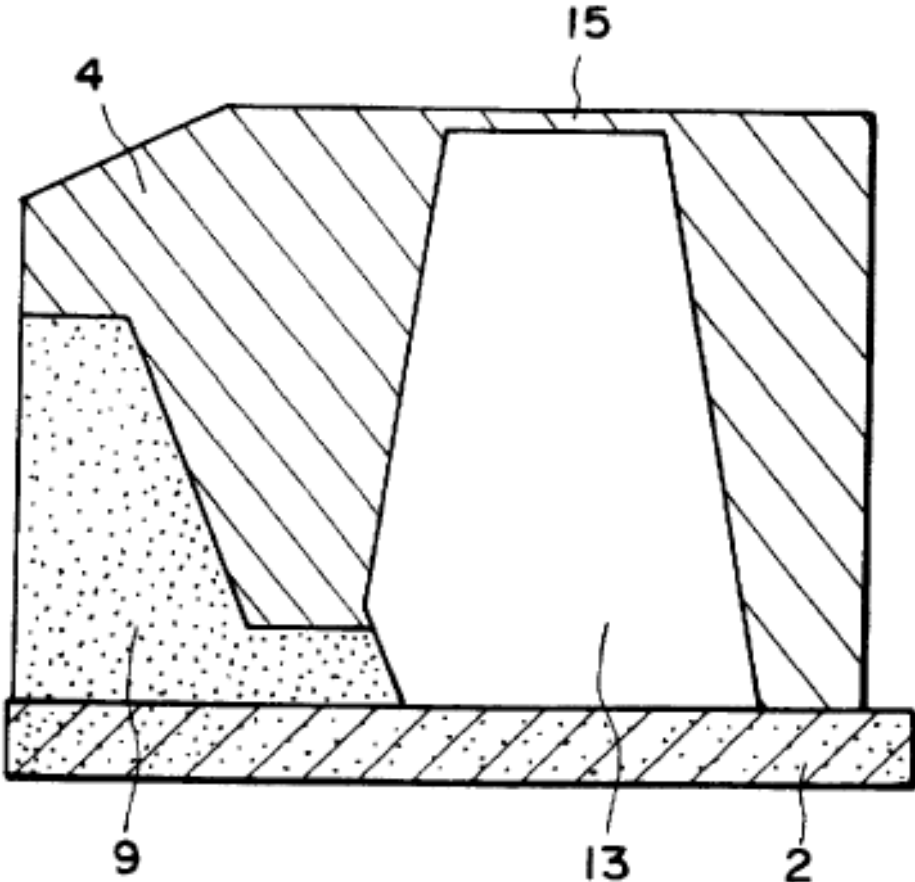
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29A</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Otsuka</p> <p>The Otsuka disclosures in each limitation of claim 5 are incorporated by reference.</p> <p>“In order to efficiently absorb the pressure wave, it is desirable that, as shown in FIG. 1, an opening to the common liquid chamber is provided in the buffering chamber 13 at a position faced to each nozzle (passage).” Otsuka, at 6:39-42.</p>

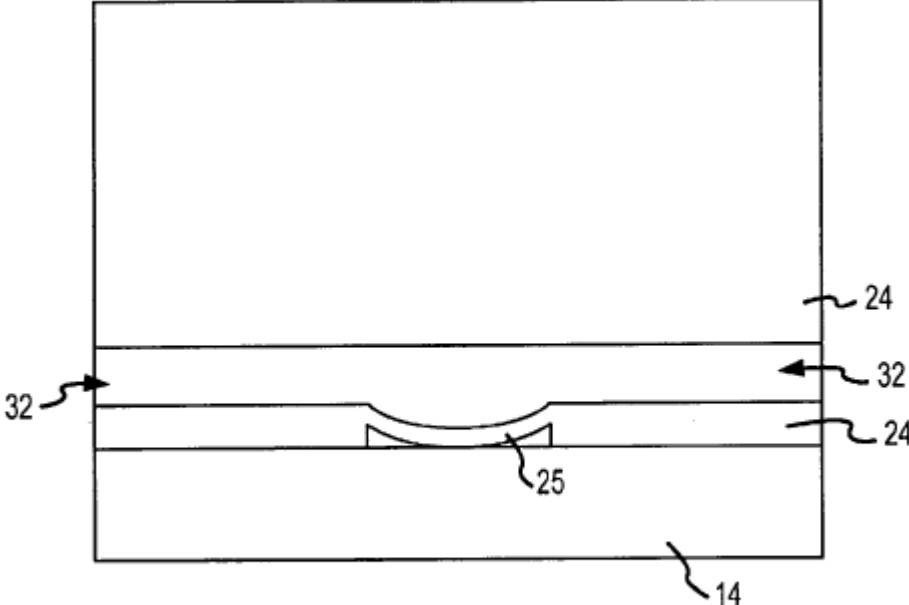
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“However, in this invention, the buffering chamber is provided with a portion (gas transmitting portion) which relatively easily permits the gases to enter the buffering chamber. Therefore, the gases (air) is external of the print head are supplied into the buffering chamber, as shown in FIG. 4. For this reason, even if the gases in the buffering chamber are reduced, the gases are refilled. In this-manner, the ink vibration can be suppressed for a long period of time, thus stabilizing the printing operation. In the structure in which an opening 11 is formed in a part of a wall constituting a buffering chamber, and it is sealed by a gas transmitting scaling material, it is desirable that the practical properly is provided by controlling the gas transmitting speed of the sealing member.” Otsuka, at 6:55-7:2.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 4</p> <p>“FIG. 11 shows another embodiment. The buffering chamber 13 of this embodiment is similar to that of the foregoing embodiment. However, it is different structurally therefrom in that there is no separate member for the gas transmission. In the structure of this embodiment, the thickness</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>of the wall at the rearmost position of the pressure buffering chamber 13 is made very thin, as compared with the other portion of the wall, so that the intended advantage of the present invention is provided. This embodiment uses the property that the amount of the gas transmission increases with decrease of the thickness of the member. By reducing the thickness to the significant extent, the rearmost position of the pressure buffering chamber 14 permits the gas transmission selectively at the position. Thus, the ink entered into the pressure buffering chamber 13 can be pushed out.” Otsuka, at 8:23-38.</p>

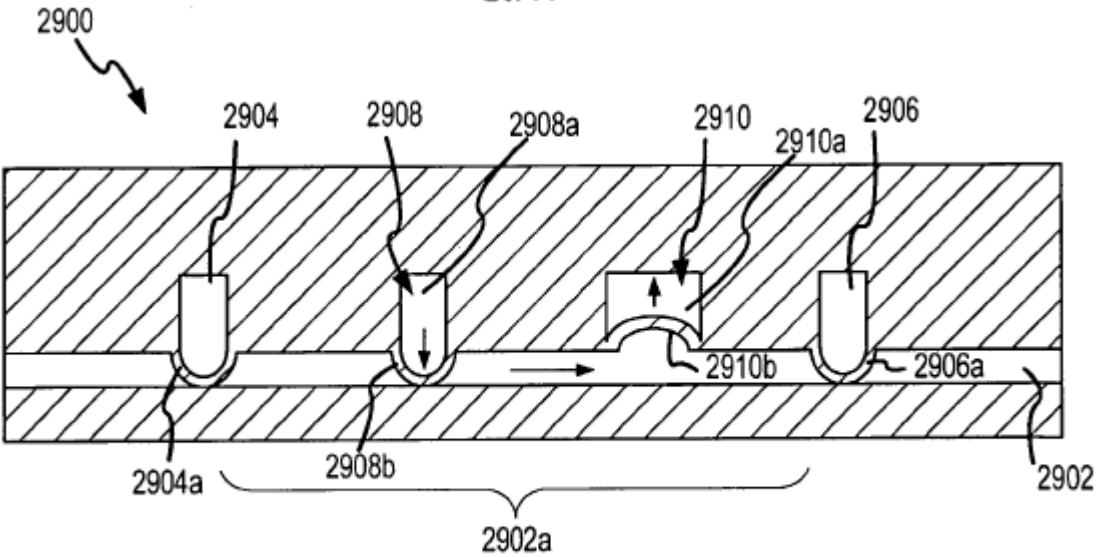
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 11</p>
[7] The system of claim 5,	The following exemplary citations to prior art references establish that this claim limitation is

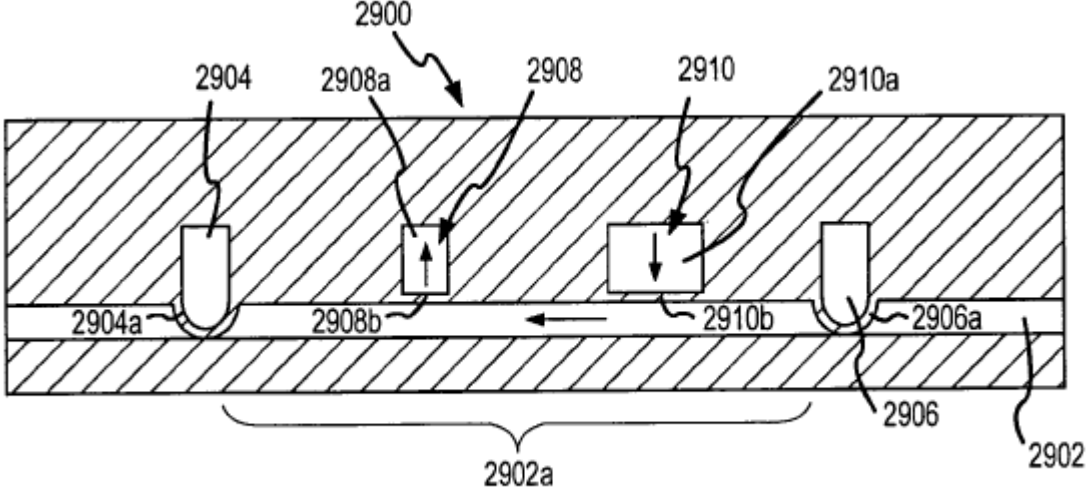
Asserted Claim Element	Exemplary Prior Art Disclosures
<p>wherein the fluid filled region includes a side channel connecting the first reservoir to the flow channel.</p>	<p>taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 5 are incorporated by reference.</p> <p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is “open”. As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>(For illustration purposes only, channel 30 in Fig. 7G is shown in a “mostly closed” position, rather than a “fully closed” position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>  <p style="text-align: center;">FIG. 7H</p>

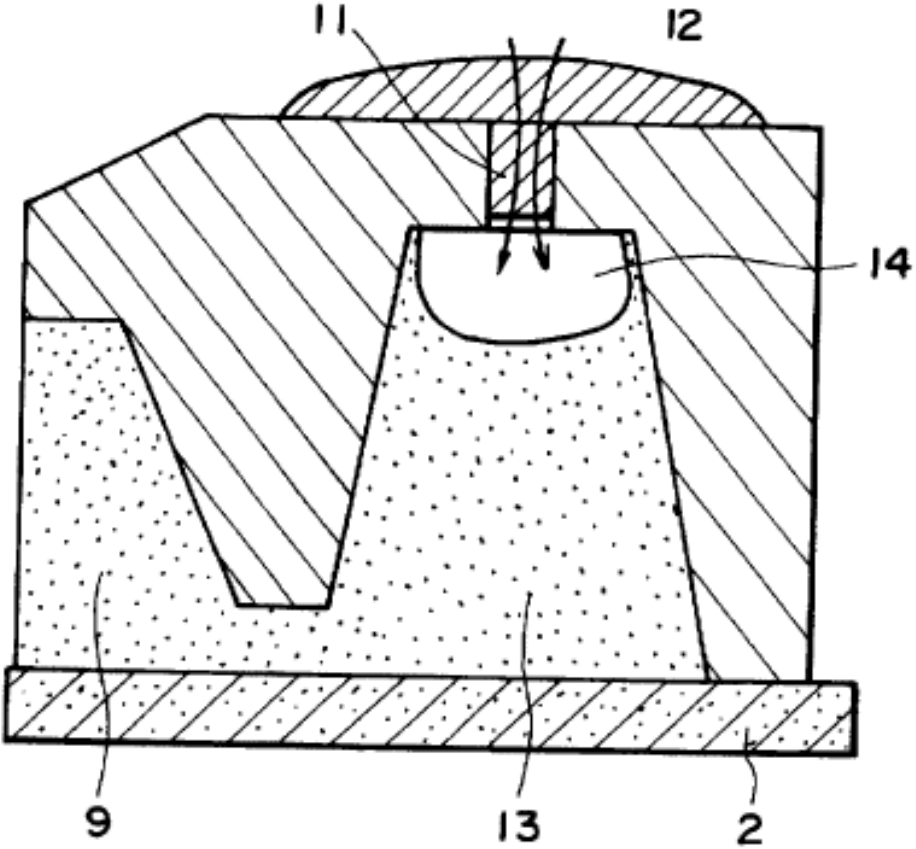
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc.” Chou, at 28:27-33.</p> <p>“As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30.” Chou, at 31:13-20.</p> <p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactuated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>

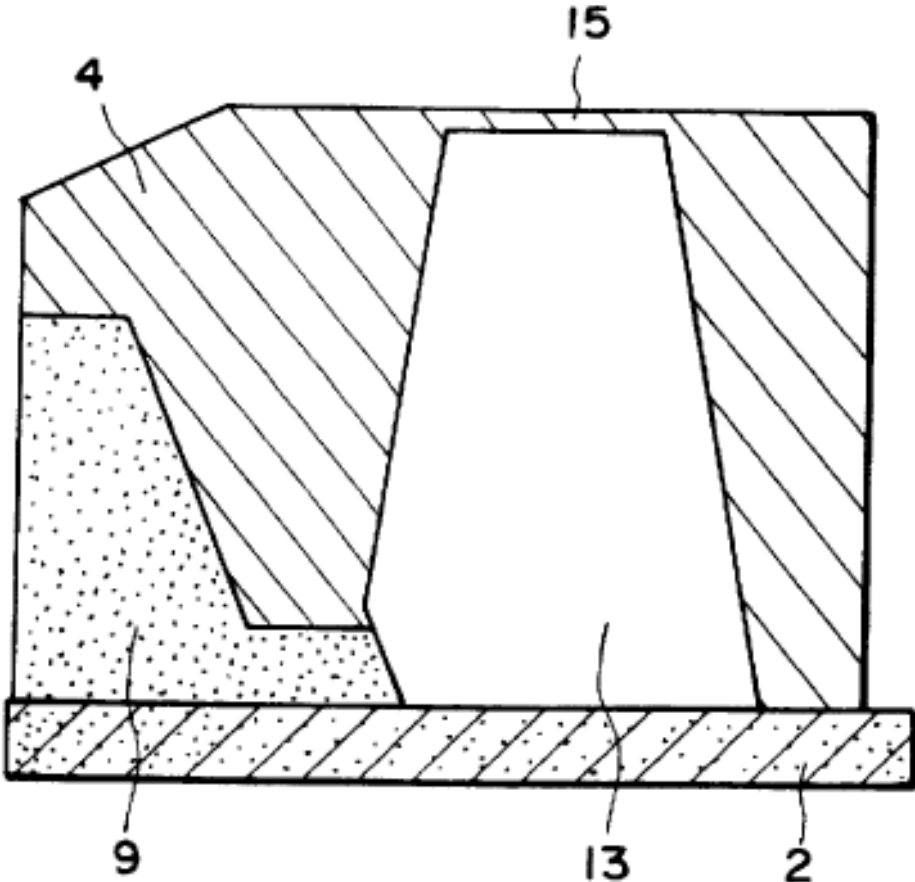
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 29A</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Otsuka</p> <p>The Otsuka disclosures in each limitation of claim 5 are incorporated by reference.</p> <p>“In order to efficiently absorb the pressure wave, it is desirable that, as shown in FIG. 1, an opening to the common liquid chamber is provided in the buffering chamber 13 at a position faced to each nozzle (passage).” Otsuka, at 6:39-42.</p>

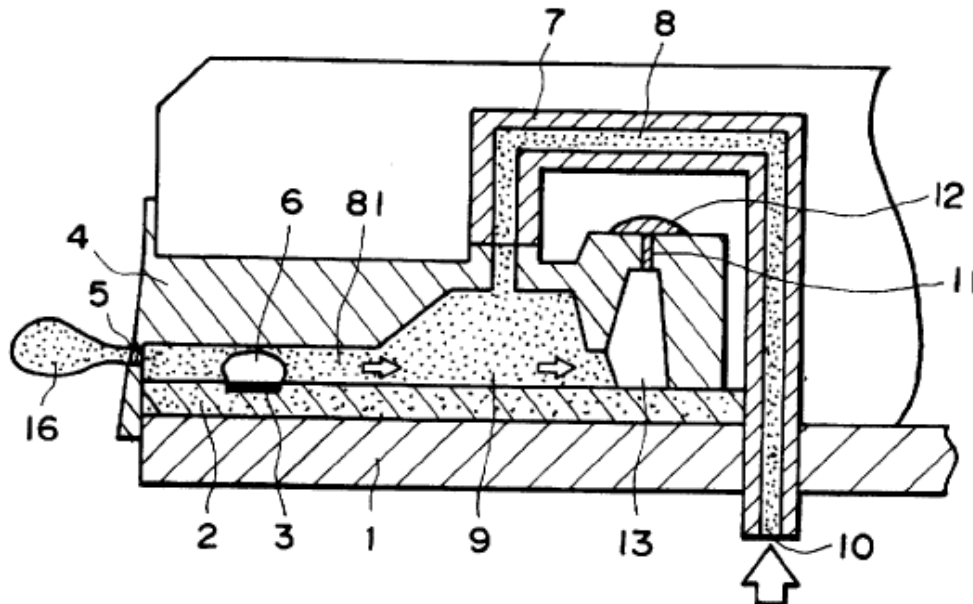
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“However, in this invention, the buffering chamber is provided with a portion (gas transmitting portion) which relatively easily permits the gases to enter the buffering chamber. Therefore, the gases (air) is external of the print head are supplied into the buffering chamber, as shown in FIG. 4. For this reason, even if the gases in the buffering chamber are reduced, the gases are refilled. In this-manner, the ink vibration can be suppressed for a long period of time, thus stabilizing the printing operation. In the structure in which an opening 11 is formed in a part of a wall constituting a buffering chamber, and it is sealed by a gas transmitting scaling material, it is desirable that the practical properly is provided by controlling the gas transmitting speed of the sealing member.” Otsuka, at 6:55-7:2.</p>

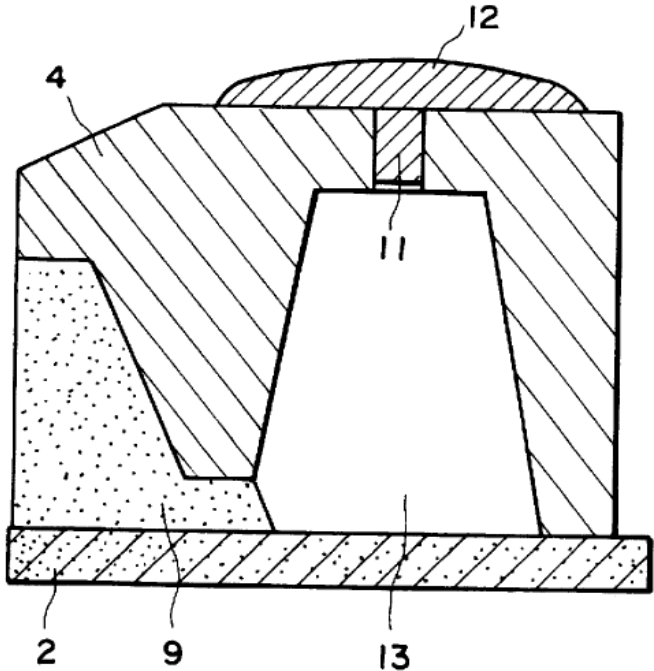
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 4</p> <p>“FIG. 11 shows another embodiment. The buffering chamber 13 of this embodiment is similar to that of the foregoing embodiment. However, it is different structurally therefrom in that there is no separate member for the gas transmission. In the structure of this embodiment, the thickness</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>of the wall at the rearmost position of the pressure buffering chamber 13 is made very thin, as compared with the other portion of the wall, so that the intended advantage of the present invention is provided. This embodiment uses the property that the amount of the gas transmission increases with decrease of the thickness of the member. By reducing the thickness to the significant extent, the rearmost position of the pressure buffering chamber 14 permits the gas transmission selectively at the position. Thus, the ink entered into the pressure buffering chamber 13 can be pushed out.” Otsuka, at 8:23-38.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 11</p>
[8] The system of claim 5,	The following exemplary citations to prior art references establish that this claim limitation is

Asserted Claim Element	Exemplary Prior Art Disclosures
<p>wherein the fluid filled region prevents the gas from the gas pocket from leaking into the flow channel.</p>	<p>taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p> <p>Otsuka</p> <p>The Otsuka disclosures in each limitation of claim 5 are incorporated by reference.</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving of the ejection energy generating elements propagate. the buffering chamber containing a gas for attenuating the pressure wave, wherein a part of a wall constituting the buffering chamber has a gas transmitting property; and driving signal supply means for supplying a driving signal for ejecting the ejecting energy generating elements.” Otsuka, at 4:49-57; <i>see also</i> Fig. 1 below.</p>

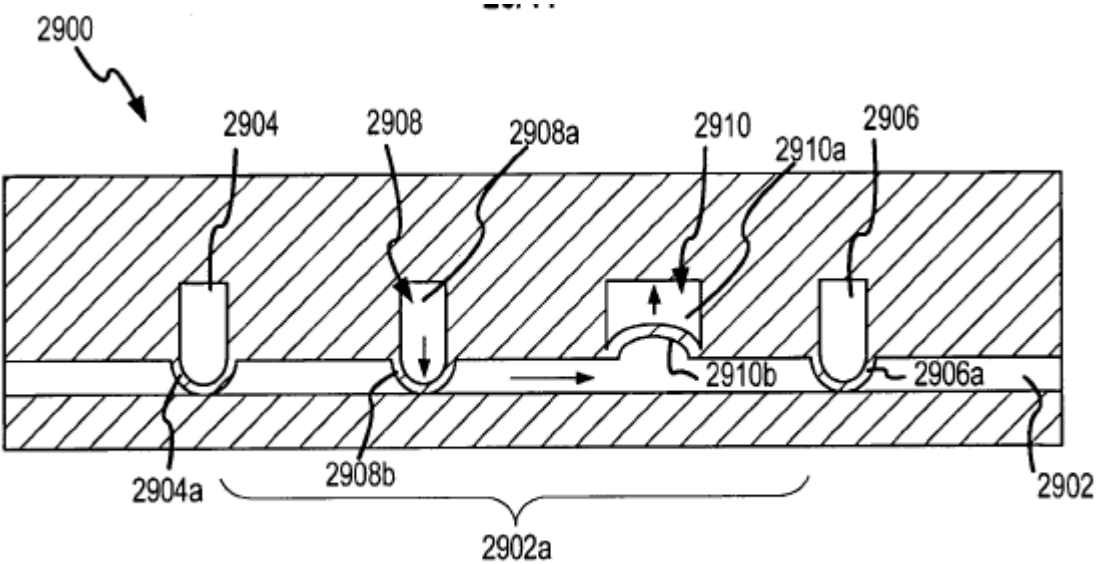
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 1</p> <p>“FIG. 2 shows an enlarged buffer chamber 13 according to an embodiment of this invention. As shown, the buffering chamber 13 filled with the gases partly communicates with the common liquid chamber 9. and the gases function to absorb the pressure wave.” Otsuka, at 6:34-38; <i>see also</i> Fig. 2 below.</p>

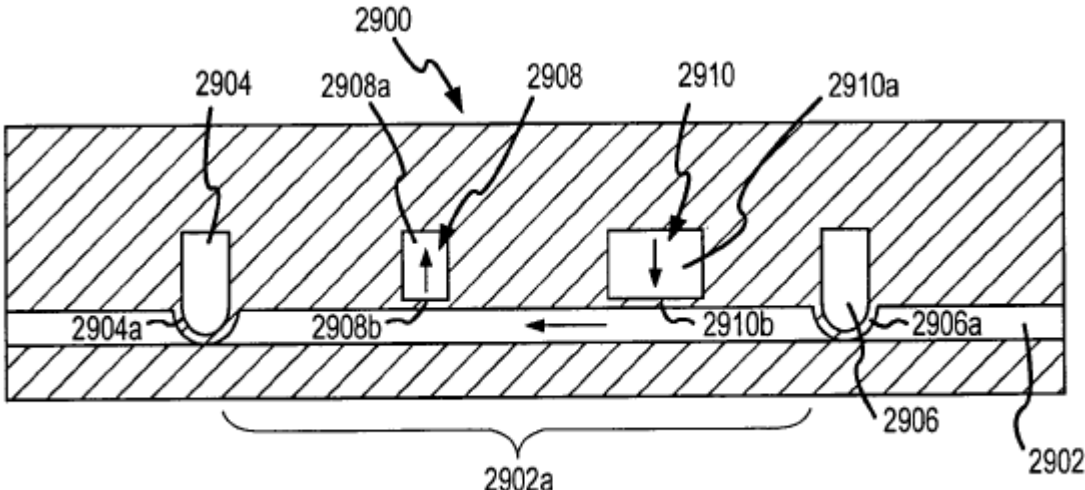
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 2</p> <p>“In each of the foregoing embodiments, the position of the bubbles is used to assure the permanent existing of the bubbles adjacent the common liquid chamber, so that the vibration of the ink in the liquid chamber is suppressed . . . By doing so, the pressure weight going to return to the upstream due to the vibration is blocked.” Otsuka, at 9:19-26.</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 5 are incorporated by reference.</p>

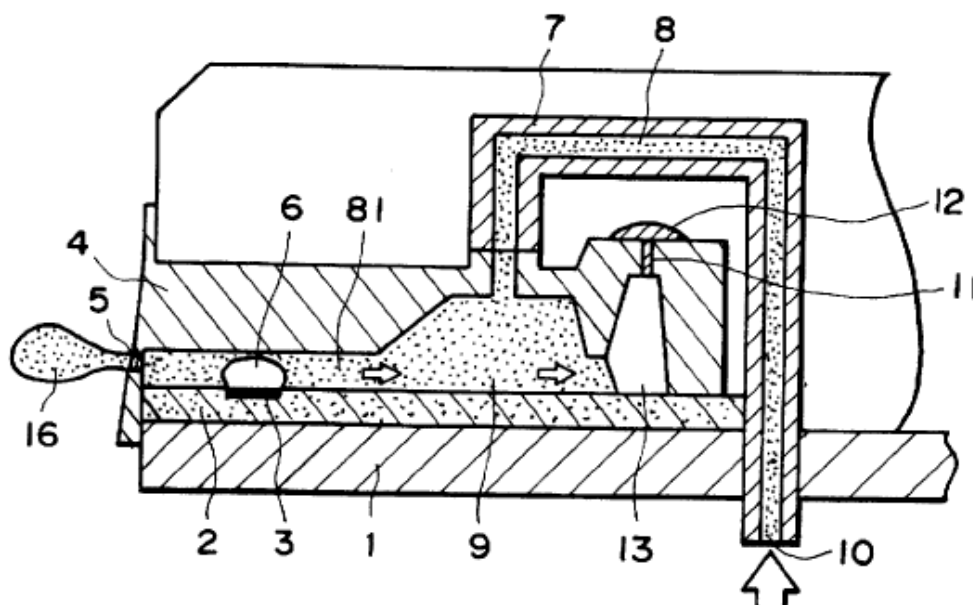
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

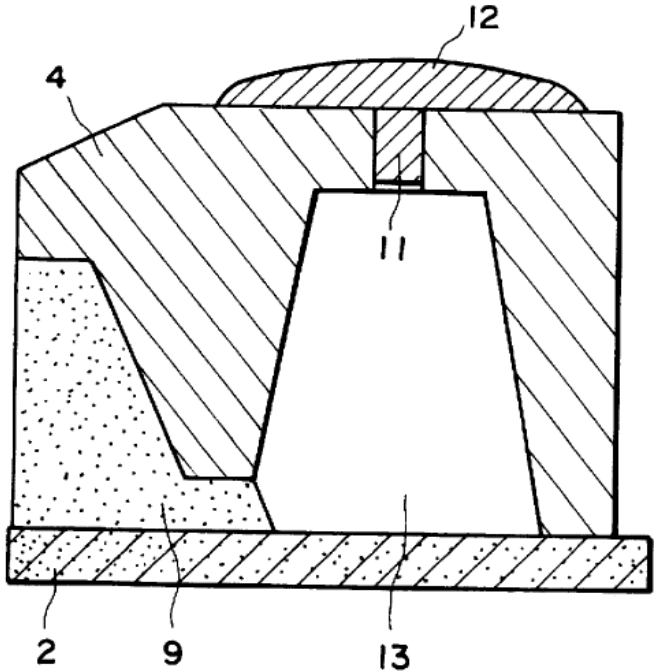
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p>FIG. 7H</p> <p>“Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc.” Chou, at 28:27-33.</p> <p>“As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30.” Chou, at 31:13-20.</p> <p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane 2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactuated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>  <p style="text-align: center;">FIG. 29A</p>

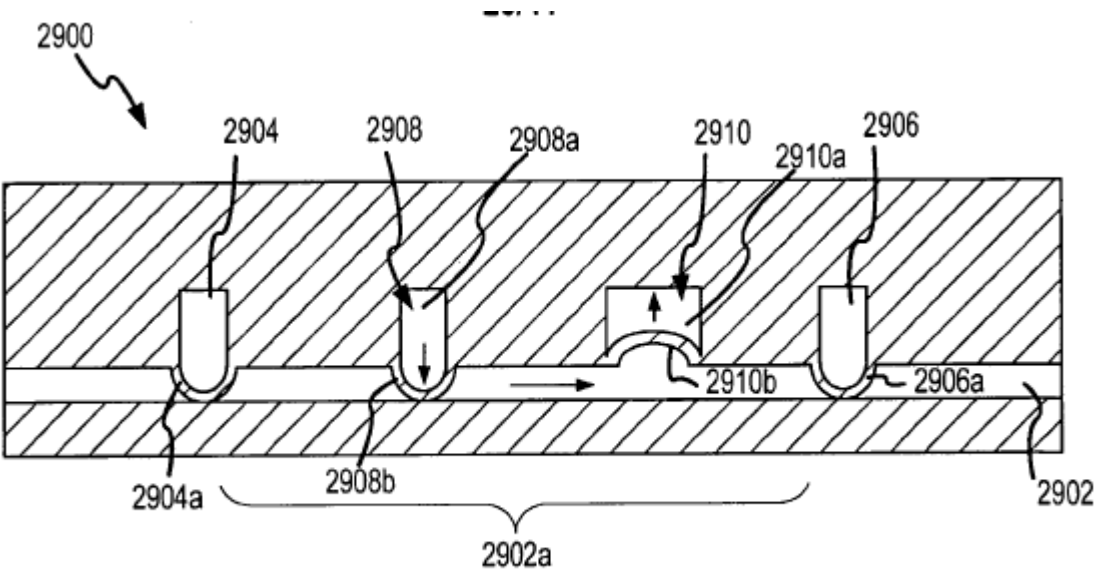
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>“In general, damper structures in accordance with embodiments of the present invention feature an energy absorber adjacent to the flow channel, the energy absorber configured to experience a physical change in response to an oscillation within the flow channel. As described below, the energy absorber can take several forms, including but not limited to a flexible membrane, a pocket filled with a compressible fluid, and/or flexible walls of the flow channel itself.” Chou, at 40:20-25.</p> <p>Otsuka</p> <p>The Otsuka disclosures in each limitation of claim 5 are incorporated by reference.</p> <p>“[A] buffering chamber disposed at a position through which a pressure wave resulting from driving of the ejection energy generating elements propagate. the buffering chamber containing a gas for attenuating the pressure wave, wherein a part of a wall constituting the buffering chamber has a gas transmitting property; and driving signal supply means for supplying a driving signal for ejecting the</p>

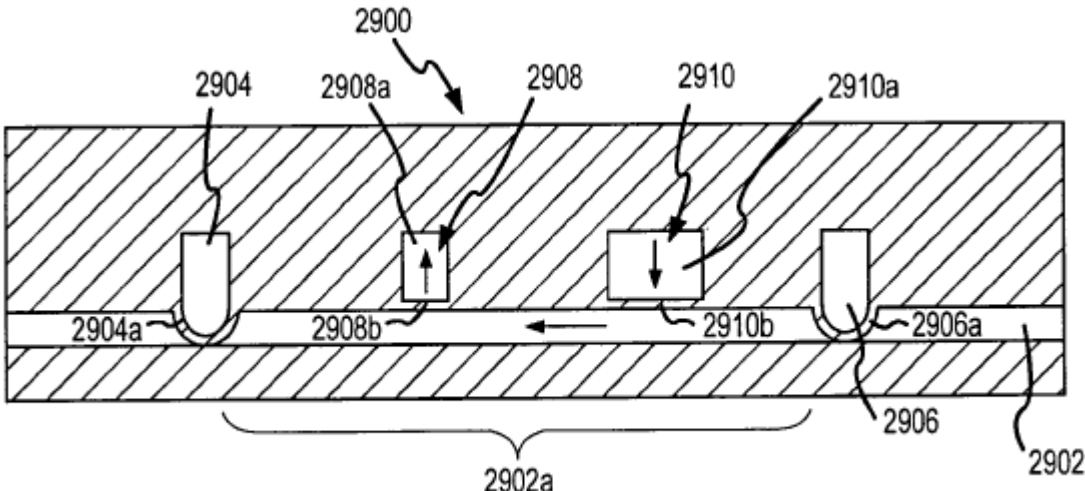
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>ejecting energy generating elements.” Otsuka, at 4:49-57; <i>see also</i> Fig. 1 below.</p>  <p style="text-align: center;">FIG. 1</p> <p>“FIG. 2 shows an enlarged buffer chamber 13 according to an embodiment of this invention. As shown, the buffering chamber 13 filled with the gases partly communicates with the common liquid chamber 9. and the gases function to absorb the pressure wave.” Otsuka, at 6:34-38; <i>see also</i> Fig. 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 2</p> <p>“In each of the foregoing embodiments, the position of the bubbles is used to assure the permanent existing of the bubbles adjacent the common liquid chamber, so that the vibration of the ink in the liquid chamber is suppressed . . . By doing so, the pressure weight going to return to the upstream due to the vibration is blocked.” Otsuka, at 9:19-26.</p>
<p>[9] The system of claim 1, wherein the first reservoir includes a resilient wall for facilitating dampening or absorbing of the pressure</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p>

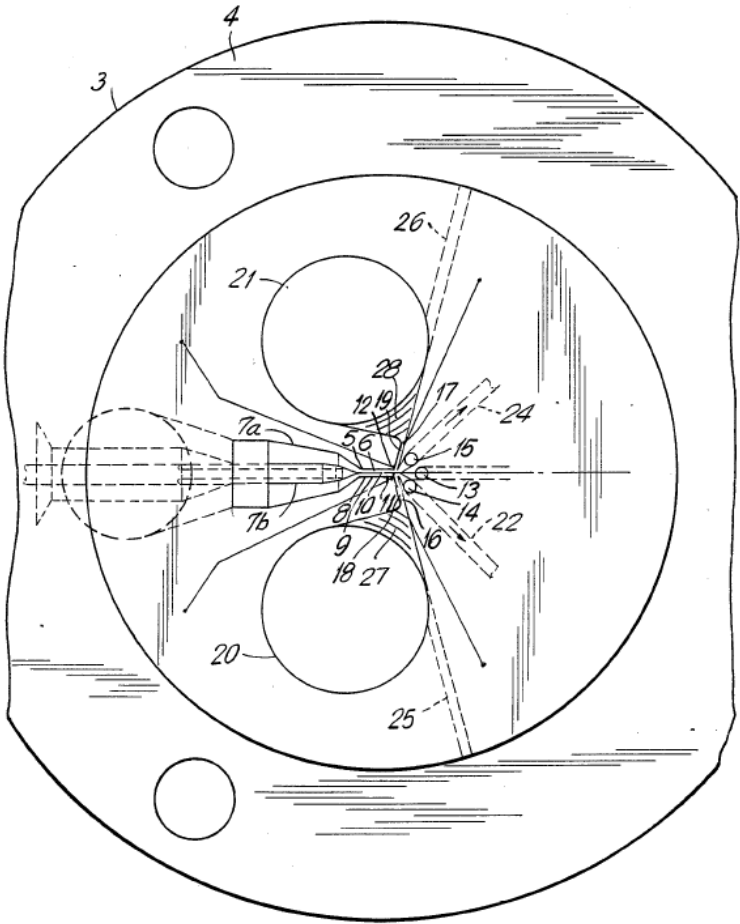
Asserted Claim Element	Exemplary Prior Art Disclosures
pulse.	<p>For example:</p> <p>Wada</p> <p>The Zöld disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“In preferred aspects, the bottom portion of the device comprises a solid substrate that is substantially planar in structure, and which has at least one substantially flat upper surface. A variety of substrate materials may be employed as the bottom portion. Typically, because the devices are microfabricated, substrate materials will be selected based upon their compatibility with known microfabrication techniques, e.g., photolithography, wet chemical etching, laser ablation, air abrasion techniques, injection molding, embossing, and other techniques. The substrate materials are also generally selected for their compatibility with the full range of conditions to which the microfluidic devices are typically exposed, including extremes of pH, temperature, salt concentration, and application of electric fields. Accordingly, in some preferred aspects, the substrate material optionally includes materials normally associated with the semiconductor industry in which such microfabrication techniques are regularly employed, including, e.g., silica based substrates, such as glass, quartz, silicon or polysilicon, as well as other substrate materials, such as gallium arsenide and the like.” Wada, at 38:18-31.</p> <p>“In additional preferred aspects, the substrate materials will comprise polymeric materials, e.g., plastics, such as polymethylmethacrylate (PM-MA), polycarbonate, polytetrafluoroethylene (TEFLON™), polyvinylchloride (PVC), polydimethylsiloxane (PDMS), polysulfone, polystyrene, polymethylpentene, polypropylene, polyethylene, polyvinylidene fluoride, ABS (acrylonitrile-butadiene-styrene copolymer), and the like.” Wada, at 39:3-8.</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“An embodiment of a damper in accordance with the present invention for a microfluidic device</p>

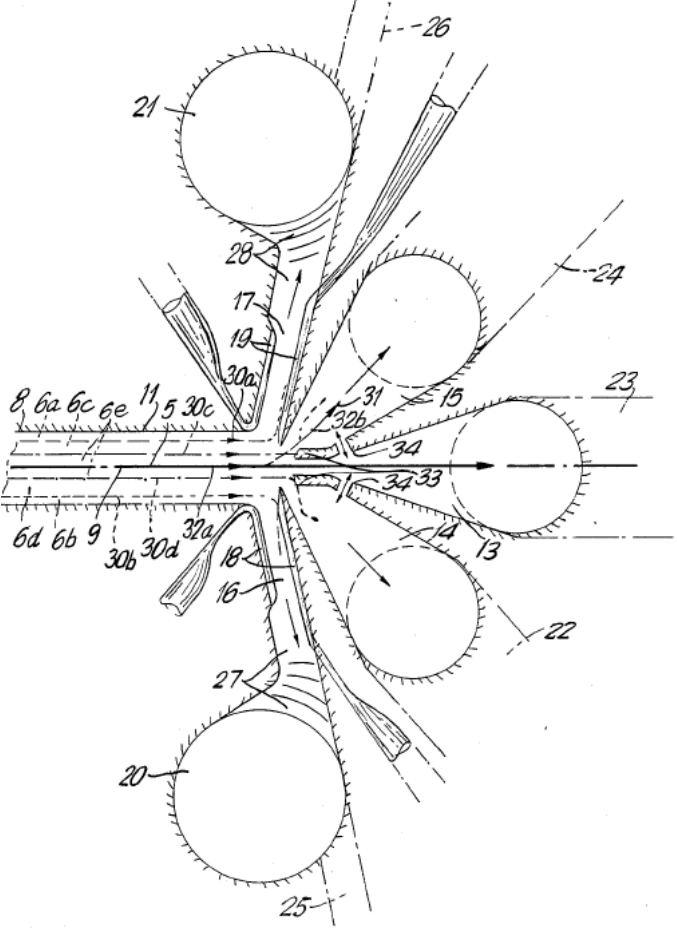
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>comprises a flow channel formed in an elastomer material, and an energy absorber adjacent to the flow channel and configured to absorb an energy of oscillation of a fluid positioned within the flow channel.” Chou, at 3:26-29.</p> <p>“In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper.” Chou, at 39:25-33.</p> <p>“The damper is separated from the fluid flow channel by a thin membrane. Preferably this thin membrane has sufficient elasticity to deflect "upward" when a fluid having a peak of sinusoidal wave-like passes underneath. In this manner, some of the fluid oscillation energy is absorbed by the damper, thereby reducing the height (i.e., peak) of fluid oscillation. Typically, the thickness of the membrane between the damper and the fluid flow channel depends on a variety of factors including the depth and width of the flow channel, the amount of fluid oscillation produced by the pump and the elasticity (i.e., the material) of the membrane. One of ordinary skill in the art can readily determine the proper membrane thickness to achieve a desired attenuation of fluid oscillation depending on a desired application and materials used.” Chou, at 40:10-19.</p> <p>“Pump 2908 and damper 2910 are positioned adjacent to sealed flow segment 2902a. Pump 2908 comprises recess 2908a separated from underlying flow channel 2902 by pump membrane 2908b. Damper 2910 comprises cavity 2910a separated from underlying flow channel 2902 by damper membrane 2910b. As shown in Figs. 29A-B, pump 2908 and damper 2910 cooperate to permit a continuous circulation of fluid within sealed segment 2902a. Specifically, pump 2908 is first actuated such that pump membrane 2908b deflects into flow channel 2902, increasing the pressure within sealed segment 2902a. In response to this increased pressure, damper membrane</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>2910b is displaced into cavity 2910a and fluid within segment 2902a circulates to occupy the additional space. Subsequently, pump 2908 is deactuated such that pump membrane 2908b relaxes to its original position, out of flow channel 2902. Because of the reduced pressure experienced by segment 2902a as a result of the deactuation of pump 2908, damper membrane 2910b also relaxes back into its original position, displacing material back into flow channel 2902. As a result of this action, the material within sealed segment 2902a experiences a back flow, and circulation is accomplished.” Chou, at 42:16-31; <i>see also</i> Figs. 29A and 29B.</p>  <p style="text-align: center;">FIG. 29A</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 29B</p> <p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 1</p> <p>The diagram shows a circular device with an outer boundary 3. Inside, there are two large circular regions, 21 (top) and 20 (bottom). A central horizontal axis passes through the center. On the left side of this axis, there are two rectangular components labeled 7a and 7b. On the right side, there are several curved and straight lines, some labeled with numbers: 12, 19, 17, 24, 15, 13, 14, 22, 16, 18, 27, 25, 26, and 28. A dashed line 26 extends from the top right towards the center. A dashed line 25 extends from the bottom right towards the center. A dashed line 28 extends from the top center towards the center. A dashed line 12 extends from the left center towards the center. A dashed line 19 extends from the left center towards the center. A dashed line 17 extends from the left center towards the center. A dashed line 24 extends from the left center towards the center. A dashed line 15 extends from the left center towards the center. A dashed line 13 extends from the left center towards the center. A dashed line 14 extends from the left center towards the center. A dashed line 22 extends from the left center towards the center. A dashed line 16 extends from the left center towards the center. A dashed line 18 extends from the left center towards the center. A dashed line 27 extends from the left center towards the center. A dashed line 25 extends from the left center towards the center. A dashed line 26 extends from the left center towards the center. A dashed line 28 extends from the left center towards the center.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“Furthermore, the suction stabilization is achieved through the use of the buffer cavities, which are large holes 20 and 21, drilled into the body 1 of the device quasi perpendicularly into its top surface 4, as shown in FIGS. 1 and 2, and most of their volume is free of an electrolyte, from where their stabilization characteristic follows. Their outlet holes are connected through flexible tubes (not shown) to a waste bottle of very large volume in such a manner that both the electrolyte and the generated gas can flow parallel to each other without blocking each other's flow into the bottle. On the other hand, the outlet holes of the only-dispenser channels 13, 14 and 15 are connected through flexible tubes to the filtering/collector bottles of very large volume where the already processed suspension is filtered, after flowing through the two-position multiple-tube valve, which, in this case, is a triple-tube valve.” Zöld, at 20:41-57.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels,</p>

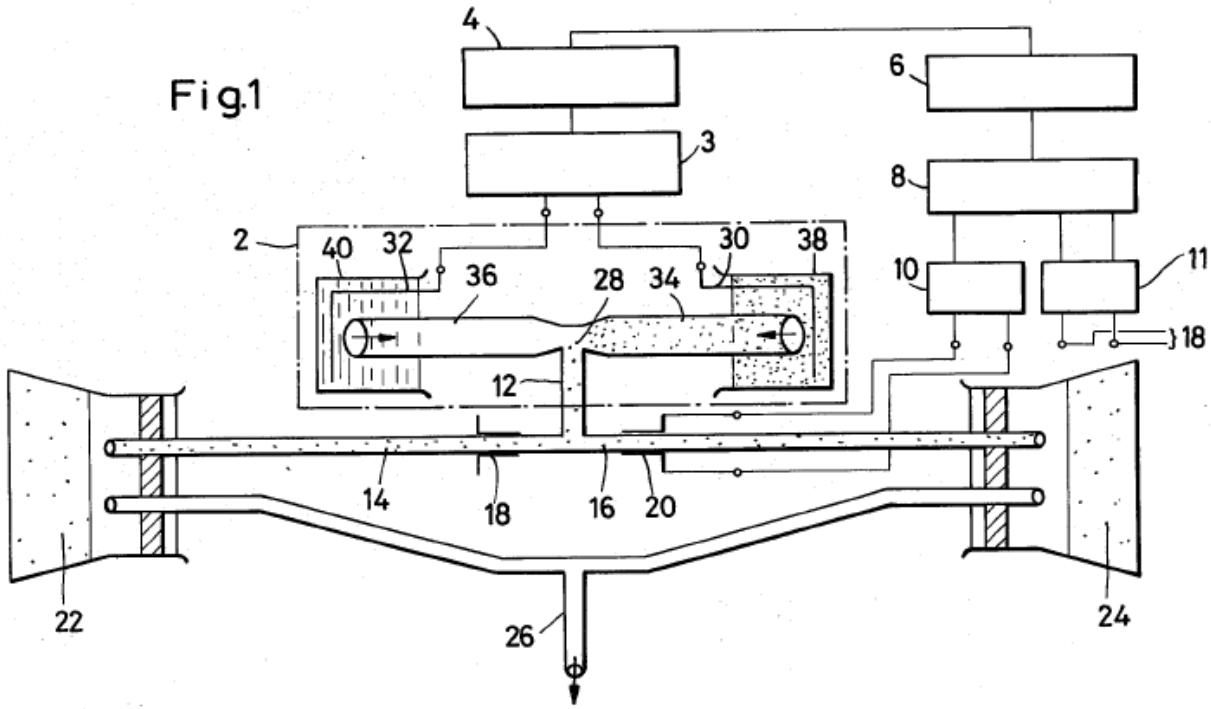
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p> <p>“It is important to note that buffer devices are often applied at other branches of the modern techniques, too. For instance, the storage elements, at the interface between the central processing unit of a computer and the attached peripheral unit, such as a keyboard, are a build-screen, functions in the same manner by permitting fast operation of the extremely fast central processing unit in spite of the quoted slowly functioning peripheral units. From the above description, it is also clear that for fast and reliable sorting, as is defined above, the use of the buffer cavities are of paramount importance both for the stabilization of the vacuum and for the decoupling of the very fast fluctuating suspension to be dispensed in the dispenser channels from the very slowly flowing, and the large amount of the processed substance of the connecting tubes. The fact that in these cavities the gas is also separated from the suspension, as the result of the known buoyancy, provides yet a third use of these cavities; this third type of cavities are used, however, only in such devices where the control and dispensing process takes place in the same channel or duct.” Zöld, at 21:60-22:13.</p> <p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic</p>

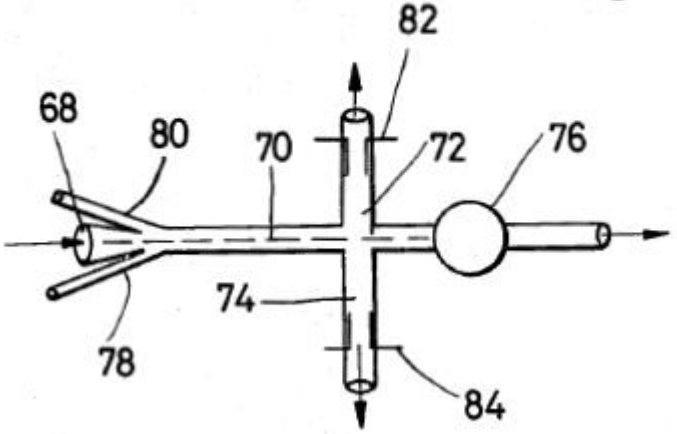
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly</p>

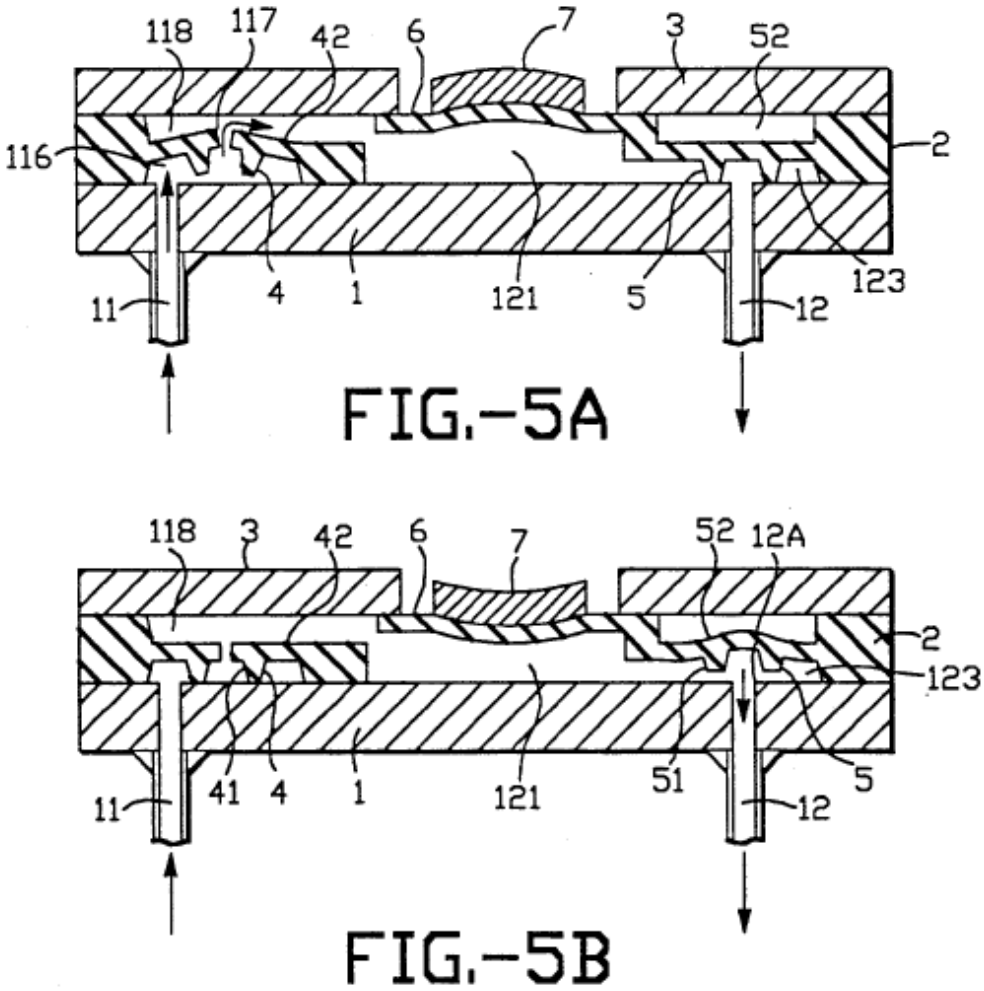
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p> <p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p> <p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig1</p> 

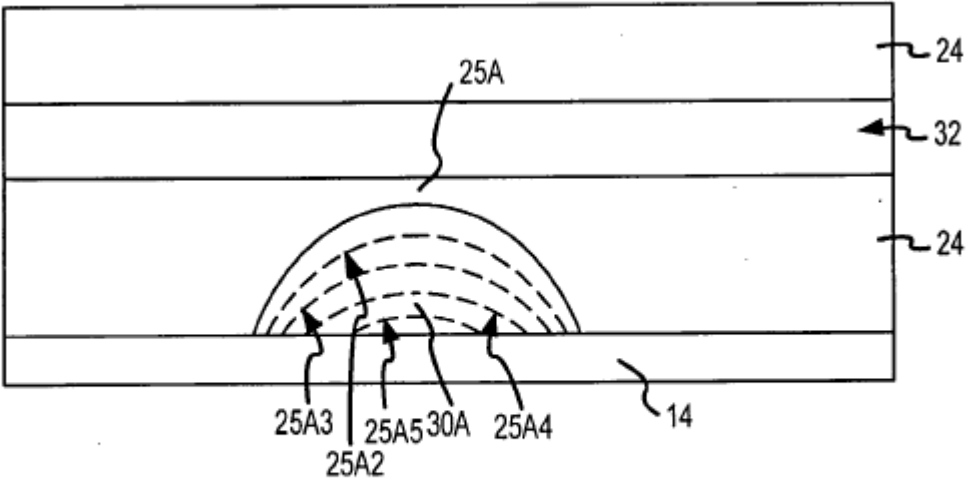
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>that the amount of the electrolyte and hence the spacing between two particles in the main channel is reduced to a desired value at those intervals during which no particle passes across the entrance of the side channels. With the reduction of the interparticle spacing the operation of another analyser such as an impulse cyto-photometer 76 can be improved since the through-put of the particles through the analyzer will be somewhat increased. It should be understood that the programming of the system should be such that the suction effect exerted from the side channels should be zero when a particle passes these channels.” Zöld 662, at 9:1-22; <i>see also</i> Fig. 7 below.</p> <p style="text-align: right;">Fig.7</p>  <p>Anderson</p> <p>“Pumping devices that are particularly useful include a variety of micromachined pumps that have been reported in the art. For example, suitable pumps include pumps which having a bulging diaphragm, powered by a piezoelectric stack and two check valves, such as those described in U.S. Patent Nos. 5,277,556, 5,271,724 and 5,171,132, or powered by a</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Alternating voltage of 50 V is periodically applied to piezoelectric element 7 providing oscillation in a range of one to several Hz. When diaphragm 6 deflects upward as shown in FIG. 5(a) due to piezoelectric effect, pressure in pump chamber 121 is reduced so that partition wall 52 of chamber 123 deflects downward to close outlet valve 5. As valve 5 closes, partition wall 42 of partition chamber 118 deflects upward so as to open 20 inlet valve 4 resulting in fluid suction of predetermined volume from chamber 116 through hole 117. When diaphragm 6 is bent downward by piezoelectric element 7, as shown in FIG. 5(b), pressure in pump chamber 121 increases and is simultaneously transferred to chambers 118, 123 through routes 120, 122. The higher inner pressure of chamber 118 pushes partition wall 42 downward forcing valve body 41 against substrate 1, thereby closing inlet valve 4. The rising pressure in chamber 123 simultaneously pushes up partition wall 52 separating valve body 51 from substrate 1 thereby opening outlet valve 5 and discharging a predetermined volume of fluid through outlet port 12. The oscillation of diaphragm 6 by piezoelectric element 7 functions to continuously draw and discharge fluid.” Miyazaki, at 7:13-35; <i>see also</i> Figs. 5A and 5B below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. -5A and FIG. -5B are cross-sectional diagrams of a device. FIG. -5A shows a device with a central channel (1) and two reservoirs (11, 12). The channel is defined by walls (121, 123) and has a central opening (121). The reservoirs are connected to the channel via openings (116, 123). FIG. -5B shows a similar device but with a different internal structure, including a central opening (121) and a central opening (121). Both diagrams show various components labeled with numbers: 1, 2, 3, 4, 5, 6, 7, 11, 12, 116, 117, 118, 121, 123, 12A, 41, 42, 51, 52.</p>
[10] The system of claim 1, wherein the second reservoir	The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been

Asserted Claim Element	Exemplary Prior Art Disclosures
includes a gas pocket, wherein compression of the gas facilitates the generating of the pressure pulse.	<p>obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

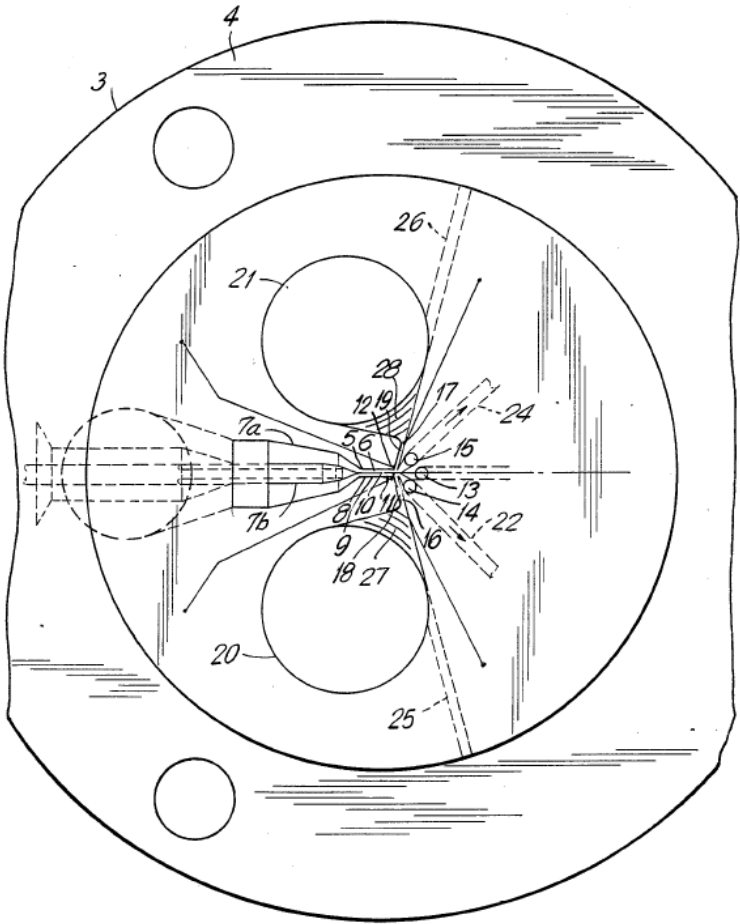
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p style="text-align: center;">FIG. 7H</p> <p> “In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in </p>

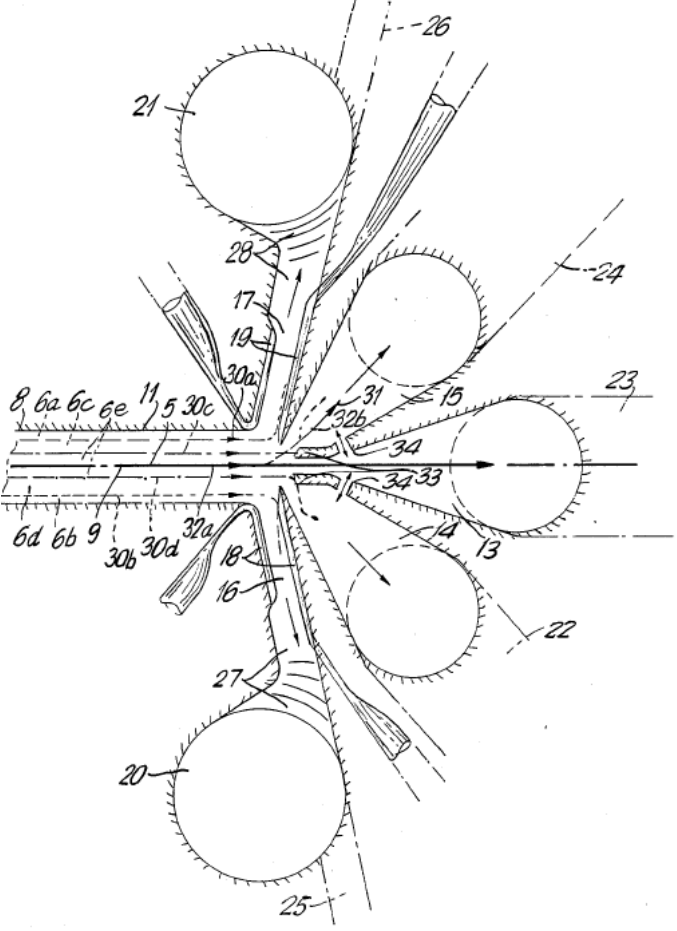
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

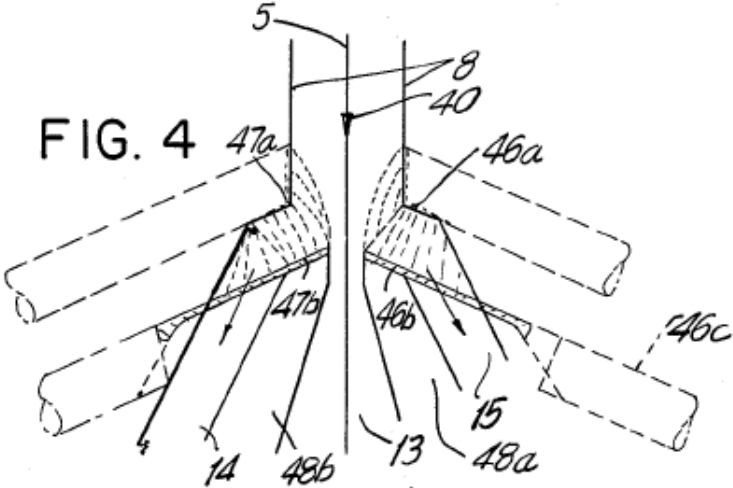
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>FIG. 4</p>  <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

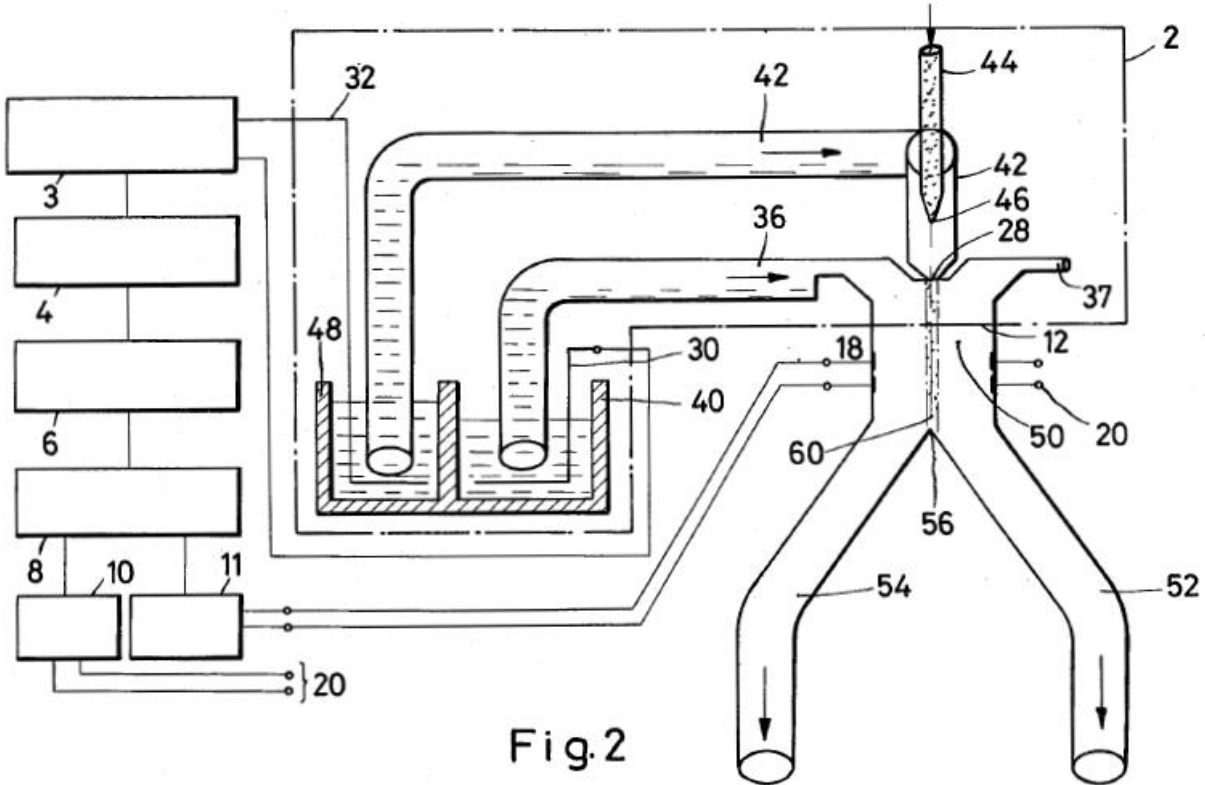
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

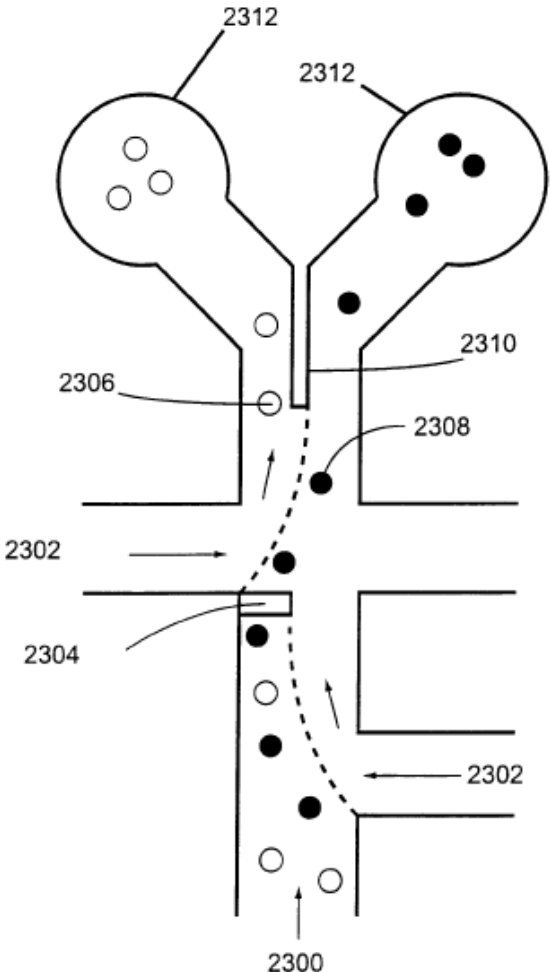
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig.1</p> <p>The diagram illustrates a medical device system, labeled Fig. 1. It features a central unit (2) with internal components including a pump (12), a catheter (14), a filter (16), and a control system (18). The central unit is connected to a control system (4, 6, 8, 10, 11, 18) and a power source (26). The central unit is also connected to a patient (22, 24) via a catheter (14, 16, 18, 20, 26). The central unit is connected to a control system (4, 6, 8, 10, 11, 18) and a power source (26). The central unit is also connected to a patient (22, 24) via a catheter (14, 16, 18, 20, 26).</p>

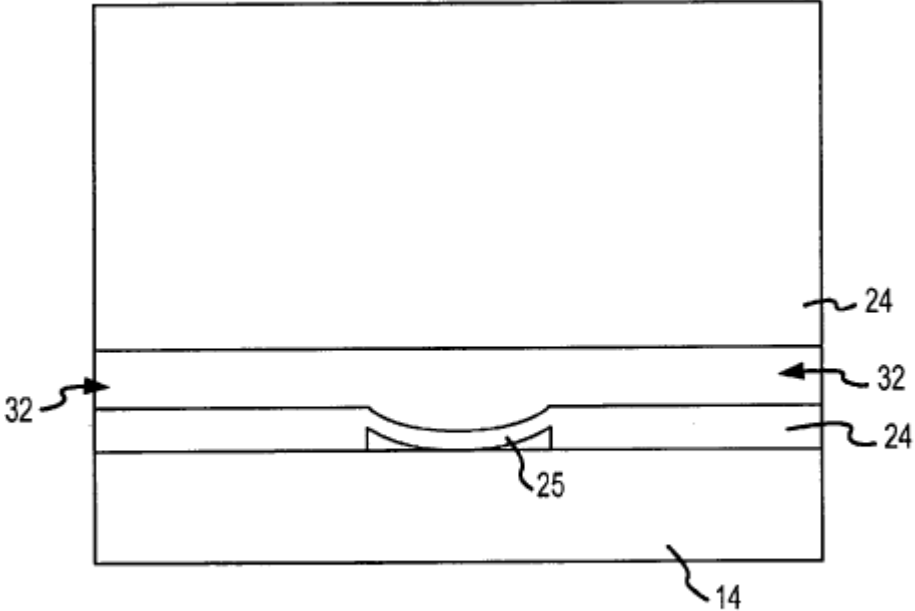
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[11] The system of claim 10 further comprising a fluid filled region interfacing with the flow channel and the gas pocket.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Wada</p> <p>The Zöld disclosures in each limitation of claim 10 are incorporated by reference.</p> <p>“Optionally, the instruction set directs individual or simultaneous fluid flow from the third and sixth microchannels by individually or simultaneously activating at least one heating element (e.g., a Joule heating electrode, a conductively coated microchannel portion, or the like) disposed within each of the third and sixth microchannels or within at least one well that fluidly communicates with each of the third and sixth microchannels.” Wada, at 8:18-23.</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300 pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 10 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

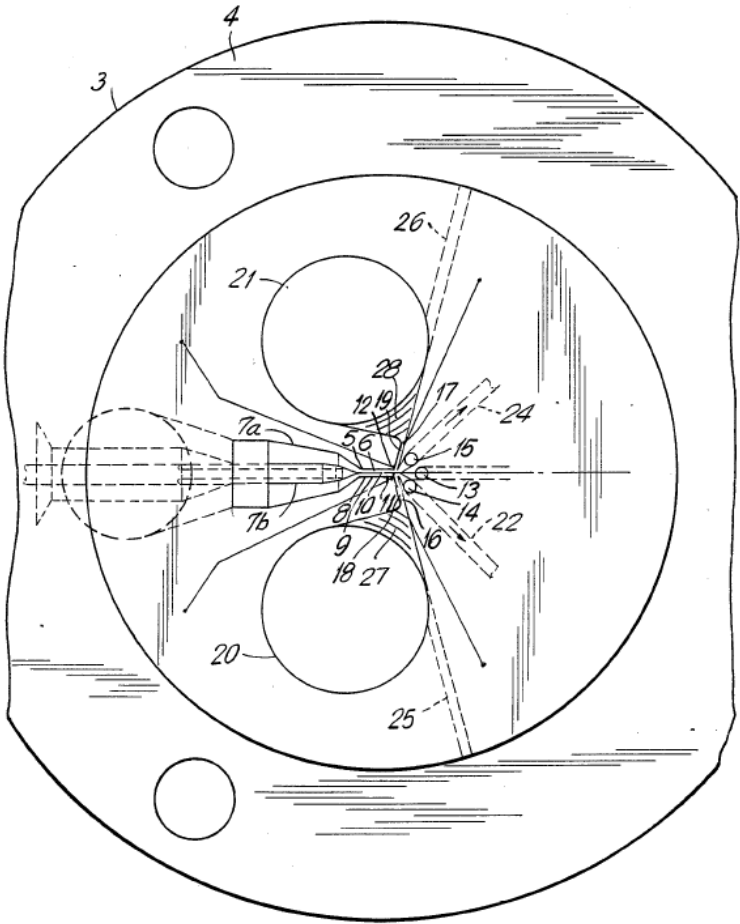
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 7H</p> <p>“In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that</p>

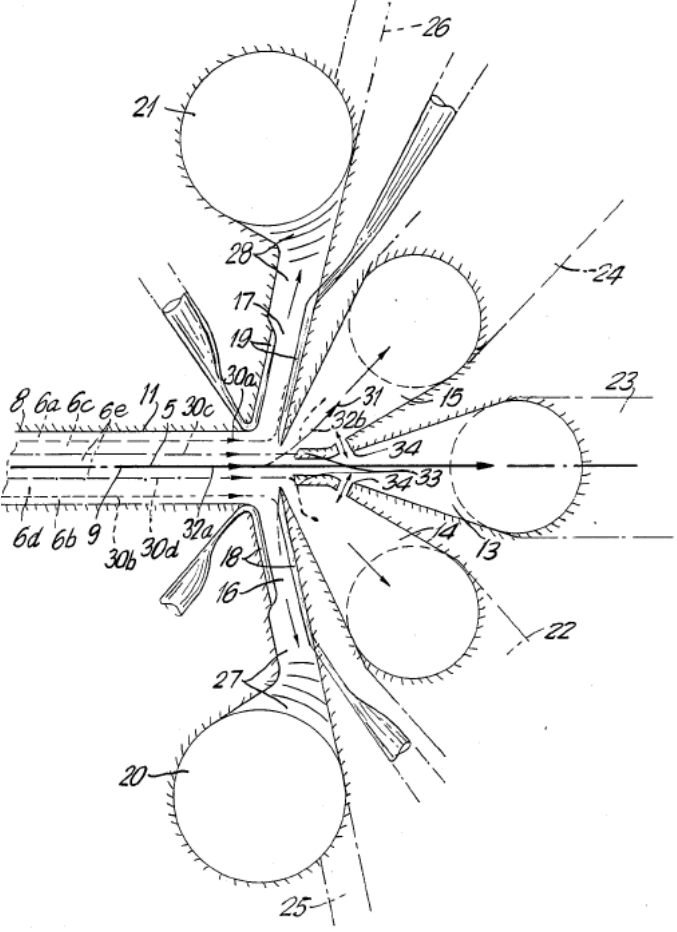
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the membrane can more readily conform to the shape and volume of the flow channel in response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p> <div> </div> <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom) can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow</p>

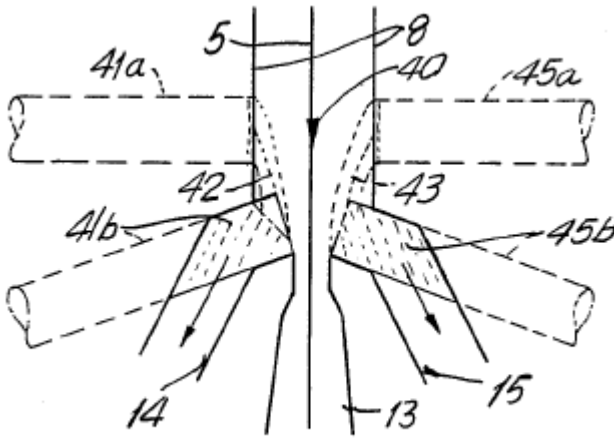
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channel 30.” Chou, at 31:13-20.</p> <p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 10 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 1</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

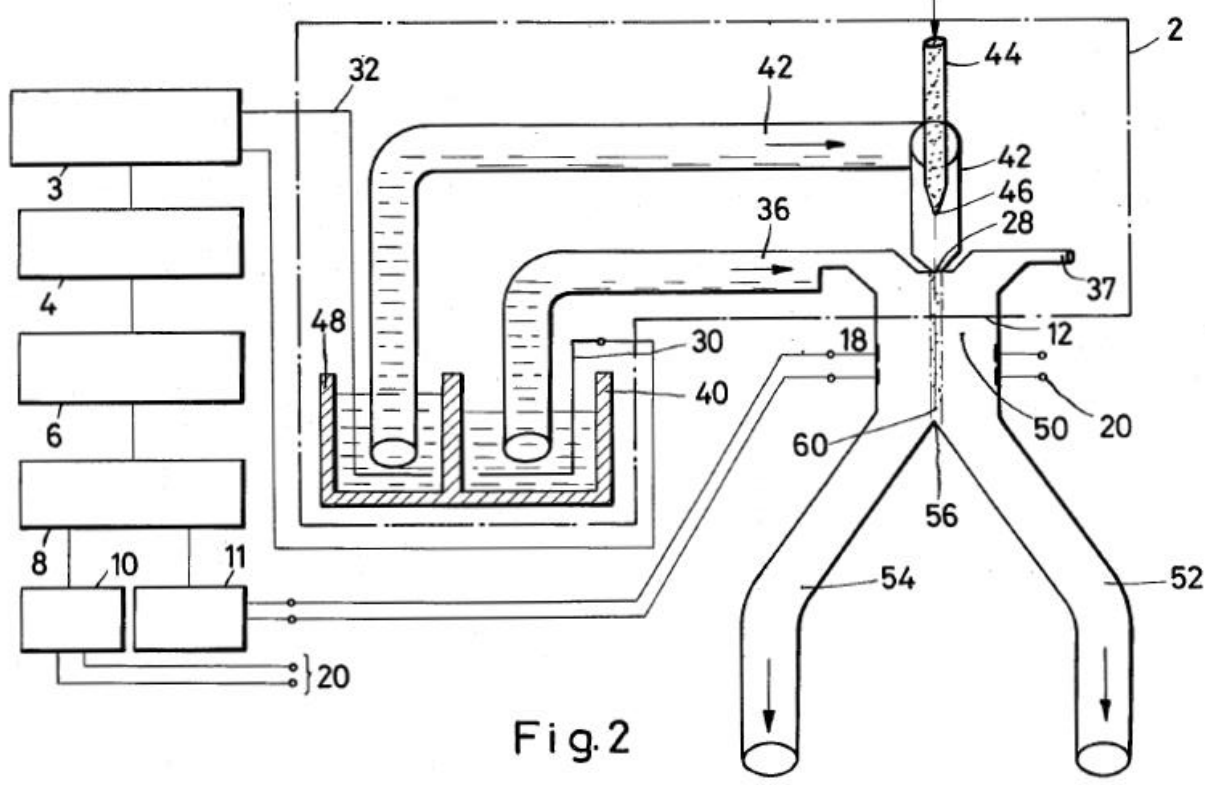
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 10 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

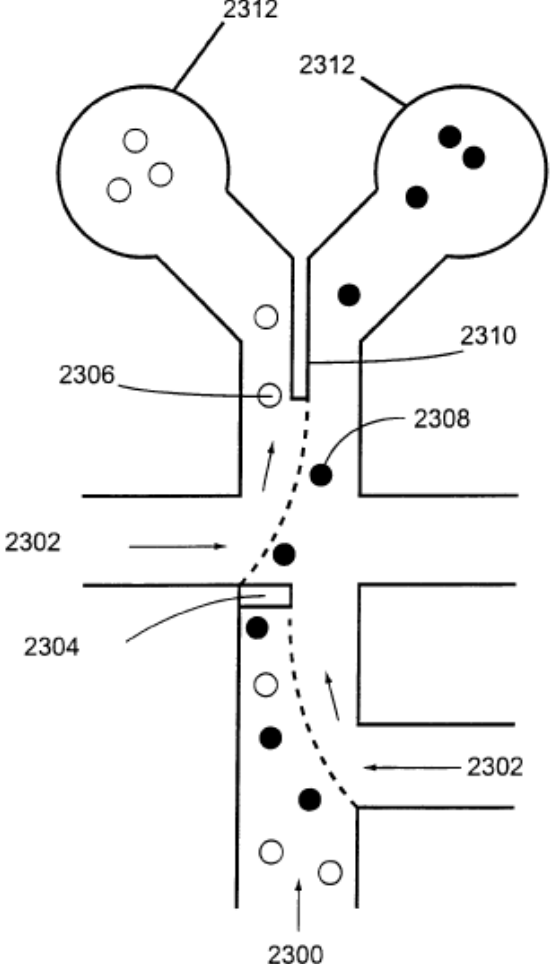
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[12] The system of claim 11, wherein the fluid filled region includes a portion of the second reservoir.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Wada</p> <p>The Wada disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“Optionally, the instruction set directs individual or simultaneous fluid flow from the third and sixth microchannels by individually or simultaneously activating at least one heating element (e.g., a Joule heating electrode, a conductively coated microchannel portion, or the like) disposed within each of the third and sixth microchannels or within at least one well that fluidly communicates with each of the third and sixth microchannels.” Wada, at 8:18-23.</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300 pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

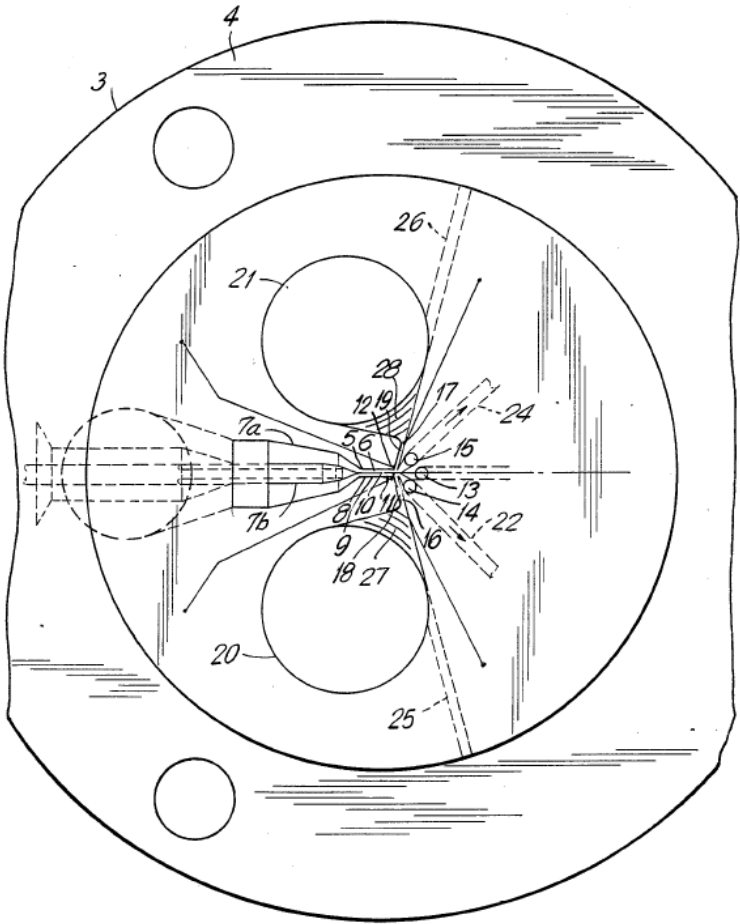
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p>FIG. 7H</p> <p> “In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that </p>

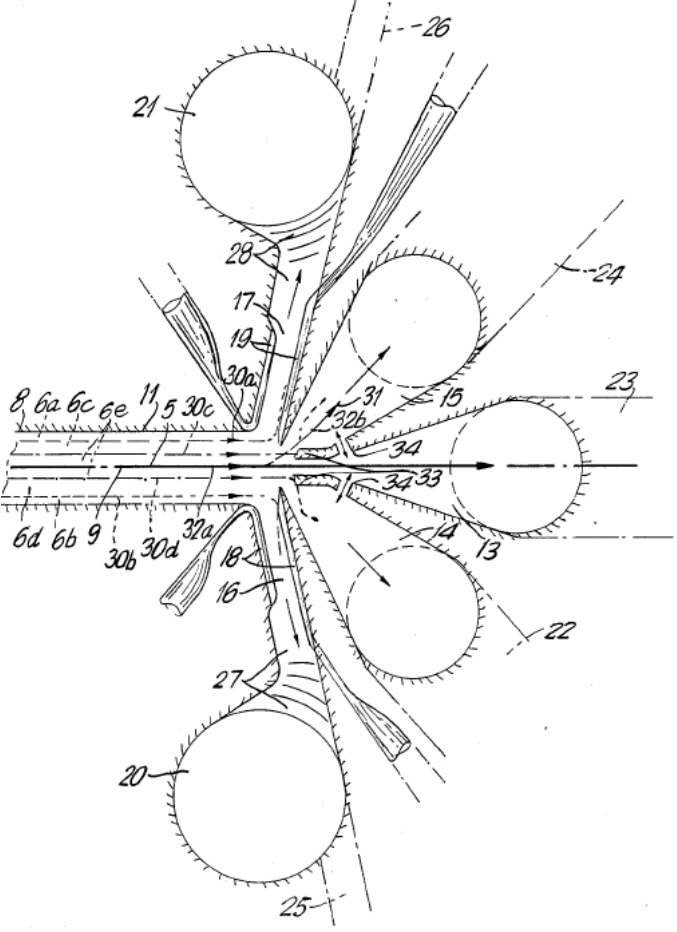
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the membrane can more readily conform to the shape and volume of the flow channel in response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p> <div> </div> <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom) can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow</p>

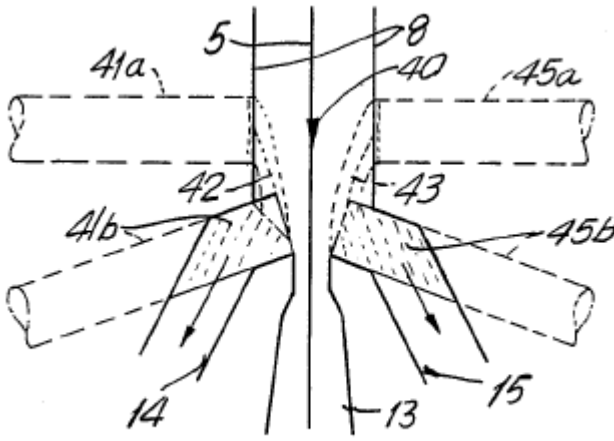
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channel 30.” Chou, at 31:13-20.</p> <p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a</p>

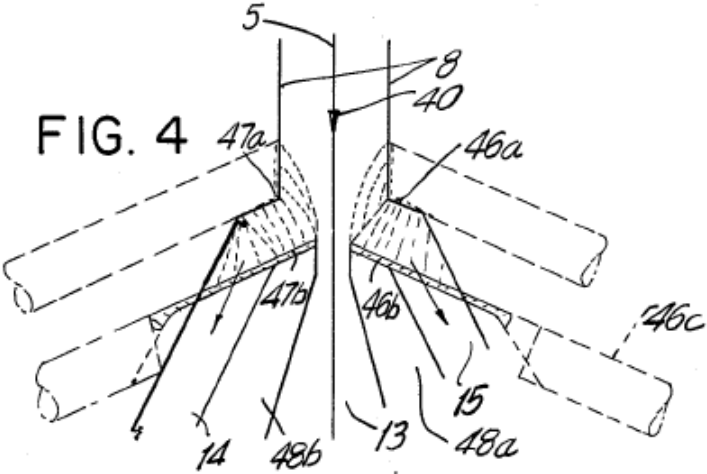
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p> <p>The diagram shows a circular device with an outer boundary (3) and an inner boundary (4). Inside, there are two large circular regions (21 and 20) and a central area with various components labeled with numbers: 28, 12, 19, 17, 24, 15, 13, 14, 22, 16, 18, 27, 9, 8, 10, 11, 5, 6, 7a, 7b, 25, and 26. Dashed lines indicate internal structures and connections.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 4</p> <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

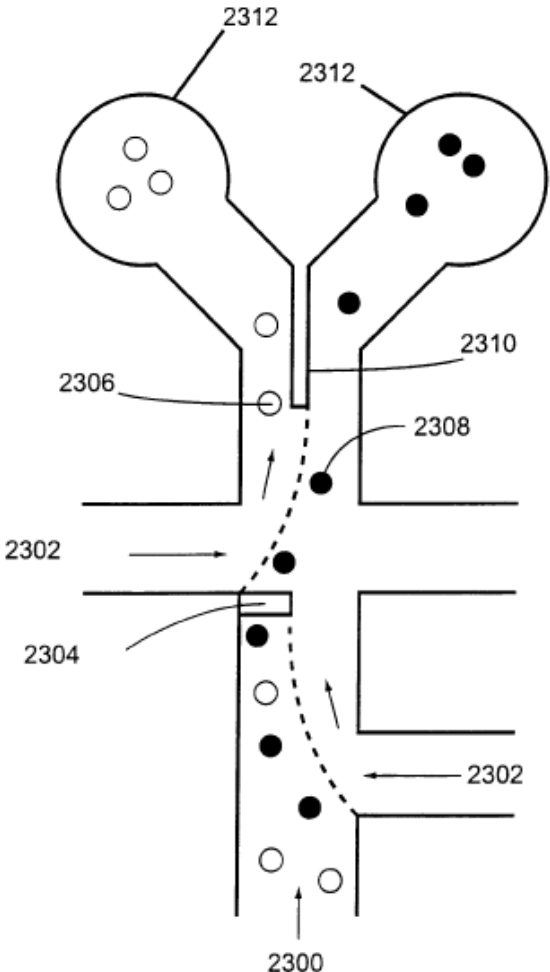
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

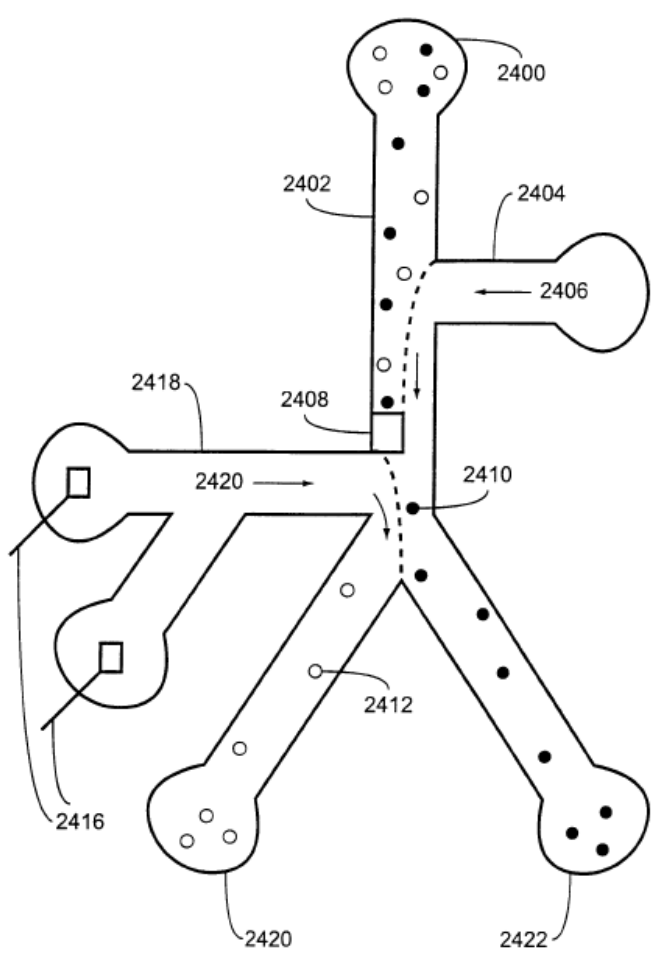
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig.1</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p style="text-align: center;">Fig. 2</p>
<p>[13] The system of claim 11, wherein the fluid filled region includes a side channel connecting the second reservoir to the flow channel.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Wada</p> <p>The Wada disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“Optionally, the instruction set directs individual or simultaneous fluid flow from the third and sixth microchannels by individually or simultaneously activating at least one heating element (e.g., a Joule heating electrode, a conductively coated microchannel portion, or the like) disposed within each of the third and sixth microchannels or within at least one well that fluidly communicates with each of the third and sixth microchannels.” Wada, at 8:18-23.</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300 pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>  <p>The diagram illustrates a microfluidic device with a central vertical microchannel 2402. At the top, a reservoir 2400 feeds into the channel. A horizontal microchannel 2404 branches off to the right, with an arrow 2406 indicating flow into it. A detector 2408 is positioned on the left wall of the main channel 2402. A selected particle 2410 is shown near the detector. Below the detector, the channel splits into two diagonal branches, 2412 and 2422, each leading to a reservoir. To the left of the detector, a horizontal channel 2420 leads to a reservoir 2418, which is connected to Joule heating electrodes 2416. Arrows indicate the flow of particles through the system.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \text{ } \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 IL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

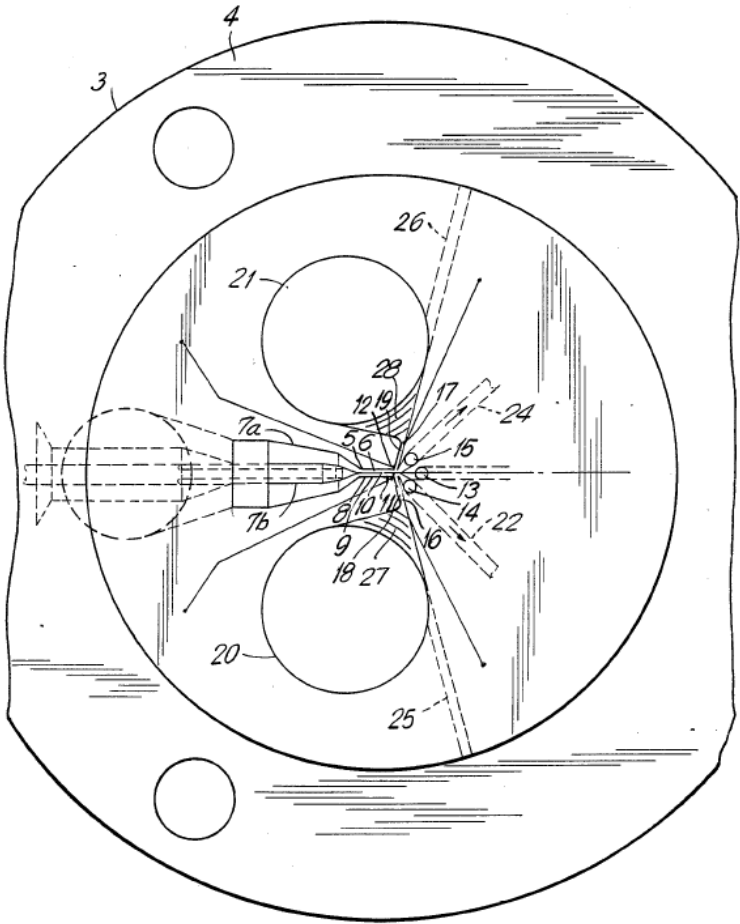
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p style="text-align: center;">FIG. 7H</p> <p> “In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that </p>

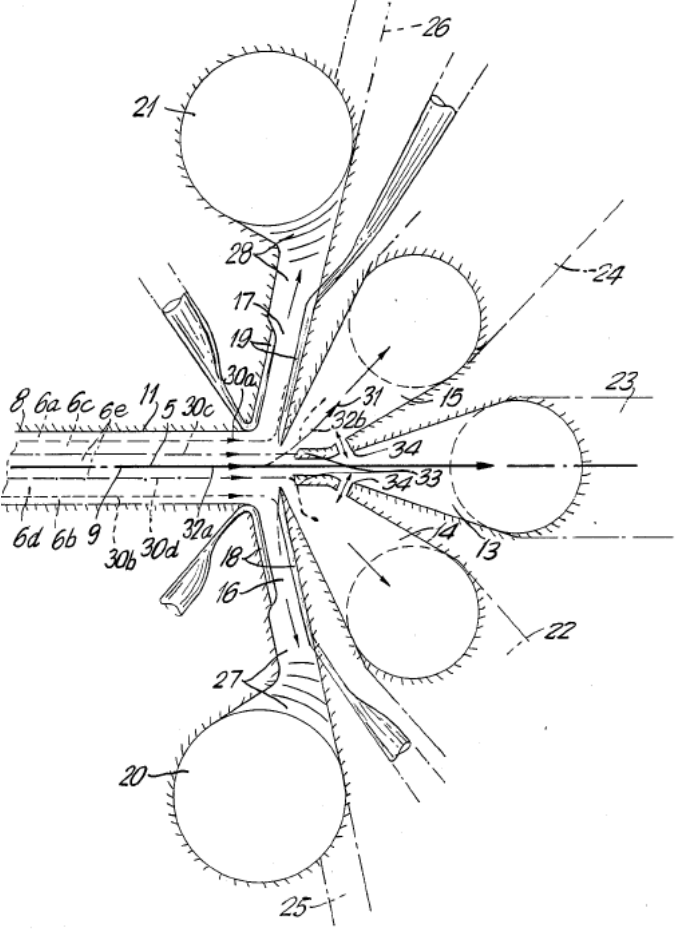
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the membrane can more readily conform to the shape and volume of the flow channel in response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p> <div> </div> <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom) can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow</p>

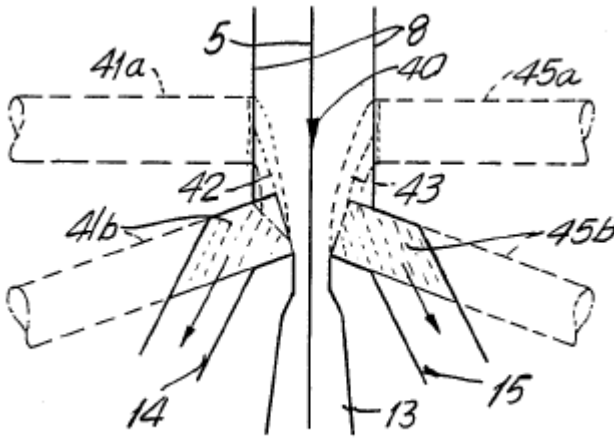
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>channel 30.” Chou, at 31:13-20.</p> <p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a</p>

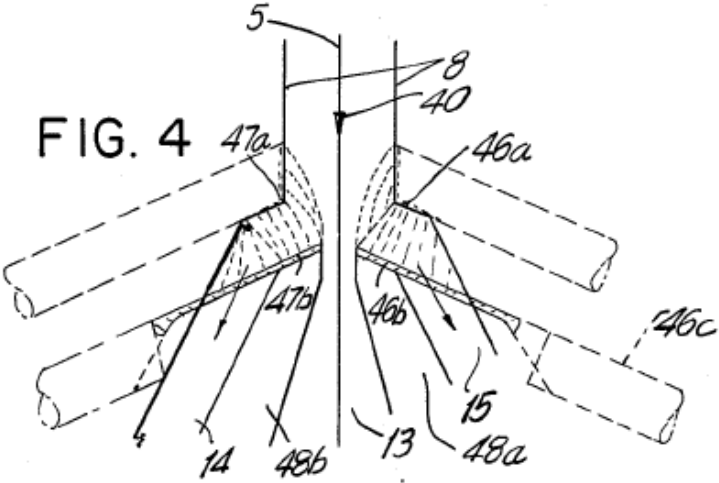
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>value and for such a long time that no further electrolyte flow into this only-control channel is possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p> <p>The diagram shows a circular device with an outer boundary labeled 3. Inside, there are two large circular regions labeled 21 and 20. A central assembly includes a component labeled 28, with various sub-components and features labeled with numbers: 4, 12, 19, 17, 24, 15, 13, 14, 22, 16, 18, 27, 9, 8, 10, 11, 5, 6, 7a, 7b, 25, and 26. Dashed lines indicate internal structures or paths. The device is shown with some external features like mounting holes and a central protrusion.</p>

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	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

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	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

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	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

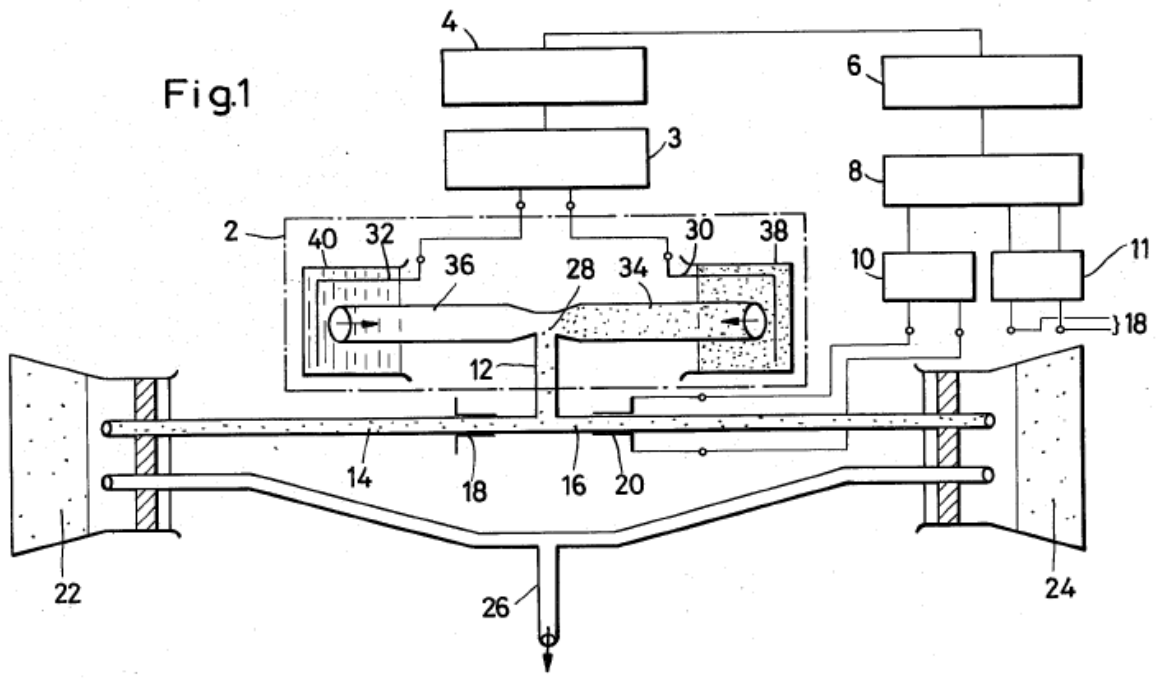
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 4</p> <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

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	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

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	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

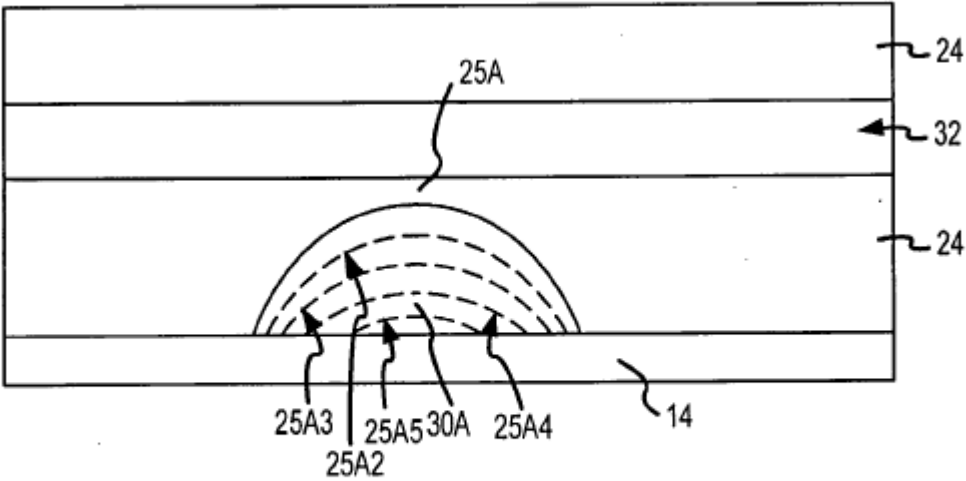
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

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	<p>Fig.1</p>  <p>The diagram illustrates a medical device, likely a dialyzer or a similar fluid-handling component. It features a central chamber (2) with internal components including a pump or motor assembly (3, 4) and a control unit (6, 8, 10, 11). The device is connected to a fluid circuit (14, 16, 18, 20, 22, 24, 26) that includes a dialyzer (12) and a filter (30, 32, 34, 36, 38). The device is shown in a cross-sectional view, revealing internal components and connections. The diagram is labeled with various numerical identifiers (1-40) corresponding to specific parts of the device.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p style="text-align: center;">Fig. 2</p>
<p>[14] The system of claim 11, wherein the fluid filled region prevents the gas from the gas pocket from leaking into the flow channel.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Chou</p> <p>The Chou disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

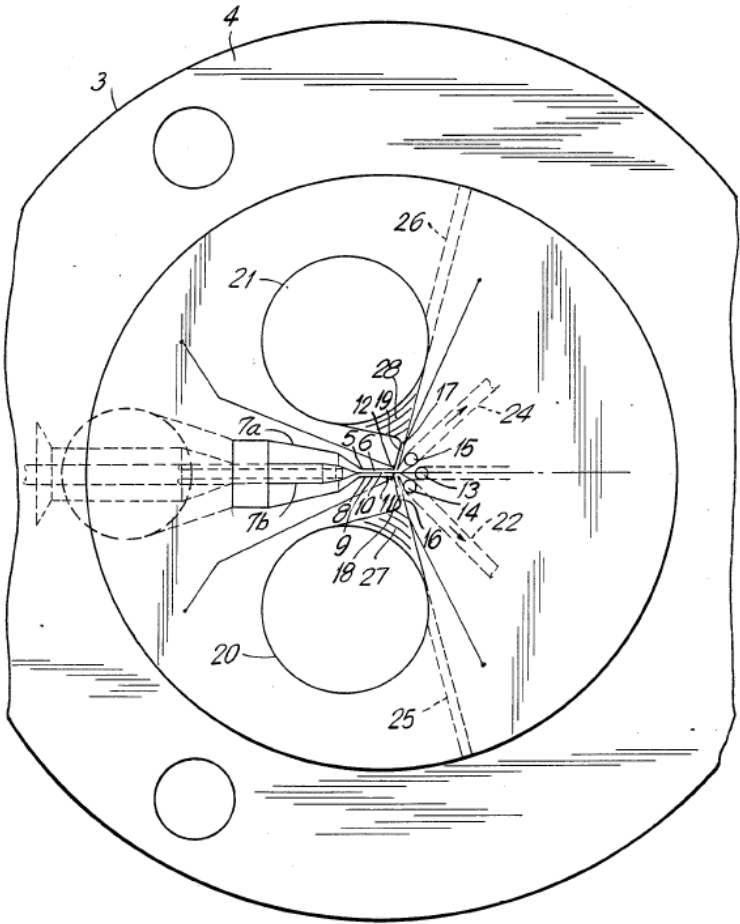
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p style="text-align: center;">FIG. 7H</p> <p> “In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in </p>

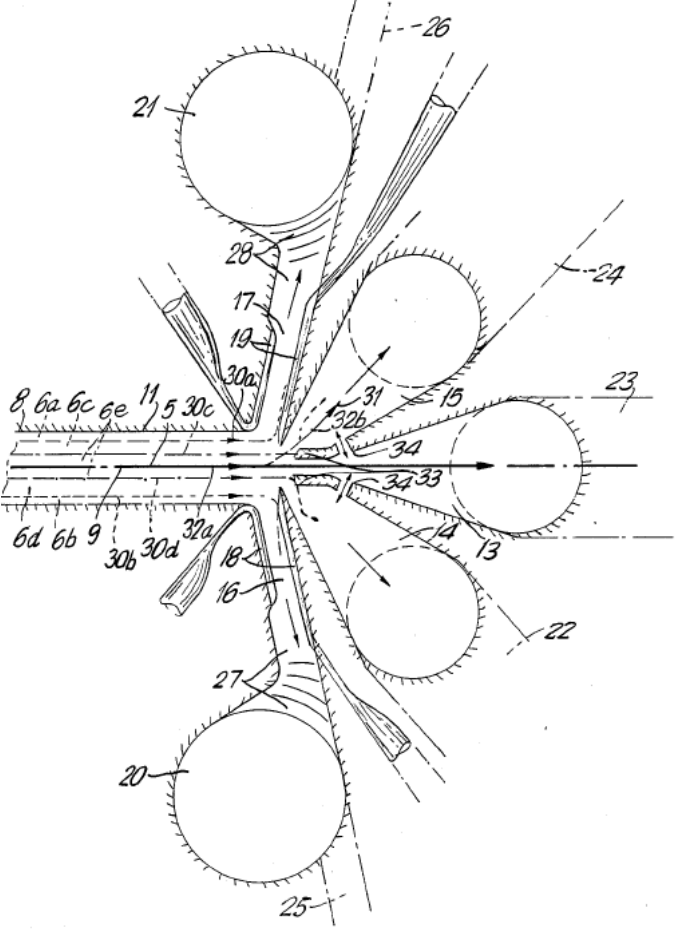
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

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	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

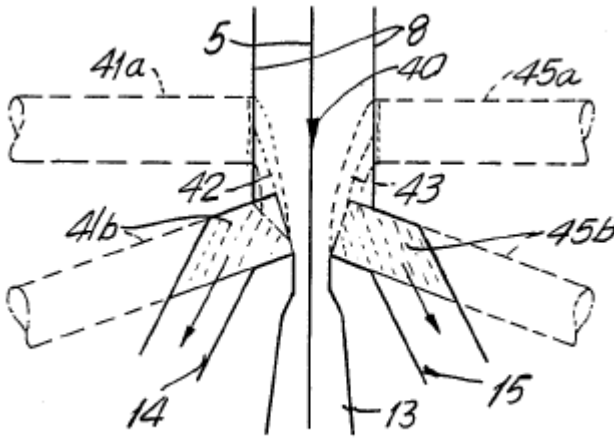
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	<p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is</p>

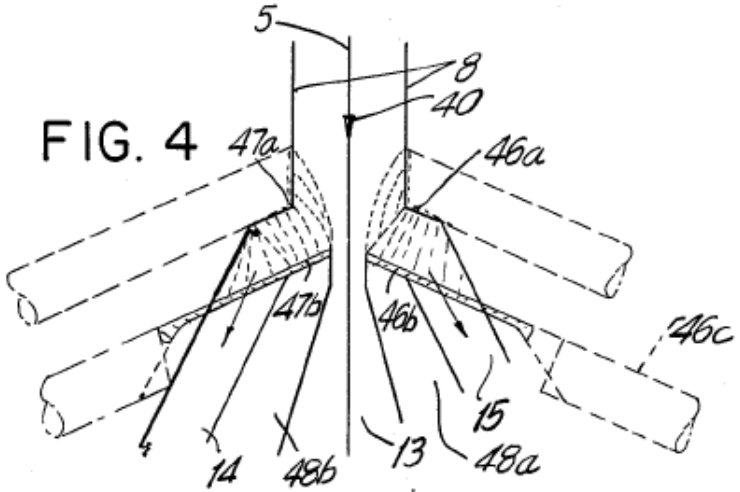
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p> <p>The diagram shows a circular device with an outer boundary labeled 3. Inside, there are two large circular regions labeled 21 and 20. A central assembly includes a component labeled 28, with various sub-components and lines labeled 12, 19, 17, 24, 15, 13, 14, 22, 16, 18, 27, 9, 8, 10, 11, 5, 6, 7a, 7b, 26, and 25. Dashed lines indicate internal structures or paths. The entire device is shown within a larger frame with horizontal lines at the top and bottom.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

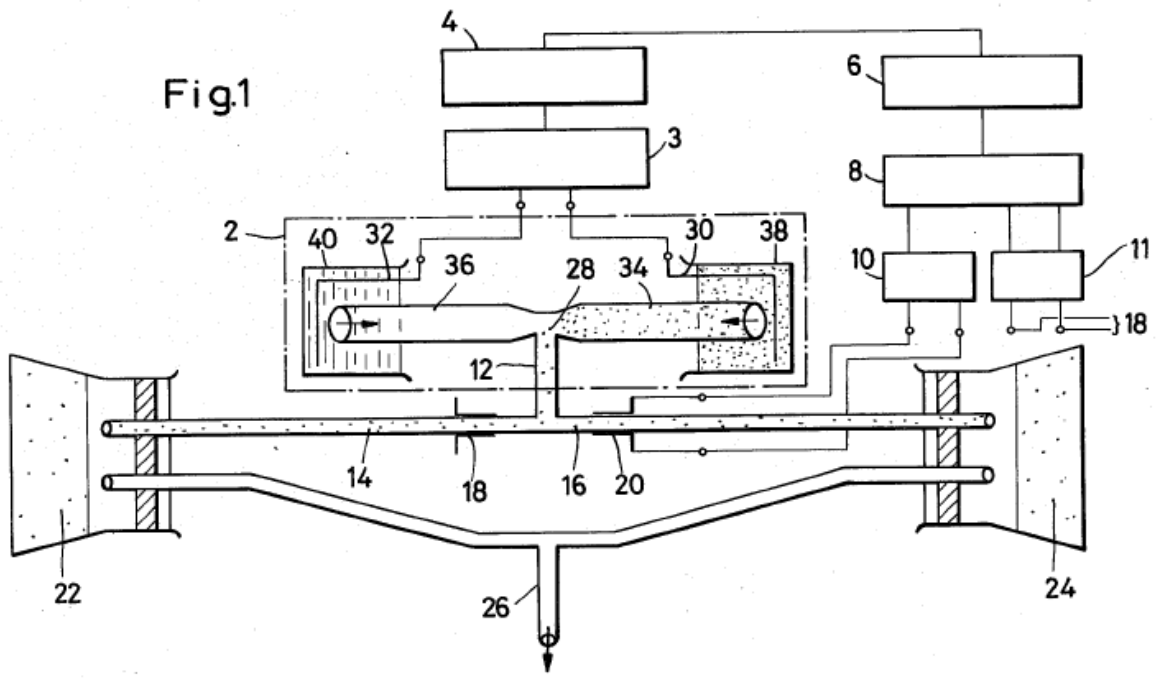
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>FIG. 4</p>  <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

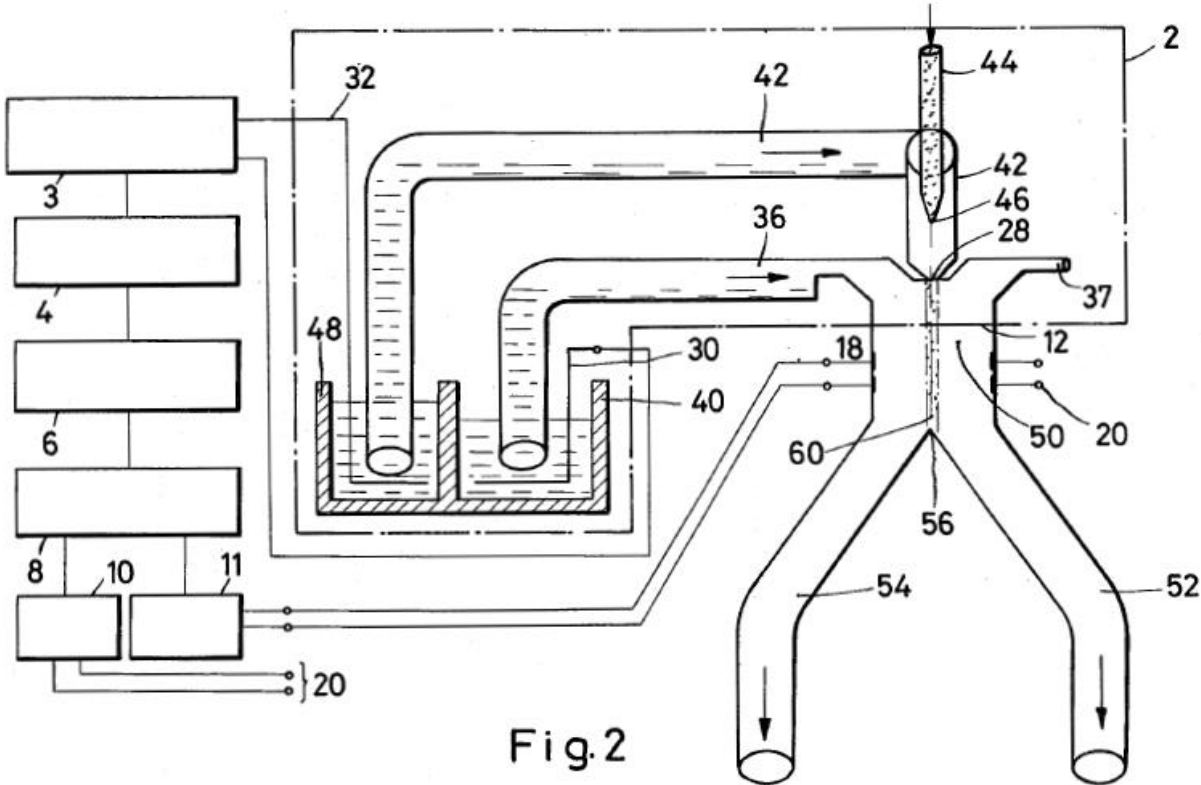
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

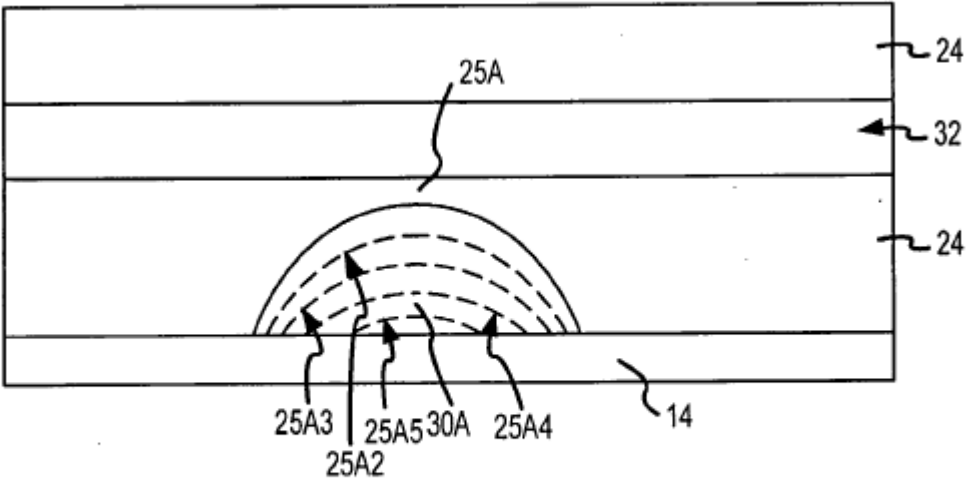
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig.1</p>  <p>The diagram illustrates a medical device, likely a dialyzer or a similar fluid-handling unit. It features a central chamber (2) with internal components including a pump or motor (12) and a filter or membrane (14). The chamber is connected to various external components via tubes and electrical lines. Key components labeled include: 4 (top left block), 3 (top center block), 6 (top right block), 8 (middle right block), 10 (bottom right block), 11 (bottom right block), 18 (bottom right block), 22 (left side panel), 24 (right side panel), 26 (bottom outlet), 28 (internal component), 30 (internal component), 32 (internal component), 34 (internal component), 36 (internal component), 38 (internal component), 40 (internal component), 16 (bottom center tube), 20 (bottom center tube), and 18 (bottom center tube). The device is shown in a cross-sectional view, revealing its internal structure and the flow paths for fluid or gas.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[15] The system of claim 11, wherein the fluid filled region forms a meniscus with the gas pocket.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Chou</p> <p>The Chou disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

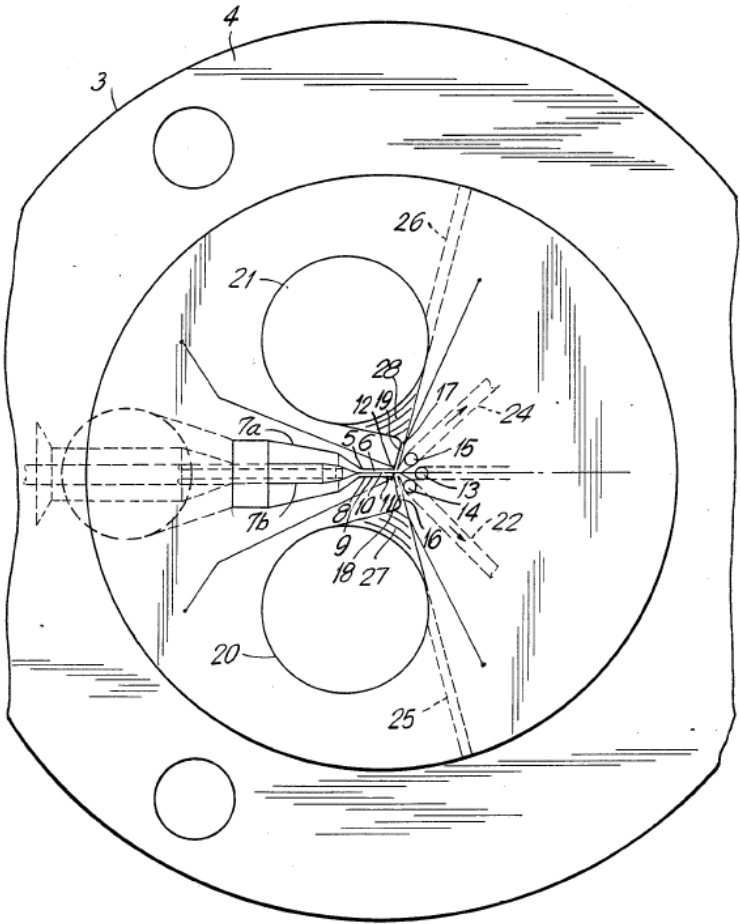
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p style="text-align: center;">FIG. 7H</p> <p> “In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in </p>

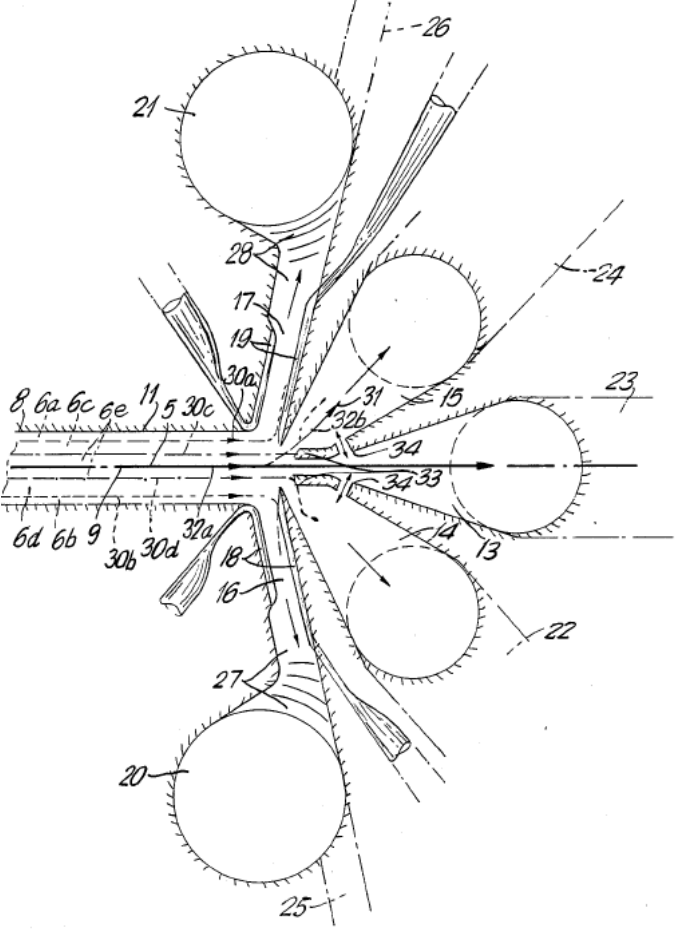
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

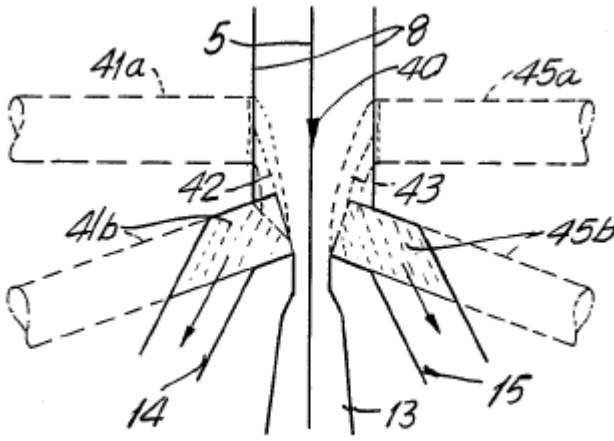
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is</p>

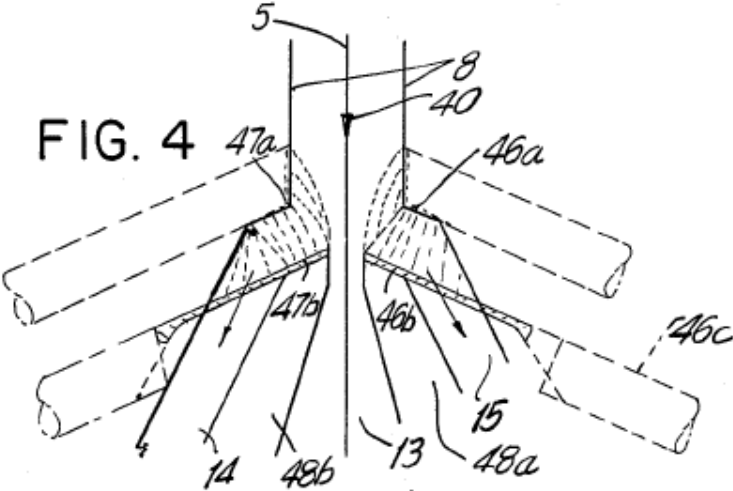
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p> <p>The diagram shows a circular device with an outer boundary labeled 3. Inside, there are two large circular regions labeled 21 and 20. A central assembly includes a component labeled 28, with various sub-components and lines labeled 12, 19, 17, 24, 15, 13, 14, 22, 16, 18, 27, 9, 8, 10, 11, 5, 6, 7a, 7b, 26, and 25. Dashed lines indicate internal structures or paths. The device is shown with some external features like a small circle at the top and bottom, and a rectangular feature on the left side.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

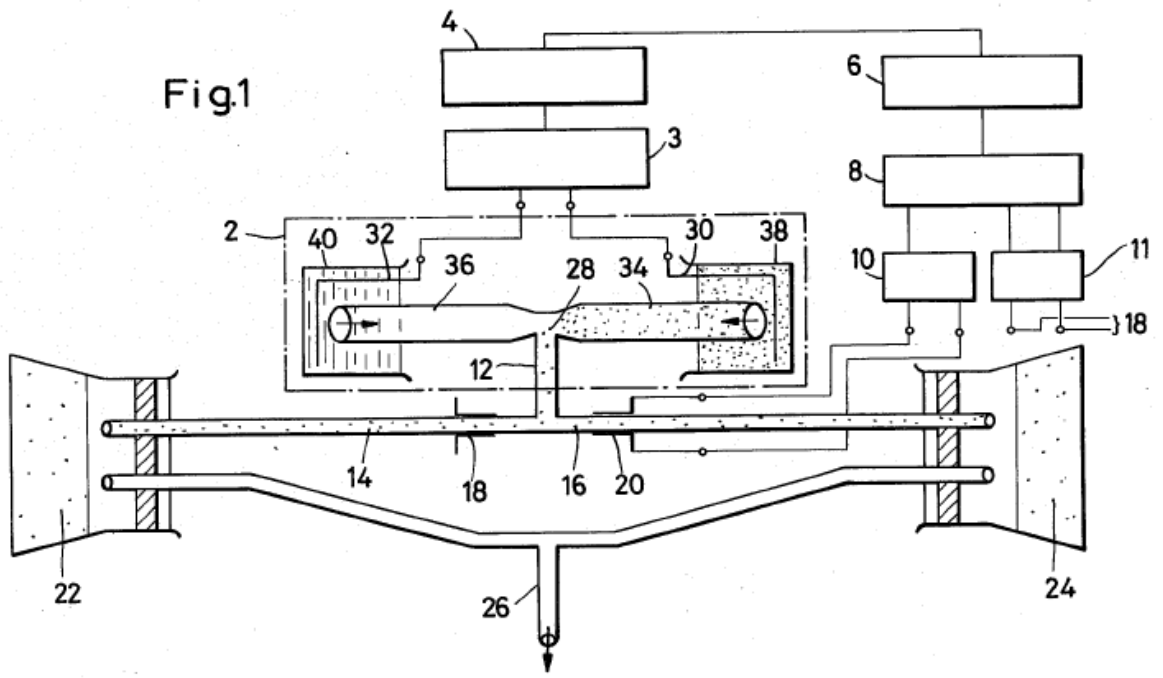
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>FIG. 4</p>  <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

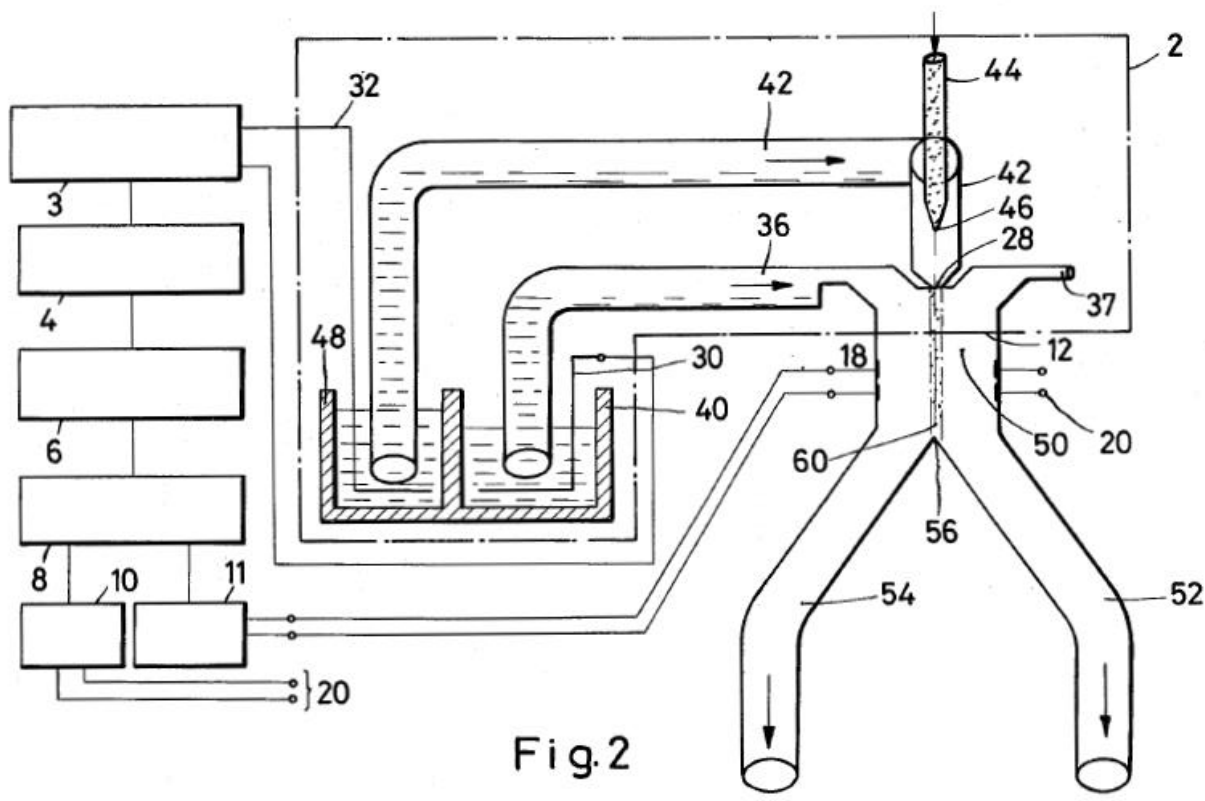
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 11 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

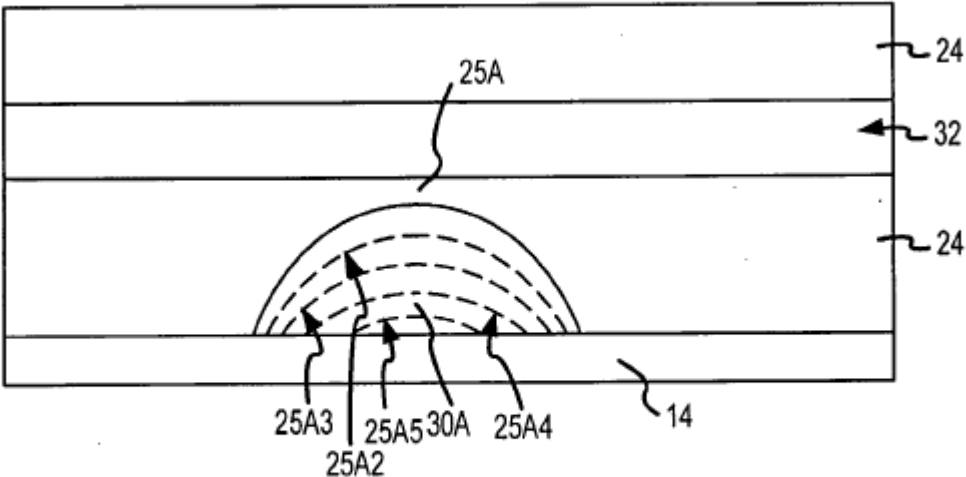
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig.1</p>  <p>The diagram illustrates a medical device, likely a dialyzer or a similar fluid-handling unit. It features a central chamber (2) with internal components including a pump or motor (12) and a filter or membrane (14). The chamber is connected to various external components via tubes and electrical lines. Key components labeled include: 4 (top left block), 3 (top center block), 6 (top right block), 8 (middle right block), 10 (bottom right block), 11 (bottom right block), 18 (bottom right block), 22 (left side panel), 24 (right side panel), 26 (bottom outlet), 28 (internal component), 30 (internal component), 32 (internal component), 34 (internal component), 36 (internal component), 38 (internal component), 40 (internal component), 16 (bottom center tube), 20 (bottom center tube), and 18 (bottom center tube). The device is shown in a cross-sectional view, revealing its internal structure and the flow paths for fluid or gas.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[16] The system of claim 15, wherein the change in volume or pressure in the second reservoir deflects the meniscus into the flow channel.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Chou</p> <p>The Chou disclosures in each limitation of claim 15 are incorporated by reference.</p> <p>“Referring to Fig. 7B, first flow channel 30 and second flow channel 32 are shown. Membrane 25 separates the flow channels, forming the top of first flow channel 30 and the bottom of second flow channel 32. As can be seen, flow channel 30 is "open". As can be seen in Fig. 7H, pressurization of flow channel 32 (either by gas or liquid introduced therein) causes membrane 25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL.” Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

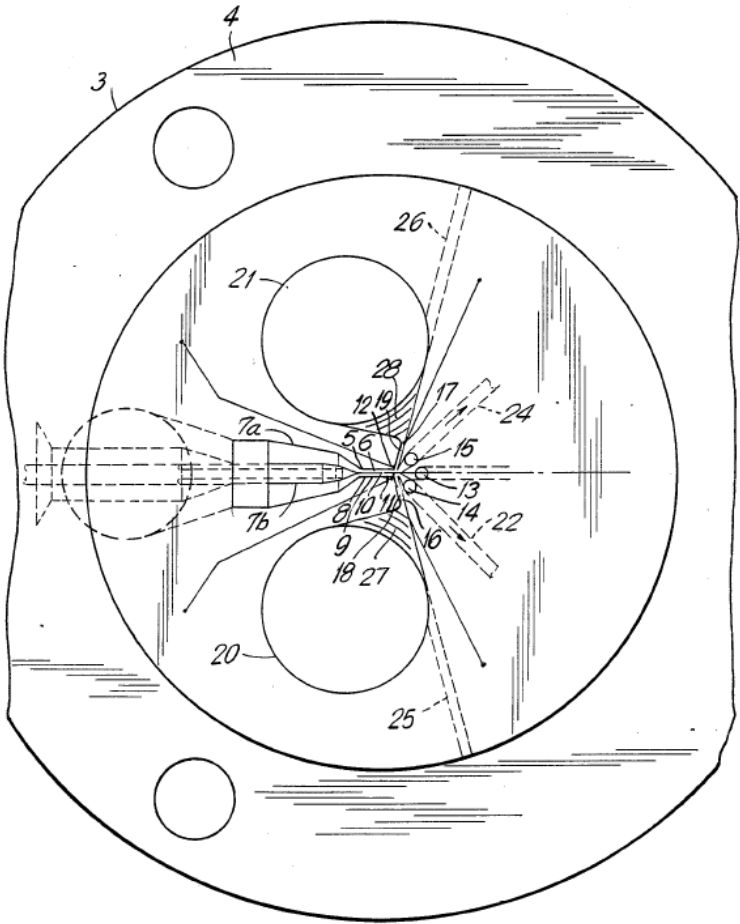
Asserted Claim Element	Exemplary Prior Art Disclosures
	<div> </div> <p style="text-align: center;">FIG. 7H</p> <p> “In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in </p>

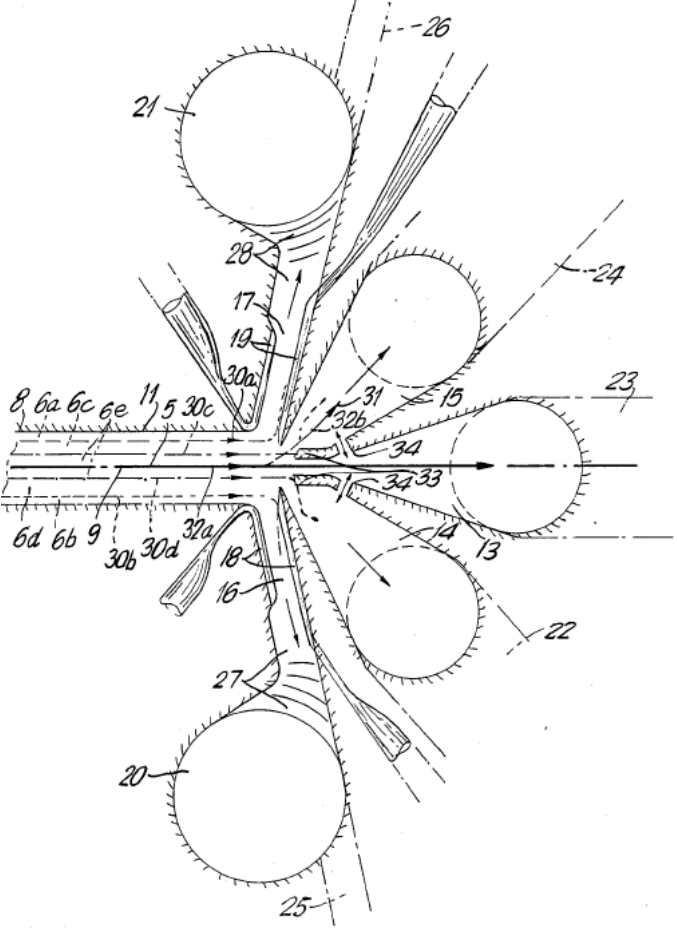
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

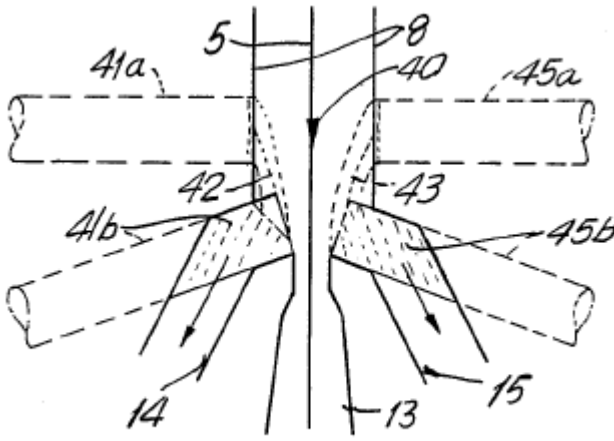
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 15 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is</p>

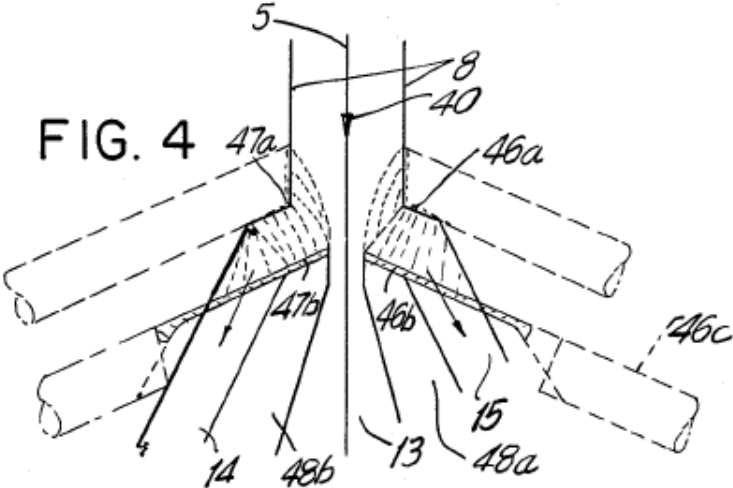
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p> <p>The diagram shows a circular device with an outer boundary labeled 3. Inside, there are two large circular regions labeled 21 and 20. A central assembly includes a component labeled 28, with various sub-components and lines labeled 12, 19, 17, 24, 15, 13, 14, 22, 16, 18, 27, 9, 8, 10, 11, 5, 6, 7a, and 7b. Dashed lines 26 and 25 indicate specific paths or boundaries. The entire device is shown within a larger frame with additional labels 4 and 2.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

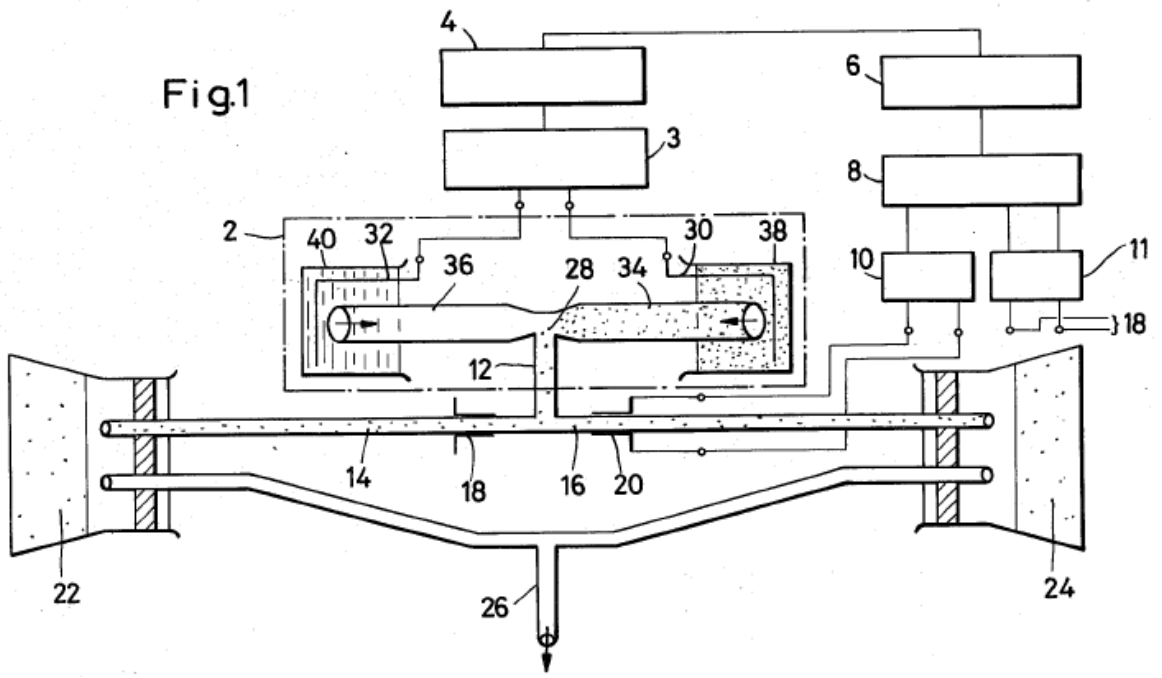
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>FIG. 4</p>  <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

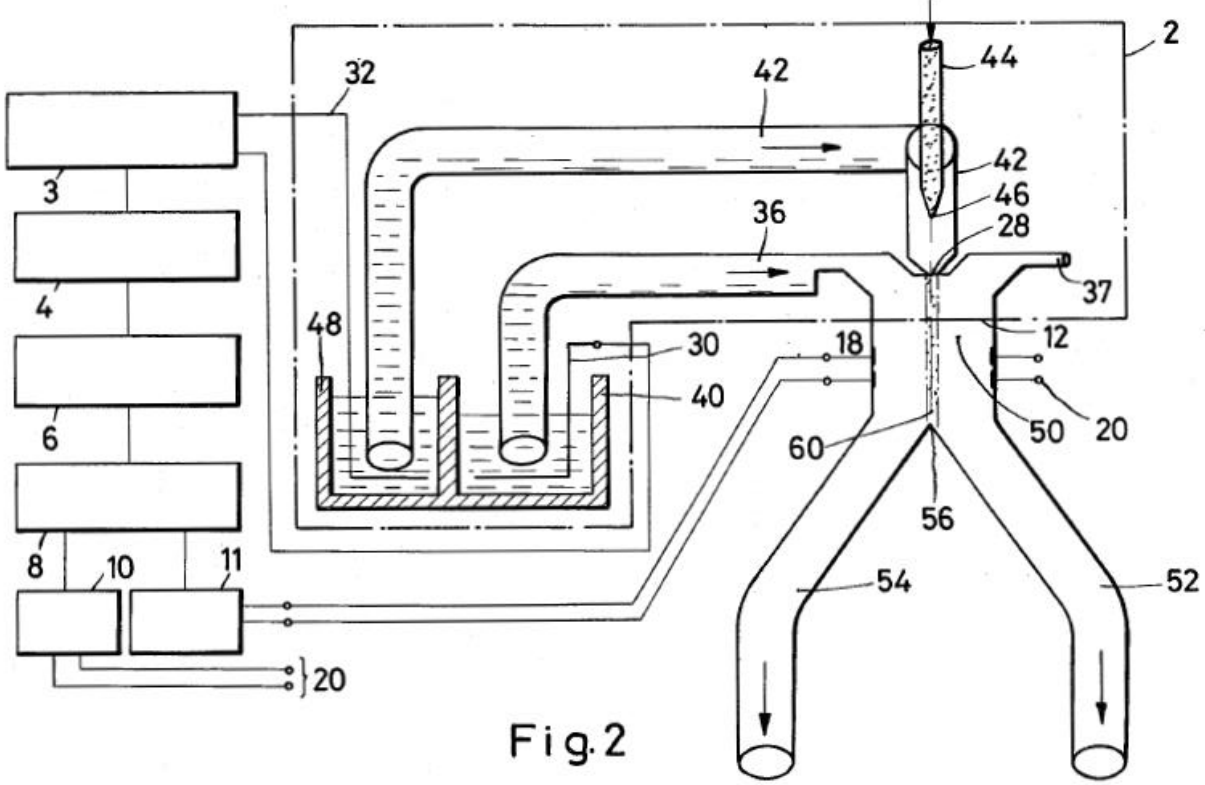
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 15 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

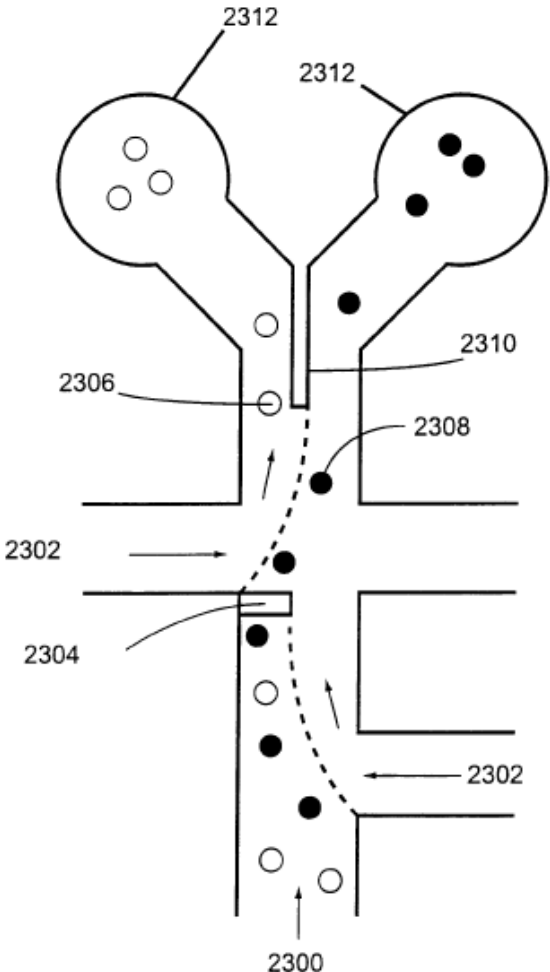
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

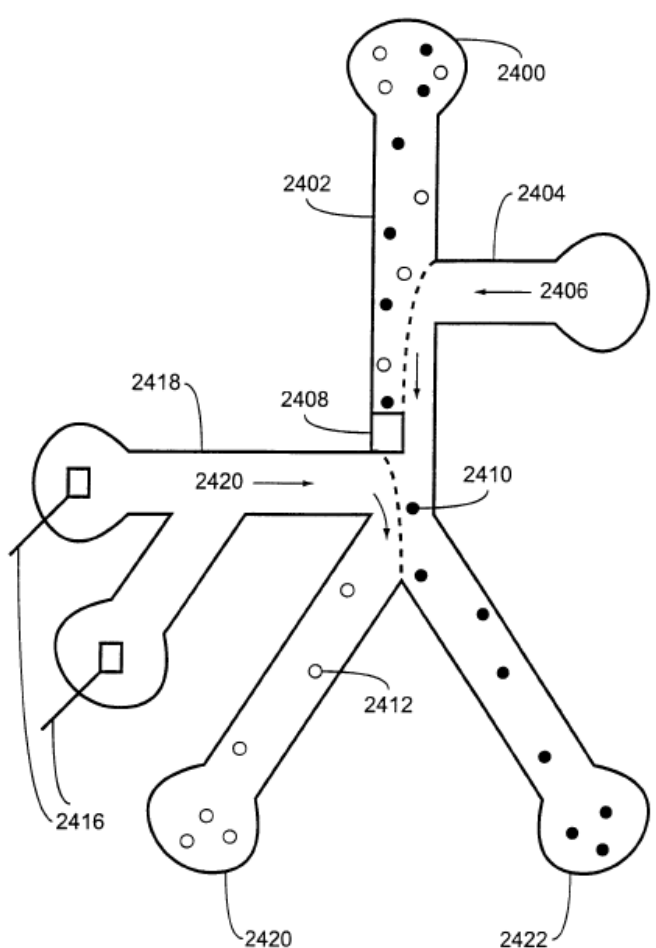
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig.1</p>  <p>The diagram illustrates a medical device system, labeled Fig. 1. It features a central processing unit (2) which contains several internal components: a pump (12), a flow control valve (14), and various sensors or actuators (30, 32, 34, 36, 38, 40). This central unit is connected to a power source (4) and a control unit (6). The system also includes a series of external components (8, 10, 11, 18) that interface with the central unit. The device is mounted on a base (22) and has a handle (24). A flow line (26) is shown exiting the device. The entire system is designed for medical applications, likely for fluid management or patient monitoring.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[17] The system of claim 1, wherein the second reservoir includes a deflectable flexible membrane wherein deflection of the membrane increases the pressure in the second reservoir.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

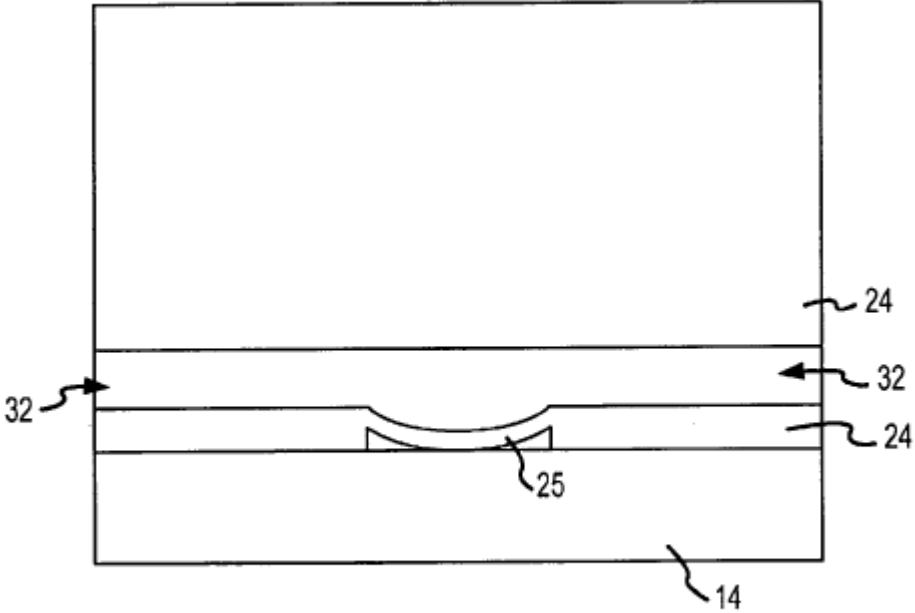
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Wada</p> <p>The Wada disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“Optionally, the instruction set directs individual or simultaneous fluid flow from the third and sixth microchannels by individually or simultaneously activating at least one heating element (e.g., a Joule heating electrode, a conductively coated microchannel portion, or the like) disposed within each of the third and sixth microchannels or within at least one well that fluidly communicates with each of the third and sixth microchannels.” Wada, at 8:18-23.</p> <p>“Figure 23 schematically depicts a microchannel configuration that includes one embodiment of separation element 2310. In this example, cells 2300 are typically flowed in a microchannel that intersects with another microchannel located upstream from detector 2304. The upstream intersecting microchannel is optionally used to focus cells 2300 to one side of the microchannel as cells 2300 pass through detector 2304 using hydrodynamic flow 2302. This illustration also includes a set of opposing microchannels located downstream from the detector for introducing at least one hydrodynamic flow 2302 to direct selected cells 2308 (e.g., fluorescently-labeled cells) and non-selected cells 2306 to either side of separation element 2310 and into, in this case, one of two microchannels, each terminating in particular collection wells 2312. Separation element 2310 is optionally omitted, with cells 2300 or other particles being directed into destination regions as desired.” Wada, at 20:3-14; <i>see also</i> Fig. 23 below.</p>

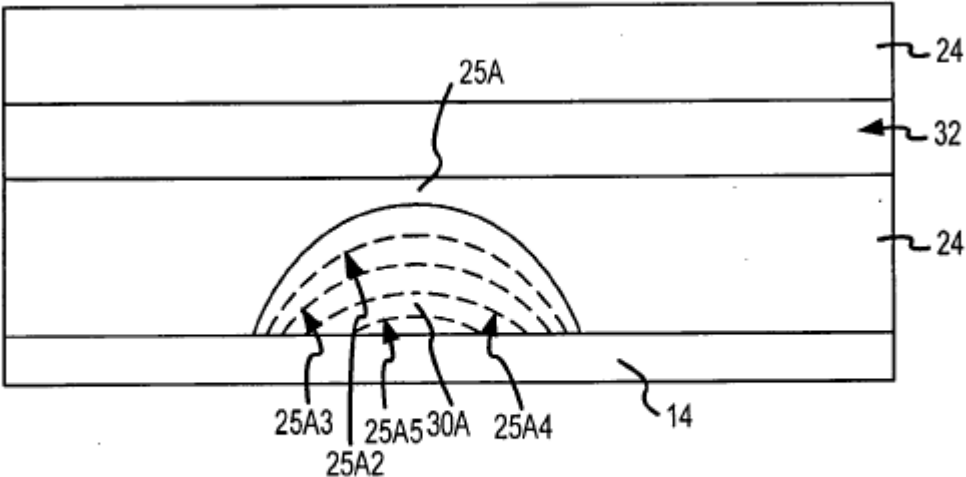
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>“In the configuration depicted, focusing microchannel 2404 intersects with main microchannel 2402 in a ‘T- junction’ upstream from detector 2408. Similar to the device represented in Figure 23 (discussed above), focusing flow stream 2406 is optionally used to focus or pinch the particles</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>against the wall of main microchannel 2402 opposing the ‘T-junction’ as the particles flow through detector 2408. When selected particle 2410 (e.g., a fluorescently-labeled particle) is detected, an electrical signal from detector 2408 typically triggers the flow of current to Joule heating electrodes 2416.” Wada, at 22:25-32; <i>see also</i> Fig 24 below.</p>  <p>“Many alternative embodiments that incorporate Joule heating to control fluid viscosity and particle</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>flow are possible. For example, although not shown in Figure 22, one or both microchannels of the second set of opposing microchannels located downstream from detector 2204 optionally include one or more Joule heating electrodes (e.g., 1, 2, 3, 4, 5, or more electrodes) and/or conductive coating portions. One or both of the opposing microchannels also optionally includes a branched channel structure similar to the branched structure depicted in Figure 24, above (i.e., branched particle sorting microchannel 2418). Optionally, one or both of the opposing microchannels includes greater than two branches, each branch of which optionally includes one or more Joule heating electrode(s). In other embodiments, separation elements, such as those discussed above are optionally included.” Wada, at 23:19-29.</p> <p>Marcus</p> <p>The Marcus disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“FIG. 1 generally teaches the apparatus and concept of the present invention. In said figure, element 1 broadly depicts the fluidic logic element. Said fluidic logic element 1 comprises input flow port 2 through which a suspension containing particulate matter is forced. Fluidic logic element 1 further comprises control port A and control port B, 4 and 3, respectively; and output port A and output port B, 5 and 6, respectively.” Marcus, at 3:28-36.</p> <p>“A suspension containing at least two visually different particulate matter is forced through input flow port 2. The suspension contains particle type A, 8, particle type B, 7, and a fluid carrier 15. Machine vision camera lens 9 reads the appearance of said particles 7 and 8. It transmits what is read to an image capture device 10 which forwards what it sees to an image interpretation device 11 which is able to interpret and register a distinction between particles 7 and 8. This distinction is then transmitted to a control decision device 12 which signals a fluidic controller device 14 to instruct control ports A and B, 4 and 3 respectively; to separate out said particles 7 and 8. These particles 7 and 8 are then sorted through output port A and output port B, 5 and 6.” Marcus, at 3:49-62.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>25 to deflect downward, thereby pinching off flow F passing through flow channel 30. Accordingly, by varying the pressure in channel 32, a linearly actuatable valving system is provided such that flow channel 30 can be opened or closed by moving membrane 25 as desired. (For illustration purposes only, channel 30 in Fig. 7G is shown in a "mostly closed" position, rather than a "fully closed" position). Since such valves are actuated by moving the roof of the channels themselves (i.e.: moving membrane 25) valves and pumps produced by this technique have a truly zero dead volume, and switching valves made by this technique have a dead volume approximately equal to the active volume of the valve, for example about $100 \times 100 \times 10 \mu\text{m} = 100\text{pL}$. Such dead volumes and areas consumed by the moving membrane are approximately two orders of magnitude smaller than known conventional microvalves. Smaller and larger valves and switching valves are contemplated in the present invention, and a non-exclusive list of ranges of dead volume includes 1 aL to 1 uL, 100 aL to 100 nL, 1 fL to 10 nL, 100 pL to 1 nL, and 1 pL to 100 pL." Chou, at 19:7-25; <i>see also</i> Fig. 7H below.</p>

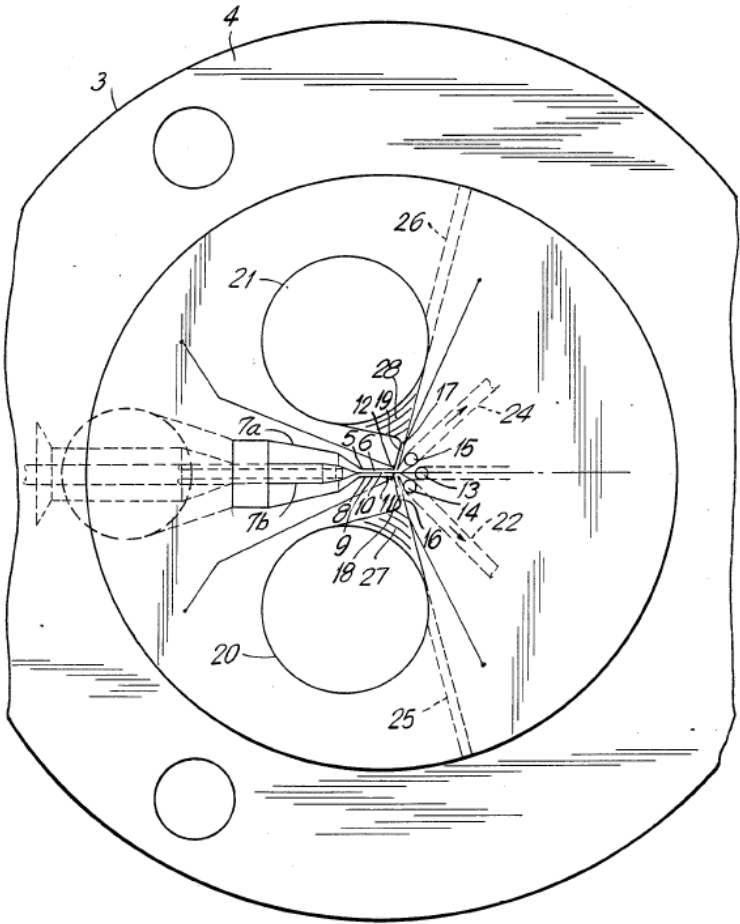
Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">FIG. 7H</p> <p> “In the alternate preferred embodiment of Fig. 11, flow channel 30a has a curved upper wall 25A. When flow channel 32 is pressurized, membrane portion 25 will move downwardly to the successive positions shown by dotted lines 25A2, 25A3, 25A4 and 25A5, with edge portions of the membrane moving first into the flow channel, followed by top membrane portions. An advantage of having such a curved upper surface at membrane 25A is that a more complete seal will be provided when flow channel 32 is pressurized. Specifically, the upper wall of the flow channel 30 will provide a continuous contacting edge against planar substrate 14, thereby avoiding the "island" of contact seen between wall 25 and the bottom of flow channel 30 in Fig. 10. Another advantage of having a curved upper flow channel surface at membrane 25A is that the membrane can more readily conform to the shape and volume of the flow channel in </p>

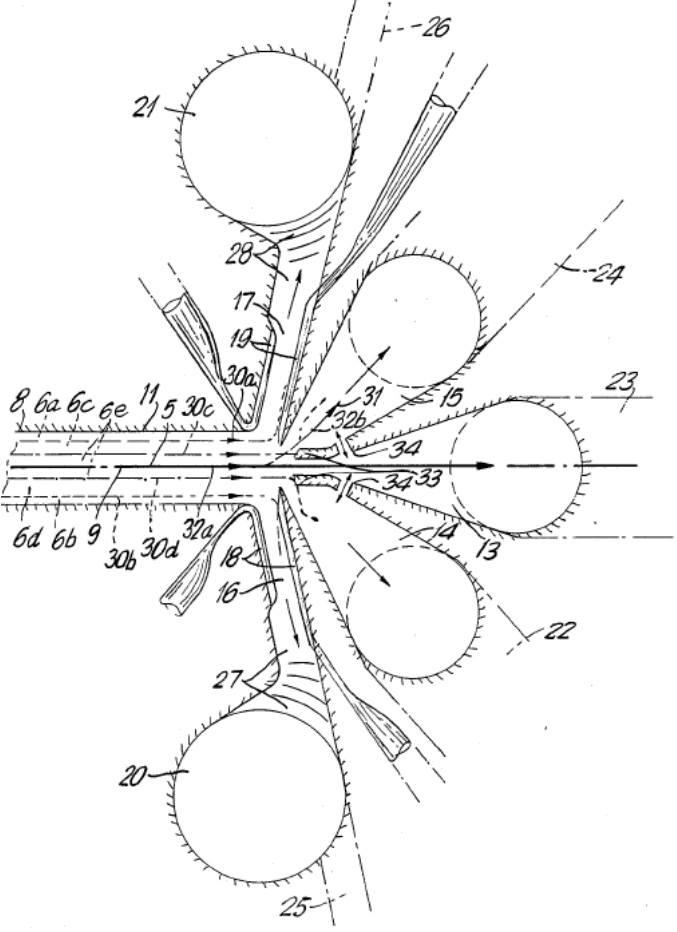
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>response to actuation. Specifically, where a rectangular flow channel is employed, the entire perimeter (2x flow channel height, plus the flow channel width) must be forced into the flow channel. However where an arched flow channel is used, a smaller perimeter of material (only the semi-circular arched portion) must be forced into the channel. In this manner, the membrane requires less change in perimeter for actuation and is therefore more responsive to an applied actuation force to block the flow channel.” Chou, at 24:17-34; <i>see also</i> Fig. 11 below.</p>  <p style="text-align: center;">FIG.11</p> <p>“In addition to pressure based actuation systems described above, optional electrostatic and magnetic actuation systems are also contemplated, as follows. Electrostatic actuation can be accomplished by forming oppositely charged electrodes (which will tend to attract one another when a voltage differential is applied to them) directly into the monolithic elastomeric structure. For example, referring to Fig. 7B, an optional first electrode 70 (shown in phantom) can be positioned on (or in) membrane 25 and an optional second electrode 72 (also shown in phantom)</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>can be positioned on (or in) planar substrate 14. When electrodes 70 and 72 are charged with opposite polarities, an attractive force between the two electrodes will cause membrane 25 to deflect downwardly, thereby closing the "valve" (i.e.: closing flow channel 30). For the membrane electrode to be sufficiently conductive to support electrostatic actuation, but not so mechanically stiff so as to impede the valve's motion, a sufficiently flexible electrode must be provided in or over membrane 25. Such an electrode may be provided by a thin metallization layer, doping the polymer with conductive material, or making the surface layer out of a conductive material. In an exemplary aspect, the electrode present at the deflecting membrane can be provided by a thin metallization layer which can be provided, for example, by sputtering a thin layer of metal such as 20 nm of gold." Chou, at 26:9-26.</p> <p>"Referring first to Figs. 12A and 12B, a schematic of flow channels 30 and 32 is shown. Flow channel 30 preferably has a fluid (or gas) flow F passing therethrough. Flow channel 32, (which crosses over flow channel 30, as was already explained herein), is pressurized such that membrane 25 separating the flow channels may be depressed into the path of flow channel 30, shutting off the passage of flow F therethrough, as has been explained." Chou, at 28:18-23.</p> <p>"Referring to Fig. 13A and 13B, a system for peristaltic pumping is provided, as follows. A flow channel 30 has a plurality of generally parallel flow channels (i.e.: control lines) 32A, 32B and 32C passing thereover. By pressurizing control line 32A, flow F through flow channel 30 is shut off under membrane 25A at the intersection of control line 32A and flow channel 30. Similarly, (but not shown), by pressurizing control line 32B, flow F through flow channel 30 is shut off under membrane 25B at the intersection of control line 32B and flow channel 30, etc." Chou, at 28:27-33.</p> <p>"As seen in the exploded view of Fig. 17C, and assembled view of Fig. 17D, elastomeric layer 110 is placed over elastomeric layer 100. Layers 100 and 110 are then bonded together, and the integrated system operates to selectively direct fluid flow F (through flow channel 30) into either or both of reaction chambers 80A and 80B, as follows. Pressurization of control line 32A will cause the membrane 25 (i.e.: the thin portion of elastomer layer 100 located below extending portion 33A and over regions 82A of reaction chamber 80A) to become depressed, thereby shutting off fluid flow passage in regions 82A, effectively sealing reaction chamber 80 from flow channel 30." Chou, at 31:13-20.</p>

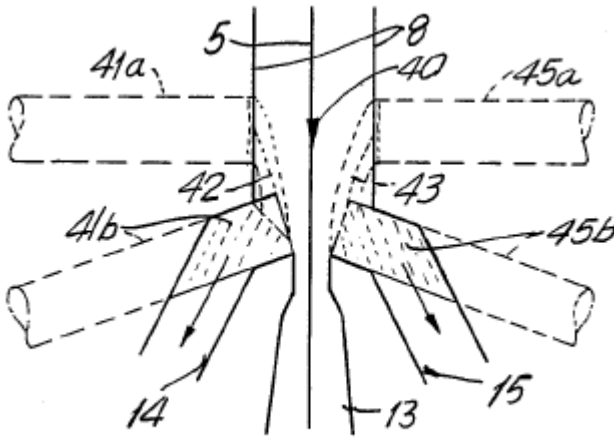
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Zöld</p> <p>The Zöld disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to the invention, if the fluids flow through the system under the influence of a vacuum created at the outlets of the whole flow system, then the use of a gas as a control medium, injected through the injection duct, is used as one possibility; in this case, an electromechanical or piezoelectrical valve controls the injection process. However, if the substance to be dispensed is of some kind of a liquid, then a gas or vapor, injected, or more properly created, through some electrical or electrochemical process, is especially advantageous here as a control medium because the gas or vapor can be generated, in many cases, right at the optimal place of its injection defined earlier, instead of being led to that place through an injection duct where the injection process is manipulated through bulky valves.” Zöld, at 8:22-36.</p> <p>“The deflection process, i.e., the deflection of the center stream 5 and, hence, that of the particles, into the left only-dispenser channel 15, which is being continued by the left outlet hole 24, in detail, is as follows. Since the device, shown in FIGS. 1 and 2, is of the suction type, therefore, the flow of the electrolyte is controlled by the generation of gas through electrolysis, or by another appropriate vapor producing process described earlier. As it is well known, such gas is generated by sending a well controlled electrical current impulse through the electrolyte, flowing between the electrode pair 18, itself being imbedded in the vertical walls of the right only control channel 16. It is easy to see, furthermore, that of the rate if the gas-volume production, which is not equal to the gas molecule production in males, between the electrode pair is not smaller than the rate of the flow of the electrolyte in the right only-control channel 16, or in its lower part 27, then the electrolyte flows undisturbed at the down stream end of the gas bubble towards the buffer cavity 20 since the generated gas fills up the volume being left empty by the electrolyte at the same rate the electrolyte flows out therefrom. This is naturally possible since during this process the pressure has been increased between the electrode pair to such a value and for such a long time that no further electrolyte flow into this only-control channel is</p>

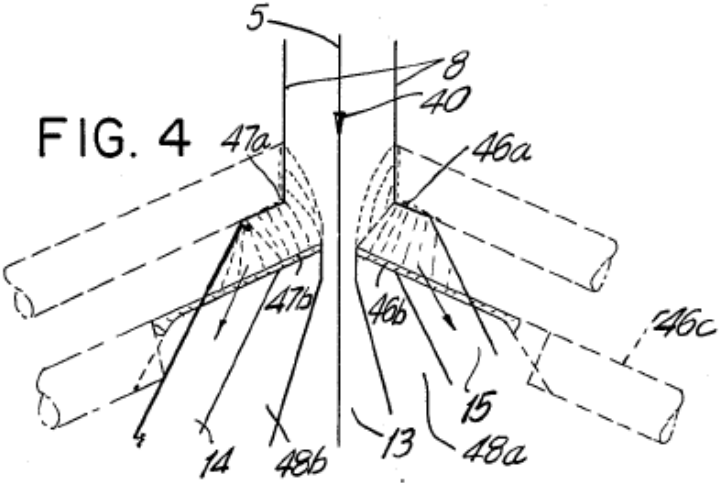
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>possible during this time. This is in accordance the invention which says that during gas production, the pressure has to be increased, i.e., the vacuum has to be decreased, to such a value that no electrolyte is able to enter into this channel. From this flows, therefore, that during gas production no suction is exerted on the electrolyte at the up-stream end of the electrode pair 18, i.e., at the inlet of channel 16. In other words, at said rate of gas generation between this electrode pair, the right only-control channel 16 is overflowed by the gas or vapor, to such an extent that at the constant vacuum, exerted at the low-stream end of channel 16, i.e., in part 27 of this channel, only the generated gas bubble and the electrolyte at the low-stream end of the former is sucked towards the right buffer cavity 20 and, therefore, there is no more suction effect left to deflect the right extreme side stream 6b into the only-control channel 16. Consequently, the symmetrical flow, which exists in the transporting channel at the steady flow state, is thereby destroyed since the otherwise powerful right only-control channel 16 is now being paralyzed in the manner described above. The consequence of this paralysis is that the left only-control channel 17 and the left only-dispenser channel 15 suck in more electrolyte than they do at the steady flow state since their capability to deflect the various partial streams is now not compensated by the right only-control channel 16. The result of this is that the right extreme side stream 6b flows now partly into the right only-dispenser channel 14 and partly also into the middle only-dispenser channel 13. Additionally, the also deflected right middle side stream 6d flows into the middle only-dispenser channel 13, and further in the middle outlet hole 23, and the middle partial sheath stream 6e, together with the center stream 5 flow into the left only-dispenser channel 15, and into the corresponding outlet hole 24, if the deflected amount of the electrolyte of the right extreme side stream 6b is large enough. Consequently, an excess flow of the electrolyte takes place both in the middle side stream 6c and in the left extreme side stream 6a.” Zöld, at 18:47-19:44; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. I</p> <p>The diagram shows a circular device with an outer boundary labeled 3. Inside, there are two large circular regions labeled 21 and 20. A central assembly includes a component labeled 28, with various sub-components and lines labeled 12, 19, 17, 24, 15, 13, 14, 22, 16, 18, 27, 9, 8, 10, 11, 5, 6, 7a, 7b, 26, and 25. Dashed lines indicate internal structures or paths. The device is shown with some external features like a small circle at the top and bottom, and a rectangular feature on the left side.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 2</p> <p>“At this phase of the deflection process, the center stream 5 takes its "to-the-left-deflected" form, as is indicated by curve 31, and if a particle is located slightly at the up-stream side of the only-control channels 16 and 17, i.e., at the position 32a, and if the center stream deflection time is</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>long enough, then said particle or cell enters into the left only-dispenser channel 15, as is indicated by the point 32b. The return to the steady flow state phase starts at the ceasing of the gas generation in the only-control channel 16 between the right electrode pair 18, i.e. timewise speaking, at the end of the electrical impulse. Consequently, the generated gas bubble is sucked out of channel 16 into the right buffer cavity 20, and the force, exerted at the right extreme side stream 6b at the steady state, is acting on it again when this stream starts to flow into channel 16 again. After this process, all the streams return to their steady state flow since the symmetry of the pressure has been restored everywhere, whereby the sorting of the particle 32a into the left only-dispenser channel 15 has been completed; after this process, the particles leave the device through the left outlet hole 24. It is easy to see that the sorting of a particle into the right only-dispenser channel 14, follows in a similar manner if a gas bubble is generated in the left only-control channel 17 between the electrode pair 19. In this case, after being deflected into the right only-dispenser channel 14, the particles leave the device through the right outlet hole 22 and enter into the corresponding filtering/collector bottle (not shown).” Zöld, at 19:45-20:6.</p> <p>“The buffer cavities, therefore, are very important elements of the new device, and of the invention too, and their necessity was clearly seen after the analysis of the performance of the previous sorter devices, constructed in accordance with U.S. Pat. No. 4,175,662, which naturally does not describe such a cavity since it was not known at that time. In the previously conducted experiments, it was observed that by generating gas bubbles only in one of the side channels, using an impulse generator to provide the electrical current impulses for the gas generation, the center stream, made visible and therefore distinguishable from the sheath stream by using a thick suspension of dyed mouse tymus cells of about 5 microns diameter, have shown a steady deflection away from that side channel where the gas bubbles were generated. This observation shows clearly that without the vacuum compensating effect of the buffer cavities, the vacuum decreases for increasing gas bubble production in the control channels, i.e., in those channels where gas is produced, and this is one of the justifications for the use of these cavities described below. High quality sorting of cells was, however, possible in the older devices when the number of cells to be sorted was about the same in both populations. However, in the asymmetrical sortings, i.e., where the cell number was considerably different in the two cell populations, only the sorting of the larger cell (number) component was good enough.” Zöld, at 21:17-44.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Therefore, the electrode pairs of the only-control channels 16 and 17 have to begin as close to the entrance of these channels as possible, although care should be taken to avoid the spilling of the control gas into the channels which are located down-stream from the entrance of these only-control channels, because such an overspilling of the gas might cause some undesirable contamination of the originally clean electrolyte flowing in the delay channel, which is the basic characteristic of this type of sorter/dispenser device. As was defined earlier, the length of the only-dispenser channels has to be at least so long that the control medium, in this case a gas, can develop in it without flowing into the corresponding buffer cavity; otherwise its development and consequently, the deflection process could be disturbed.” Zöld, at 22:39-54.</p> <p>“FIGS. 3 and 4 show two other practical arrangements for the control electrodes, which are imbedded in 4 the device body in such a manner that the control gas is generated partly inside and partly at the very vicinity of the channel branching volume, defined here by the joining of the transport channel 8 and the three dispensing control channels 13, 14 and 15, which are called in this manner since they carry out both types of operation;” Zöld, at 23:44-52; <i>see also</i> Figs. 3 and 4 below.</p>  <p style="text-align: center;">FIG. 3</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p>FIG. 4</p> <p>“In accordance with the invention, these types of electrode arrangements are the optimal ones for the operation of such types of devices, i.e., where the same outlet channels carry out both the flow control and the dispensing operations. Accordingly, the deflection of the center stream 5 is caused to the left, relative to its steady flow state line 40, through the generation of gas between the electrode pair 41a and 41b when an electrical field 42, shown by discontinuous curves, and the concomitant electrical current, is created between the electrodes. In the same manner, deflection of the center stream is caused to its right, if the electric field 43 is generated between the electrode pairs 45a and 45b. It is clearly seen from FIG. 3 that the active surfaces of the electrodes 41a and 45a are mostly only their tips, with which they form a part of the walls of the transporting channel 8. On the other hand, the active surfaces of the electrodes 41b and 45b, i.e., the shaded areas, form a part of the bottom of the dispenser channels 14 and 15 at the channel branching volume. Consequently, the gas generation takes place, off-center, partly at the inside of the channel branching volume and partly in the channels. Since the electrode tips of 41a and 45a can be made of the pointed form, therefore, this electrode arrangement can also be used readily for the generation of well controlled electrical arcs, described earlier as other means for the generation of the control medium, i.e., of the control vapor.” Zöld, at 23:53-24:12.</p>

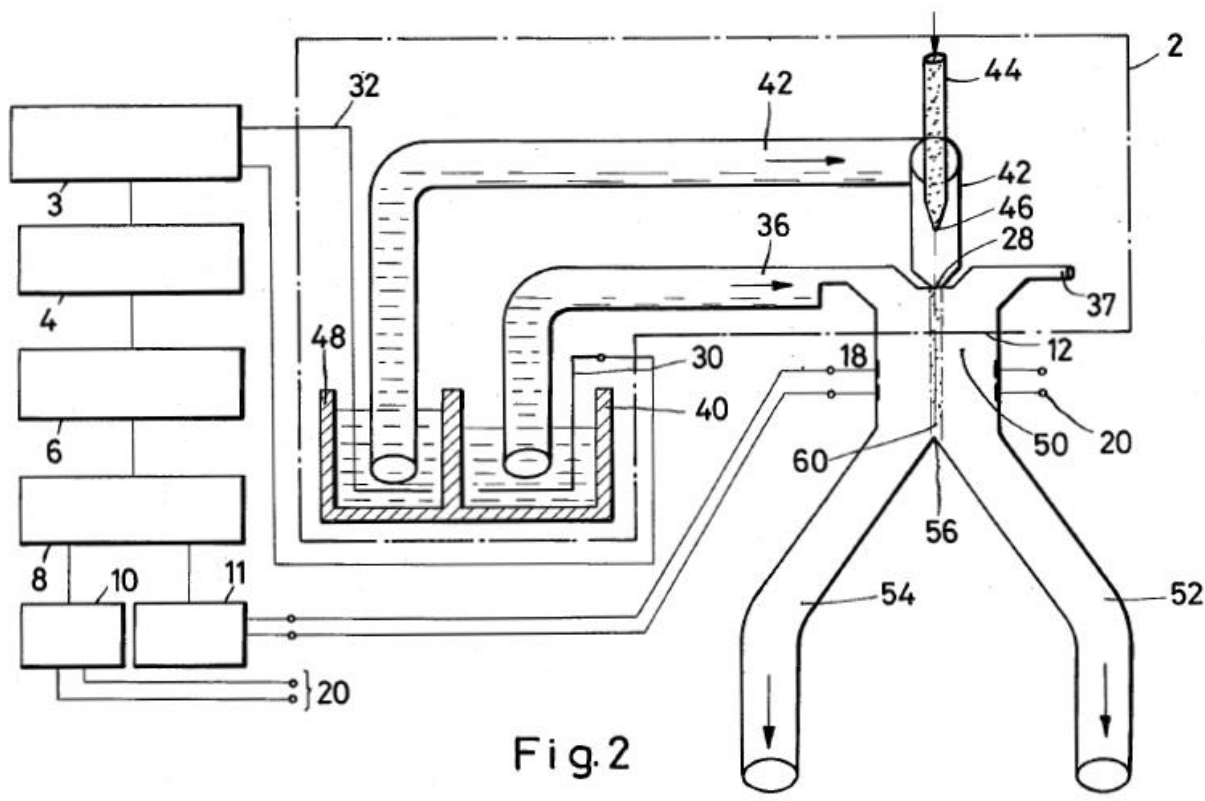
Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“Numerous alterations of the structure herein disclosed will suggest themselves to those skilled in the art. However it is to be understood that the present description is for purposes of illustration only and not to be construed as a limitation of the subject invention. All such modifications which do not depart from the spirit of the invention are intended to be included within the scope of the appended claims.” Zöld, at 26:23-30.</p> <p>Zöld 662</p> <p>The Zöld 662 disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“According to a preferred embodiment of the invention a middle channel is provided with relatively large cross-section, or more preferably, the channel should be rather wider than deep. In this middle channel there flows a rather thin suspension stream surrounded by a laminar stream of pure electrolyte. In the quiescent state the suspension stream flows right at the center of the middle channel. The middle channel at its downstream end splits up into at least two but rather three or more side channels symmetrically arranged with respect to the center of the middle channel, obtaining in this manner a system with two, three, or more side channels in which one, two, or more kinds of particles can be separated, respectively, in accordance with their properties, analysed in the analysing system located at the upstream end of the sorter and transformed into respective electrical impulses used to trigger the control electrode pairs at appropriate times, i.e. just before the particle corresponding to a certain trigger impulse reaches the selected pair of control electrodes.” Zöld 662, at 2:64-3:15.</p> <p>“In accordance with the invention a plurality of side channels can be provided at the end of the middle channel and by properly triggering the gas impulses the suspension stream can be deflected successively into any of these side channels, thus providing a means to sort particles of more than one or two kinds at one and the same flow-through of the particle mixture.” Zöld 662, at 3:39-45.</p> <p>“In accordance with one embodiment of the invention the particles flow from the analyser portion through the middle channel which ends in two side channels which are perpendicular to</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>the middle channel. In the quiescent state the electrolyte and therefore also the particle are equally split between the two side channels. In each of the side channels a pair of control electrodes is located preferably at the inner side walls of the side channels in such a manner that the electrodes of each pair are aligned in parallel to each other. When a particle to be sorted out from the mixture is programmed to enter into the left side channel an appropriate amount of gas is produced by supplying the electrodes in the right side channel with a trigger impulse at the right time to block this side channel for the passing of the respective particle. By this blocking action only in the left side channel suction will be exercised on the electrolyte sucking in this manner the particle into the left channel. All the other particles which do not arrive at the same time as the electrodes in the right channel will enter into the right side channel due to the production of gas impulses in the left side channel. Due to its shape this embodiment is called T-sorter.” Zöld 662, at 3:66-4:20.</p> <p>“In an improved embodiment of the T-sorter the suspension enters into the middle channel in a very thin hydro-dynamically focused stream. In this case the velocity of all particles within the stream is about the same. Thus, the proper triggering of the gas production relative to arriving particles is facilitated as the flow velocity is strongly dependent on the position of the particle relative to the middle axis of the channel.” Zöld 662, at 4:21-28.</p> <p>“An embodiment similar to the T-sorter is the so-called Y-sorter which can, however, operate only in the hydro-dynamically focused form. In this device two side streams enter laminarly preferably on both sides of the suspension stream at the upstream end of the middle channel in parallel alignment to the very thin suspension stream. The two side channels in this version are provided with equal acute angles relative to the axis of the middle channel where the thin suspension stream flows. The gas producing electrode pairs can be located either in the side channels in the same manner as in the T-sorter or at the inner wall of the middle channel slightly before the branching into the side channels. In any case, the thin suspension stream can be deflected into either of the side channels by the production of gas impulses either in the opposite side channel or at the electrode pair located on the opposite side of the middle channel. It follows from its advantageous geometry that the sorting capability of the Y-sorter is higher than that of the T-sorter.” Zöld 662, at 4:34-54.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“In another embodiment of the invention the middle channel is branched into three narrower channels, the middle exit channel and the two side channels, symmetrically arranged to the middle exit channel, such that the suspension stream in the quiescent state flows in the substantially straight middle exit channel. Either only the two side channels or the two side channels and the middle exit channel have a pair of gas producing electrodes. In the first case the side channels should be several times wider than the middle exit channel in order to achieve an appropriate deflection of the suspension stream. With this model two different kinds of particle groups can be sorted by the two deflection paths of the suspension stream. This device will be called "T-sorter". Clearly such a channel element or stage can be connected in series, in such a manner that the middle exit channel is provided at its downstream end with two additional laminar side streams forming in this manner another middle channel which can be branched into another triplet of channels as was the case in the first stage of the device. With such a multiple system a very large number of particle groups with different characteristics can be sorted out from the mixture by one and the same flow of the mixture.” Zöld 662, at 4:55-5:10.</p> <p>“In accordance with the principles of the invention there is an additional field of use for the controlling of the electrolyte flow by electrolytic gas production in order to reduce the large distance and irregular sequence of particles flowing in a channel or very small cross-section. Such a device consists of a main channel for the suspension from which at least one side channel branches out substantially perpendicular and provided with control electrodes. By the control of the electrolyte output through the side channels which reduces the electrolyte content of the suspension, the spacing between two particles can be controlled during the time in which any of the particles are remote from the side channel. An electronic circuit controls the gas production of the electrodes and receives the control impulses from a sensor, such as a channel counter, in such a manner that the spacing between two particles can be reduced to a desirable extent by letting out the appropriate amount of electrolyte through the side channels. In the programming of such a system or device care must be taken that neither of the particles can enter the side channels because such a particle would be lost. This is achieved by closing the side channels with the aid of the gas production at the control electrodes during the particles pass the side channel entrance.” Zöld 662, at 5:54-6:11.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>“FIG. 1 shows a first embodiment of the invention, the so-called T-sorter, and a channel counter as volume sensor as lines 21 and 22 have been rewritten as the above referred to co-pending application. A capillary exit channel 12 of the channel counter 2 which serves as a volume sensor for the particles suspended in an electrolyte, branches at its downstream end into two side channels 14 and 16 of the same cross-section and length transversely to the axis of the exit channel 12. By flexible tubes the side channels are connected to the containers 22 and 24, respectively, which are under low vacuum, to exercise a suction effect on the contents of the side channels via tube 26 which in turn is connected to a suction pump (not shown). Under the suction operation of the pump suspension electrolyte and pure electrolyte flow from containers 38 and 40, respectively, into the counter 2 where they mix and continue to flow through the exit channel 12 and equally divided through the side channels 14, 16 and finally into the containers 22 and 24, respectively. In each of the side channels 14 and 16 a pair of control electrodes 18, 20 is located preferably on the surface of the channel wall. The control electrodes 18, 20 produce controlling gas impulses at the proper time determined by the electronic circuit, which transmits a voltage impulse to the selected control electrode pair for each single control action.” Zöld 662, at 6:38-64; <i>see also</i> Figs. 1 and 2 below.</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Fig.1</p> <p>The diagram illustrates a medical device system. A central unit (2) is shown with internal components including a pump (12), a catheter (14), a filter (16), a valve (18), and a sensor (20). The central unit is connected to a control system (4, 6, 8, 10, 11, 18) and a power source (26). The central unit is also connected to a patient (22, 24) via a catheter (14, 16, 18, 20, 26). The central unit is connected to a control system (4, 6, 8, 10, 11, 18) and a power source (26). The central unit is also connected to a patient (22, 24) via a catheter (14, 16, 18, 20, 26).</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	 <p style="text-align: center;">Fig. 2</p>
<p>[18] The system of claim 1, wherein the change in volume or pressure in the second reservoir is a transient change in volume or pressure.</p>	<p>The following exemplary citations to prior art references establish that this claim limitation is taught by the prior art. Additionally, they show that this claim limitation would have been obvious in view of the prior art (including the following references alone and in combinations) and the knowledge of the person having ordinary skill in the art.</p> <p>For example:</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>Wada</p> <p>The Wada disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“Joule heating is typically produced by flowing current through an electrode or other conductive component positioned within a well, microscale channel, or other cavity within the device. The resulting flow of current into fluid within the well, channel, or cavity results in resistive heating of the fluid. By substantially increasing the current across the channel, rapid temperature changes are induced that are optionally monitored by conductivity. Because nanoliter volumes of fluid have tiny thermal mass, transitions between temperatures are typically extremely short. For example, oscillations between any two temperatures above 0°C and below 100°C in 100 milliseconds have been performed.” Wada, at 20:23-31.</p> <p>Chou</p> <p>The Chou disclosures in each limitation of claim 1 are incorporated by reference.</p> <p>“A microfluidic device comprises pumps, valves, and fluid oscillation dampers. In a device employed for sorting, an entity is flowed by the pump along a flow channel through a detection region to a junction. Based upon an identity of the entity determined in the detection region, a waste or collection valve located on opposite branches of the flow channel at the junction are actuated, thereby routing the entity to either a waste pool or a collection pool. A damper structure may be located between the pump and the junction. The damper reduces the amplitude of oscillation pressure in the flow channel due to operation of the pump, thereby lessening oscillation in velocity of the entity during sorting process.” Chou, at Abstract.</p> <p>“Microfluidic devices of the present invention comprise an integrated pump which can be electronic, magnetic, mechanical, or preferably pneumatic pumps. By using a pneumatic pump, microfluidic devices of the present invention allow more precise control of the fluid flow within the fluid channel. In addition, unlike electro-osmotic driven fluid flow, pneumatic pump allows the flow of fluids in both directions, thereby allowing reversible sorting of materials, as</p>

Asserted Claim Element	Exemplary Prior Art Disclosures
	<p>discussed in greater detail below. Furthermore, a pneumatic pump provides at least 10 times, preferably at least about 20 times, and more preferably at least about 30 times the fluid flow rate capacity compared to the capacity of electro-osmotic fluid flow. In addition, microfluidic devices of the present invention may comprise a damper which reduces or eliminates the fluid oscillation within the fluid channel. The damper can any device which attenuates the fluid oscillation. For example, the damper can simply be a channel which is open to the ambient atmosphere and has a thin elastic membrane between the channel and the fluid flow channel. Preferably, the damper is an encapsulated pocket of fluid medium with a thin elastic membrane above the fluid flow channel. The fluid medium can be a liquid or, preferably, a gas. The damper is generally located above the fluid flow channels with a thin membrane, preferably an elastic membrane, between the fluid flow channel and the damper. Typically, there is at least 1 damper posterior to the pump in the direction of the fluid flow. Preferably, there is at least 2 dampers, more preferably at least 3 dampers and most preferably at least about 5 dampers posterior to the pump.” Chou, at 39:16-40:2.</p>