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Samseong 1-dong, Gangnam-gu, Seoul 135-866 (KR).  
**CHANG, Jun Keun** [KR/KR]; 501, Grangciel Villa,  
Bangbae 4-dong, Seocho-gu, Seoul 137-064 (KR).

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(74) Agent: **NAM, Sang Sun**; KAL Bldg. 3rd Fl., 41-3, Seosomun-dong, Jung-gu, Seoul 100-813 (KR).

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(71) Applicant (for all designated States except US): **DIGITAL BIO TECHNOLOGY CO., LTD.** [KR/KR]; 304, Institute of Advanced Machinery, Seoul National University, San 56-1, Sillim-dong, Gwanak-gu, Seoul 151-742 (KR).

(72) Inventors; and

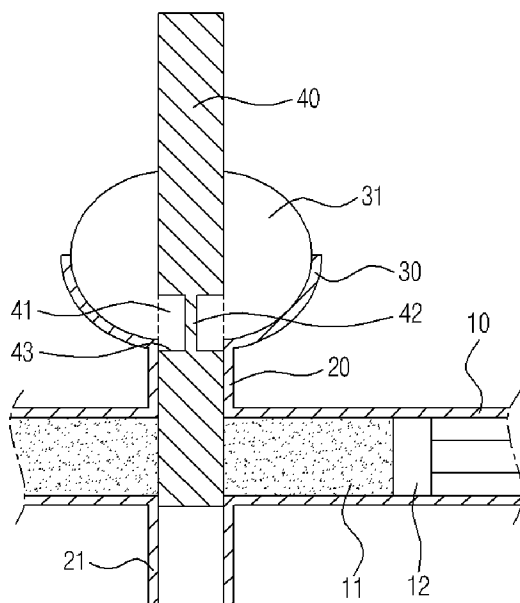
(75) Inventors/Applicants (for US only): **PARK, Jun Ha** [KR/KR]; 817-1905, Daewol Jugong Apt., Jeongja 3-dong, Jangan-gu, Suwon-si, Gyeonggi-do 440-303 (KR). **CHO, Keun Chang** [KR/KR]; 109-501, Gwanak Dreamtown Apt., Bongcheon 5-dong, Gwanak-gu, Seoul 151-770 (KR). **CHUNG, Chan Il** [KR/KR]; 6-907, Hongsil Apt.,

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(54) Title: A SAMPLE PREPARATION DEVICE AND SAMPLE ANALYSIS APPARATUS USING THE SAME



(57) Abstract: Disclosed are a sample preparation device and a sample analysis apparatus using the same. The sample preparation device has a sample mixing chamber, within which a reagent, such as diluent, is stored, and a pair of tubular guide members oppositely formed on the wall of the sample mixing chamber, wherein a sample transfer member holding a precisely fixed amount sample is moved along the tubular guide members, so that the sample and the reagent in the amount desired by a user are mixed, thereby pre-treating the sample. Therefore, the sample preparation device has advantages in that the sample is precisely extracted and pre-treated prior to analyzing the sample, and the sample preparation device is easy to fabricate and use and has a compact size.

## Description

### A SAMPLE PREPARATION DEVICE AND SAMPLE ANALYSIS APPARATUS USING THE SAME

#### Technical Field

- [1] The present invention relates to a sample preparation device and a sample analysis apparatus employing the same, and in particular to a sample preparation device, which allows easy preparation of an exact amount of a sample, and is easy to manufacture and use.

#### Background Art

- [2] In general, experiments for analyzing particles of a sample are frequently conducted in various researches. Sample analysis methods include a sieve separation method, an electrical sensing zone method, a sedimentation method, etc.
- [3] For example, an electrical sensing zone method is illustrated in FIG. 1. According to the electrical sensing zone method, an inner receptacle formed with one or more orifices, the diameter of which has been previously known, is affixed within an outer receptacle filled with an electrolyte, in such a manner that the inner receptacle is insulated from the outer receptacle. In addition, electrodes are provided inside and outside of the inner receptacle so that electric current can flow through the orifices. If a suction device is arranged within the inner receptacle and extracts the electrolyte in a predetermined rate, sample particles dispersed in the electrolyte flow into the inner receptacle through the orifices together with the electrolyte. If the particles dispersed in the electrolyte pass through the orifice in this manner, electrical resistance will be instantly varied. As the size (volume) of the particles increases, the electrical resistance will be more highly varied. The variation of electrical resistance corresponds to the variation of voltage, which appears by pulses. On the basis of the number and magnitude of the pulses, it is possible to measure the number and size of the sample particles. On the basis of the number and size of the particles, it is also possible to analyze the sample particles.
- [4] In such a sample analysis method, what is important is to prepare a sample. The sample preparation means extracting and precisely processing a desired amount of a sample in a proper ratio with diluent or the like. For this purpose, a desired amount of a sample is typically prepared by using a pipette or a spoid. However, in a sample analysis in a lab-on-a-chip or lab-on-a-tip unit, the amount of a sample used in preparation is very small, and the sample should be prepared very precisely. However, it is difficult to precisely prepare a very small amount of sample as desired by using a pipette or a spoid.

- [5] A cell counter technique is disclosed in International Patent Application No. PCT/DK03/00383 (entitled, Lysing Reagent, Cartridge and Automatic Electronic Cell Counter for Simultaneous Enumeration of Different Types of White Blood Cells filed in the name of Chempaq AS on November 6, 2003. FIGs. 2 and 3 show conceptual views of devices for preparing a small amount of sample in a conventional cell counter. Referring to FIGs. 2a to 2d, the device includes a cylindrical sampling member 78 formed with a cavity 82, wherein the cavity 82 in the sampling member 78 communicates with openings 87, 76, 79 and 80 at its first position, so that the cavity 82 in the sampling member 78 is filled with sample through the openings. Next, if the sampling member 78 is rotated and arranged at a second position, the cavity 82 in the sampling member 78 communicates with a diluent storage chamber 83 of the device.
- [6] At this time, the diluent in the storage chamber 83 is lowered and mixed with the sample in a mixing chamber 77. Meanwhile, when a small amount of sample (for example, blood) is introduced into a fixed amount chamber (prepared liquid), it is necessary to assure a fixed amount according to the prior art, as shown in FIG. 3. Therefore, since it is necessary to prevent the prepared liquid from escaping from the mixing chamber 77, valves 51, 52 and 53 are needed. In the prior art, since the cavity 82 in the sampling member 78 is filled with a fixed amount of sample, and only the sample is diluted, the sample preparation is precisely implemented.
- [7] However, Chempaq's device is not efficient because the storage chamber and the mixing chamber are essentially required, and thus the size of the device is increased. In addition, because the sampling member 78 should be rotated, bubbles may be produced, which are fatally harmful to the measurement of sample. Consequently, Chempaq's device has a problem in that it is not easy to manufacture and use. Furthermore, fixed amount dilution of the sample and prepared liquid is very important. For this purpose, because it is necessary to block the flow of the prepared liquid at the time of introducing the sample, one or more valves are essentially needed, which renders the entire system more complicated.

## **Disclosure of Invention**

### **Technical Problem**

- [8] Accordingly, the present invention has been made in order to solve the above-mentioned problems, and an object of the present invention is to provide a sample preparation device for preparing a sample precisely prior to a sample analysis.
- [9] In addition, another object of the present invention is to provide a compact sample preparation device which is easy to fabricate and use.
- [10] In particular, still another object of the present invention is to provide a very simple system adapted to retain the volume of a mixing chamber holding a preparation liquid

constant, even if a sample is introduced into the mixing chamber.

### **Technical Solution**

- [11] In order to achieve the above-mentioned objects, there is provided a sample preparation device having a sample mixing chamber within which a reagent, such as diluent, is stored, and a pair of tubular guide members oppositely formed on the wall of the sample mixing chamber, wherein a sample transfer member holding a precisely fixed amount sample is moved along the tubular guide members, so that the sample and the reagent in the amount desired by a user are mixed, thereby pre-treating the sample.
- [12] According to an aspect, the inventive sample preparation device includes: a sample mixing chamber with an internal space; at least one tubular guide member extending from an external surface of the sample mixing chamber and communicating with the internal space of the sample mixing chamber; a sample storage member formed at an end of the tubular guide member and providing a space for holding a sample; and a sample transfer member with a length extending through the interior of the tubular guide member, the sample transfer member being slidably inserted into the tubular guide member, wherein the longitudinal central area of the sample transfer member is partially removed so that a core part is left, thereby forming a recess surrounding the core part, the recess being capable of holding a desired amount of the sample.
- [13] According to another aspect, the inventive sample preparation device includes: a sample mixing chamber with an internal space; at least one tubular guide member formed within a wall of the sample mixing chamber and communicating with the internal space of the sample mixing chamber; a sample storage member formed at an end of the tubular guide member and providing a space for holding a sample; and a sample transfer member with a length extending through the interior of the tubular guide member, the sample transfer member being slidably inserted into the tubular guide member, wherein the longitudinal central area of the sample transfer member is partially removed so that a core part is left, thereby forming a recess surrounding the core part, the recess being capable of holding a desired amount of the sample.
- [14] The sample storage chamber may be concavely formed on the external wall of the sample mixing chamber communicating with the tubular guide member.
- [15] In addition, the sample transfer member is preferably formed from plastic, rubber, metal or optical material. The sample storage member may have a hemispherical shape. In addition, the cross-section of the sample transfer member may be a circular, rectangular or triangular shape. Moreover, the wall of the sample mixing chamber may be formed with index marks for measuring the sample-mixed liquid or a reagent contained in the sample mixing chamber.

- [16] According to an embodiment of the present invention, at least one mixing member may be provided on the core part of the sample transfer member so as to render the reagent and the sample easily mixed. The mixing member has a fan shape or a vane shape, so that the sample is evenly diffused in the reagent.
- [17] One end of the sample mixing chamber may be provided with a piston for extracting a sample-mixed liquid, and the other end of the sample mixing chamber may be formed with an extraction part, through which the sample-mixed liquid is extracted. In such a case, the extraction part may be connected to a sample analysis apparatus for analyzing the prepared sample, for example, a Coulter counter using the electrical sensing zone method, or an optical analysis apparatus projecting light to the sample, thereby analyzing the sample.
- [18] If the sample preparation device is connected to the Coulter counter, the sample transfer member can be used as an electrode.

### **Advantageous Effects**

- [19] As described above, because the inventive sample preparation device is adapted to be capable of introducing a precise amount of a sample desired for analysis prior to a sample analysis, it is possible to perform a precise sample analysis within a very short length of time.
- [20] In addition, the inventive sample preparation is easy and convenient to use and stock, and can be manufactured in a compact size.
- [21] In particular, the present invention makes it possible to retain the volume of a mixing chamber holding a preparation chamber constant with a very simple system, even if a sample is introduced into the mixing chamber.

### **Brief Description of the Drawings**

- [22] The above and other objects, features and advantages of the present invention will be more apparent from the following detailed description taken in conjunction with the accompanying drawings, in which:
- [23] FIG. 1 is a view for illustrating a particle analysis method by an electrical sensing zone method;
- [24] FIGs. 2a to 3 show conventional sample preparation devices;
- [25] FIGs. 4a to 7 are views for illustrating the construction and action of embodiments of the inventive sample preparation devices;
- [26] FIG. 8 shows another embodiment of the inventive sample preparation device;
- [27] FIGs. 9a and 9b show another embodiment of the inventive sample preparation device;
- [28] FIG. 10 shows another embodiment of the inventive sample preparation device;
- [29] FIG. 11 shows another embodiment of the inventive sample preparation device;

[30] FIG. 12 shows an embodiment of a sample analysis apparatus fabricated by using the inventive sample preparation device; and

[31] FIG. 13 shows another embodiment of a sample analysis apparatus fabricated by using the inventive sample preparation device.

[32] \*Reference Numerals\*

[33] 10: sample mixing chamber

[34] 12: piston

[35] 20, 21: through-hole guide member

[36] 30: sample storage member

[37] 40: sample transfer member

[38] 41: sample capture part

[39] 42: column part

[40] 44: mixing member

[41] 45: cover

[42] 50: internal electrode

[43] 51: sensing member

[44] 61, 73: discharge hole

[45] 70: element

[46] 71: top plate of the element

[47] 71a: insertion hole

[48] 72: bottom plate of the element

### **Mode for the Invention**

[49] FIGs. 4a to 7 are views for illustrating the construction and action of the inventive sample preparation device. Referring to FIGs. 4a to 4d, the inventive sample preparation device includes a sample mixing chamber 10, in which a piston 12 is provided. The sample mixing chamber 10 may have a tubular shape so that a reagent 11, such as diluent, is stored within the sample mixing chamber 10. Tubular guide members 20 and 21 are formed at the longitudinal central area of the sample mixing chamber 10, the guide members being opposed to each other.

[50] The cross-section of the sample mixing chamber 10 may have a polygonal shape, such as a circular, rectangular, or triangular shape. The peripheral wall of the sample mixing chamber 10 may be formed with a scale mark, so that the amount of an internal mixed liquid or reagent 10 can be measured, and the introduced amount of a sample-mixed liquid can be adjusted.

[51] The piston 12 is installed at one end of the sample mixing chamber 10, and the other end of the sample mixing chamber 10 is formed with an extraction part for extracting the sample-mixed liquid. The extraction part of the sample mixing chamber

may be connected to a sample analysis apparatus to be employed for analyzing the prepared sample, such as a Coulter counter using an electrical sensing zone method, and an optical analysis apparatus for projecting light to a sample so as to analyze the sample.

[52] A sample storage member 30 is connected to one end of any of the tubular guide members 20 and 21, wherein the sample storage member 30 is preferably formed in a hemispheric shape, and the inner part of the sample storage member 30 provides a space for holding a sample 31.

[53] The inventive sample preparation device includes a sample transfer member 40 having a diameter received within the tubular guide members 20 and 21, wherein the sample transfer member 40 may be formed in a rod shape. The sample transfer member 40 may be formed with a recess 41 at the longitudinal central part thereof, leaving a core part 42 surrounded by the recess 41. A fixed amount of a sample may be contained within the recess 41 (hereinafter, the recess is referred to as sample capture part 41). The cross-section of the sample transfer member 40 may also have a polygonal shape, such as a circular, rectangular, or triangular shape. In that event, the tubular guide members 20 and 21 should have a cross-sectional shape corresponding to that of the sample transfer member 40. The height of the sample capture part 41 should be equal to or less than the height of the tubular guide members 20 and 21 communicating with the sample storage member 30.

[54] The sample transfer member 40 may be formed from a member applicable to detect an electrical, optical or physical signal, and the material of the sample transfer member 40 may be selected from plastic, rubber, glass, metal, and optical materials.

[55] For example, if the sample preparation device is used in connection with a Coulter counter using the electrical sensing zone method, the sample transfer member 40 is formed from a metal, so that the sample transfer member 40 can be used as an electrode. In addition, if the sample preparation device is used in connection with an optical analysis apparatus, the sample transfer member 40 is formed from an optical material, such as an optical fiber or a transparent material, so that light can be projected into the sample mixing chamber 10 through the sample transfer member 40.

[56] Now, a procedure of preparing a sample with the inventive sample preparation device will be described with reference to FIGs. 4a to 7.

[57] At first, the sample mixing chamber 10 is filled with a reagent, such as diluent, to an amount desired by a user. The sample transfer member 10 is inserted into the tubular guide members 20 and 21 formed through the wall of the sample mixing chamber 10. As shown in FIGs. 4a to 4d, the bottom surface of the sample capture part 41 of the sample transfer member 40 is arranged at a position to be capable of holding the sample of the sample storage member 30.

[58] The sample 31 flows into the sample storage chamber. For example, the sample may be human blood. If the sample 31 flows into the sample storage chamber 30, the sample capture part 41 of the sample transfer member 40 will be fully filled with the sample. In the drawings, it is shown that the sample 31 is charged to the top of the sample storage chamber 30. However, it is sufficient if the sample flows into the sample storage chamber to the extent that only the sample capture part 41 of the sample transfer member 40 is filled with the sample 31. Because the sample transfer member 40 and the tubular guide members 20 and 21 are fabricated in such a manner that a gastight condition is maintained between them, the sample 31 cannot flow into the sample mixing chamber 10 along the wall of the tubular guide members 20 and 21.

[59]

[60] \*Next, the sample transfer member 40 is moved, so that the sample capture part 41 of the sample transfer member 40, which contains the sample 31, is introduced into the sample mixing chamber 10 through the tubular guide members 20 and 21 (see FIG. 6). If the sample capture part 41 of the sample transfer member 40, which contains the sample 31, is positioned within the sample mixing chamber 10, which contains a reagent 11, the sample 31 in the sample capture part 41 of the sample transfer member 40 is scattered and mixed with the reagent 11 within the sample mixing chamber 10. The amount of the reagent 11 in the sample mixing chamber 10 can be properly determined by the user, depending on the volume of the sample capture part of the sample transfer member 40 and the testing purpose.

[61] In order to prevent the sample stored in the sample storage member 30 from flowing into the sample mixing chamber 10, the height of the space for holding the sample on the sample transfer member, i.e. the sample capture part 41, is preferably determined in such a manner that the sample capture part 41 does not simultaneously communicate with both of the sample mixing chamber 10 and the sample storage member 30.

[62] As shown in FIG. 4d, if the reagent 11 and the sample 31 are mixed in the sample mixing chamber 10, the piston 12 located at one end of the sample mixing chamber 10 is moved, thereby extracting the sample-mixed liquid. The sample mixing member 10 may be connected to a sample analysis apparatus for analyzing the sample using the sample-mixed liquid, for example, a Coulter counter using the electrical sensing zone method, or an optical analysis apparatus for projecting light to the sample so as to analyze the sample.

[63] FIG. 8 shows another embodiment of the inventive sample preparation device. The sample preparation device of FIG. 8 has only one tubular sample guide member 20 for guiding the sample transfer member 40, the sample guide member 20 being formed through one side of the wall of the sample mixing chamber 10. The present

embodiment is easy to fabricate because only one tubular guide member is formed through one side of the wall of the sample mixing chamber 10, and because the length and moving distance of the sample transfer member 40 is entirely reduced, the size of the sample preparation device can be reduced. However, in the embodiment of FIG. 8, a prepared liquid may leak because the volume of the sample mixing chamber 10 is increased when the sample transfer member 40 moves.

[64] FIGs. 9a and 9b show another embodiment of the inventive sample preparation device. The sample preparation device of FIGs. 9a and 9b includes guide members 20 and 21, and a sample storage member 30 formed within one side of the wall of the sample mixing chamber 10. The present embodiment is similar to the embodiment of FIGs. 4a to 4d, except that the sample storage member 30 is formed within one side of the wall of the sample mixing chamber 10. Because a very small amount of a sample is required in a lab-on-a-chip unit sample analysis, it is possible to sufficiently analyze the sample by using the wall of the sample mixing chamber 10 as a sample storage means. The present embodiment has an advantage in that the size of the sample preparation device can be reduced. In the embodiment of FIGs. 9a and 9b, the tubular guide members 20 and 21 are formed through both of the sample storage member-formed side and the opposite side of the wall of the sample mixing chamber 10. However, it is also possible to form the tubular guide member only through the sample storage member-formed side of the sample mixing chamber 10, as in the embodiment of FIG. 8.

[65] FIG. 10 shows another embodiment of the inventive sample preparation device. In the sample preparation device of FIG. 10, at least one mixing member 44 is formed on the core part 42 of the sample transfer member 40. If the core part 42 of the transfer member 40 is located within the sample mixing chamber 10 so that the sample 31 within the sample capture part 41 of the sample transfer member 40 is mixed with the reagent 11 within the sample mixing chamber 10, the mixing member 44 is operated so that the sample 31 and the reagent 11 are well mixed. The mixing member 44 is formed in a fan or vane shape, for example. If the user rotates the sample transfer member 40, the fan-shaped or vane-shaped mixing member 44 is also rotated, thereby rendering the sample 31 and the reagent 11 well mixed.

[66] FIG. 11 shows another embodiment of the inventive sample preparation device. In the sample preparation device, the tubular guide members 20 and 21 are formed through the wall of the sample mixing chamber 10, and the sample storage chamber 30 is connected to one of the tubular guide members 20 and 21, the sample chamber 30 being outwardly spaced from the wall of the sample mixing chamber 10 rather than being formed within the wall. In addition, the inventive sample preparation device may include a cover 45 for covering the top of the sample transfer member 40 and the

sample storage member 30. The cover 45 is formed from a soft material such as rubber or soft plastic. The cover 45 prevents the sample in the sample storage member 30 from being polluted. In addition, the cover 45 prevents the sample from splashing the user when the user presses the sample transfer member 40.

[67] FIG. 12 shows an embodiment of the inventive sample analysis apparatus using the electrical sensing zone method, wherein the inventive sample preparation device is employed in the sample analysis apparatus.

[68] The sample analysis apparatus includes a sample preparation device, an internal electrode 50, a discharge hole, 61, a sensing member 51, and a receptacle 60, wherein the sample preparation device includes a sample mixing chamber 10, a piston 12, tubular guide members 20 and 21, a sample storage member 30, and a sample transfer member 40. As shown in FIGs. 12a and 12b, one end of the sample preparation member is connected to the sensing member 51, which is formed with at least one orifice 52, so that sample-mixed liquid flows out through the orifice 52. The orifice 52 is positioned opposite to the piston 12 with reference to the sample mixing chamber 10. The internal electrode 50 is positioned within the receptacle 60. In the present embodiment, the sample transfer member 40 is formed from a metal, so that it serves as an external electrode of the sample analysis apparatus. Alternatively, it is possible to provide a separate external electrode. A discharge hole 61 is formed through the hole of the receptacle 60, so that an electrolyte can easily flow out through the orifice. The present embodiment includes a cover 45 for covering the sample transfer member 40, the cover 45 being formed from rubber or soft plastic. The cover 45 protects the sample transfer member 40 and makes it easy to insert the sample transfer member 40.

[69] With reference to FIG. 12, the action of the inventive sample analysis apparatus will be described. In FIG. 12a, if the sample flows into the sample storage member 30, the sample is received within the sample capture part of the sample transfer member 40 by the amount desired by the user. If the sample capture part is filled with the desired amount of the sample, the cover 45 is pressed so that the sample capture part is positioned within the sample mixing chamber 10 as shown in FIG. 12b. If the sample capture part arrives at the interior of the sample mixing chamber 10, the sample in the sample capture part is mixed with the reagent 11 of within the sample mixing chamber 11. Next, if the piston 12 is moved so that the sample-mixed liquid flows out through the orifice 52 of the sensing member 51, the sample particles in the sample-mixed liquid pass the orifice 52. According to Coulter principle, if the sample particles pass the orifice 52, an instant variation of electric resistance occurs, and the variation of resistance appears as the variation of voltage. Therefore, it is possible to measure the size and number of the sample particles by measuring the variation of voltage.

[70] FIG. 13 shows another embodiment of an optical sample analysis apparatus

employing the inventive sample preparation device.

[71] The sample analysis apparatus includes a sample preparation device, and an element 70 consisting of a top plate 71 and a bottom plate 72, wherein the sample preparation device includes a sample mixing chamber 10, a piston 12, tubular guide members 20 and 21, a sample storage member 30, and a sample transfer member 40. Through an end of the sample mixing chamber 10, at least one orifice 10a is formed so that a sample-mixed liquid flows out through the orifice 10a. The top plate 71 of the element 70 has an insertion hole 71a formed at a side of the top plate 71, the sample mixing chamber 10 being inserted into the insertion hole 71a. At least one side of the element 70 is formed from a transparent material so as to perform an optical measurement of the sample. In addition, it is apparent that the element may include a specific structure for efficiently measuring the sample. As shown in FIG. 13, one end of the sample preparation device is connected to another member for conducting an optical measurement. As a result, it is possible to analyze the mixed sample without exposing the sample to the outside. A discharge hole 73 is formed through a part of the element 70, so that the sample can easily flow out from the sample preparation device.

[72] The action of the sample analysis apparatus of the present embodiment will be described. When a sample flows into the sample storage member 30, a desired amount of the sample is received within the sample capture part of the sample transfer member 40. If the sample capture part is filled with the desired amount of the sample, the cover 45 is pressed so that the sample capture part is positioned within the sample mixing chamber 10 which contains a material representing an optical characteristic. If the sample capture part arrives at the interior of the sample mixing chamber 10, the sample in the sample capture part is mixed with the reagent 11 containing a material representing an optical characteristic within the sample mixing chamber 10.

[73] Next, the piston 12 is moved so that sample-mixed liquid flows to the element 70 for optical measurement, and then an optical signal is inputted to the element. If so, the inputted optical signal represents an optical characteristic by the sample-mixed liquid, and the characteristic of the sample-mixed liquid is measured by analyzing the optical characteristic.

[74] While the invention has been shown and described with reference to certain preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

### **Industrial Applicability**

[75] According to the present invention, because a sample preparation device is adapted to be capable of introducing a precise amount of a sample desired for analysis prior to

a sample analysis, it is possible to perform a precise sample analysis within a very short length of time.

[76]

[77]       \*In addition, according to the present invention, there is provided a sample preparation which is easy and convenient to use and stock, and which can be fabricated in a compact size.

[78]       In particular, according to the present invention, it is possible to retain the volume of a mixing chamber holding a preparation chamber constant with a very simple system, even if a sample is introduced into the mixing chamber.

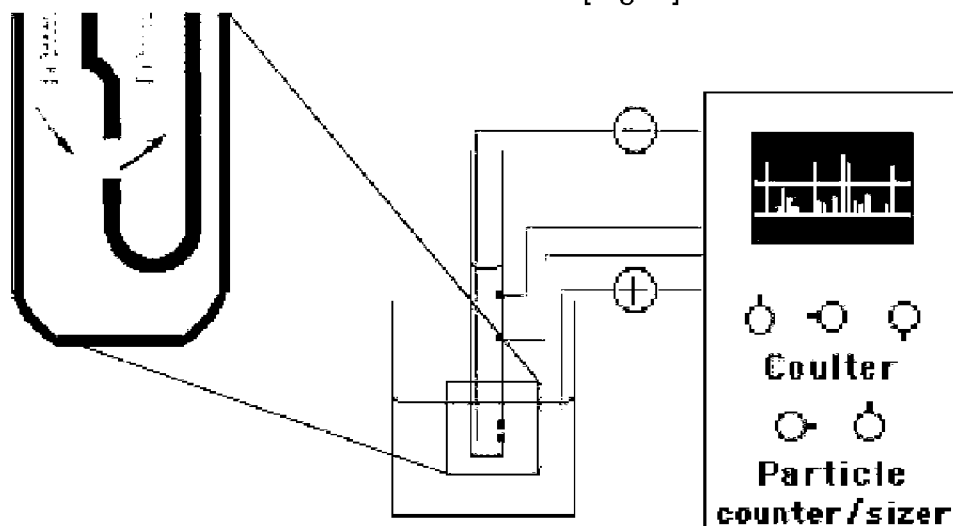
## Claims

- [1] A sample preparation device comprising:  
a sample mixing chamber with an internal space;  
at least one tubular guide member extending from an external surface of the sample mixing chamber and communicating with the internal space of the sample mixing chamber;  
a sample storage member formed at an end of the tubular guide member and providing a space for holding a sample; and  
a sample transfer member with a length extending through the interior of the tubular guide member, the sample transfer member being slidably inserted into the tubular guide member, wherein the longitudinal central area of the sample transfer member is partially removed so that a core part is left, thereby forming a recess surrounding the core part, the recess being capable of holding a desired amount of the sample.
- [2] A sample preparation device comprising:  
a sample mixing chamber with an internal space;  
at least one tubular guide member formed within a wall of the sample mixing chamber and communicating with the internal space of the sample mixing chamber;  
a sample storage member formed at an end of the tubular guide member and providing a space for holding a sample; and  
a sample transfer member with a length extending through the interior of the tubular guide member, the sample transfer member being slidably inserted into the tubular guide member, wherein the longitudinal central area of the sample transfer member is partially removed so that a core part is left, thereby forming a recess surrounding the core part, the recess being capable of holding a desired amount of the sample.
- [3] The sample preparation device as claimed in claim 2, wherein the sample storage chamber is concavely formed on the external wall of the sample mixing chamber communicating with the tubular guide member.
- [4] \*The sample preparation device as claimed in any of claims 1 to 3, wherein the sample transfer member is formed from plastic, rubber, metal or optical material.
- [5] The sample preparation device as claimed in any of claims 1 to 3, wherein the sample storage member has a hemispherical shape.
- [6] The sample preparation device as claimed in any of claims 1 to 3, wherein the cross-section of the sample transfer member is a circular, rectangular or triangular shape.

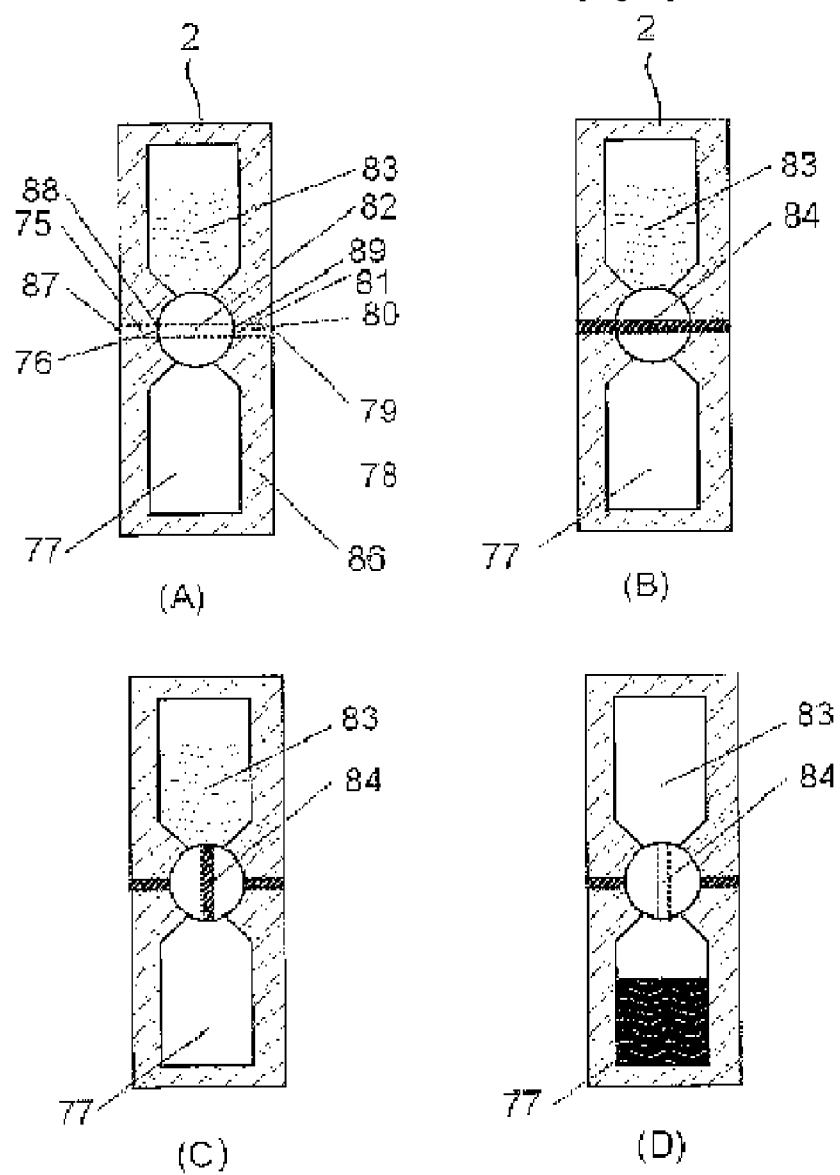
- [7] The sample preparation device as claimed in any of claims 1 to 3, wherein one end of the sample mixing chamber is provided with a piston for extracting a sample-mixed liquid, and the other end of the sample mixing chamber is formed with an extraction part, through which the sample-mixed liquid is extracted.
- [8] The sample preparation device as claimed in any of claims 1 to 3, wherein the wall of the sample mixing chamber is formed with index marks for measuring the sample-mixed liquid or a reagent contained in the sample mixing chamber.
- [9] The sample preparation device as claimed in any of claims 1 to 3, wherein the height of the recess formed on the sample transfer member for holding the sample is determined in such a manner that the recess does not simultaneously communicate with both of the sample mixing chamber and the sample storage member.
- [10] The sample preparation device as claimed in claim 7, wherein the extraction part of the sample mixing chamber is connected with a sample analysis apparatus.
- [11] The sample preparation device as claimed in any of claims 1 to 3, wherein at least one mixing member is provided on the core part of the sample transfer member so as to render the reagent and the sample easily mixed.
- [12] The sample preparation device as claimed in any of claims 1 to 3, further comprising a cover for covering the sample transfer member and the sample storage member.
- [13] The sample preparation device as claimed in any of claims 1 to 3, wherein two tubular guide members are formed, and are positioned opposite to each other.
- [14] A sample analysis apparatus comprising:  
a sample preparation device claimed in any of claims 1 to 3;  
a receptacle holding an electrolyte, the receptacle receiving a sample-mixed liquid extracted from the sample preparation device;  
an internal electrode installed within the receptacle;  
a sensing member positioned opposite to the piston with reference to the sample mixing chamber of the sample preparation device, the sensing member having at least one orifice; and  
a discharge hole, by which the measured liquid is blocked by the wall of the receptacle while the liquid to be measured is smoothly extracted,  
wherein the sample transfer member of the sample preparation member is formed from a metal so that it is used as an electrode, and a voltage opposite to that applied to the internal electrode is applied to the sample transfer member, and  
wherein the sample-mixed liquid in the sample mixing chamber passes the orifice by the movement of the piston, so that the number and size of the sample particles passing the orifice are measured.

- [15] A sample analysis apparatus comprising:  
a sample preparation device claimed in any of claims 1 to 3, the sample preparation device having an orifice formed through the sample mixing chamber at a position opposite to the piston, so that the sample-mixed liquid can flow out through the orifice; and  
an element consisting of a top plate formed with an insertion hole, the end of the sample mixing chamber having the orifice being inserted into the insertion hole, and a bottom plate attached or spaced from the bottom of the top plate, wherein, according to the movement of the piston, the sample-mixed liquid flows out through the orifice to the outside of the sample mixing chamber and passes the element, whereby the optical characteristic of the particles of the sample is analyzed, the sample-mixed liquid being formed as the sample is mixed with a substance representing an optical characteristic within the sample mixing chamber.

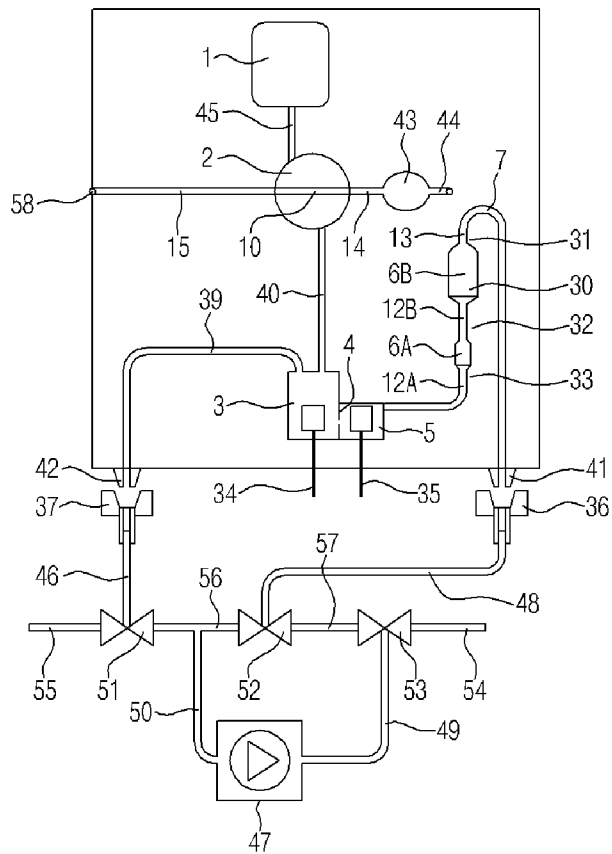
[Fig. 1]



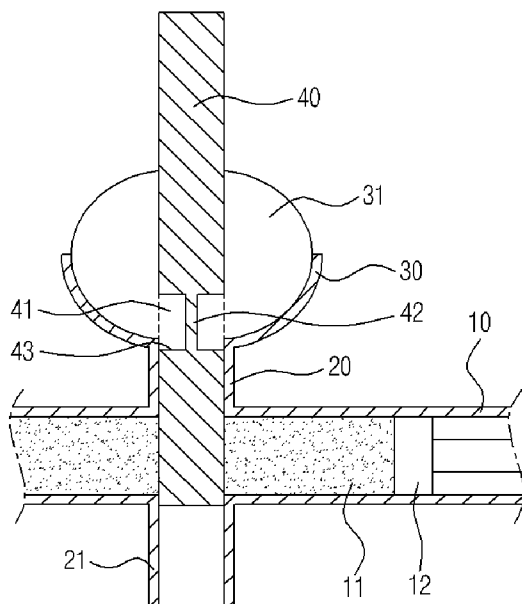
[Fig. 2]



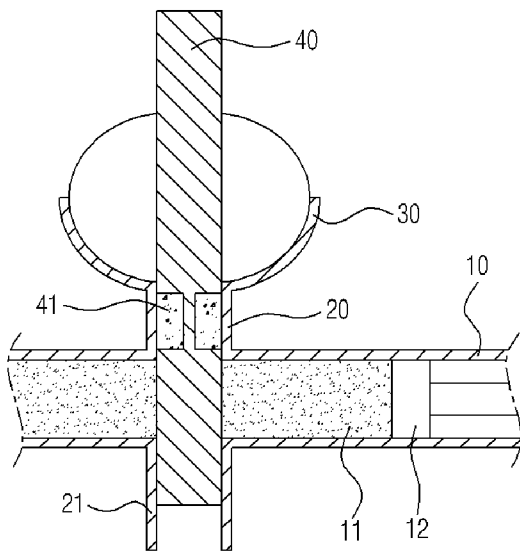
[Fig. 3]



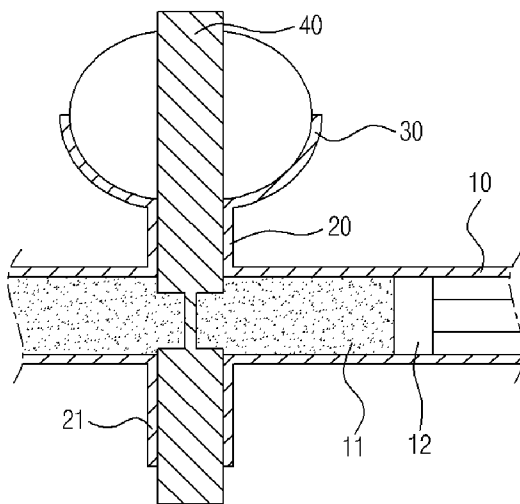
[Fig. 4]



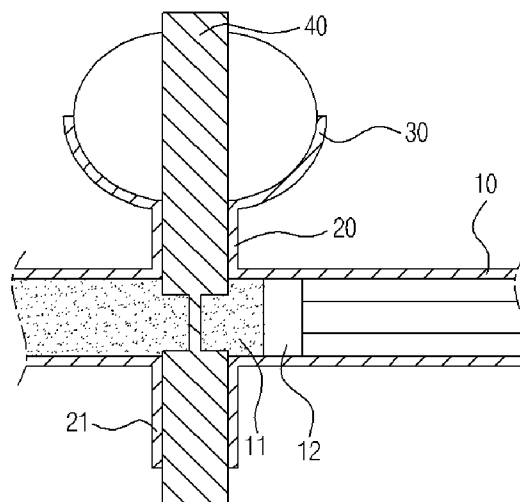
[Fig. 5]



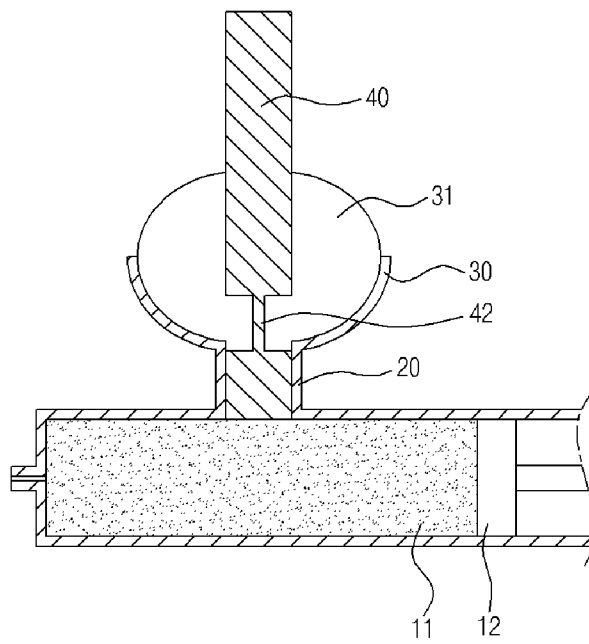
[Fig. 6]



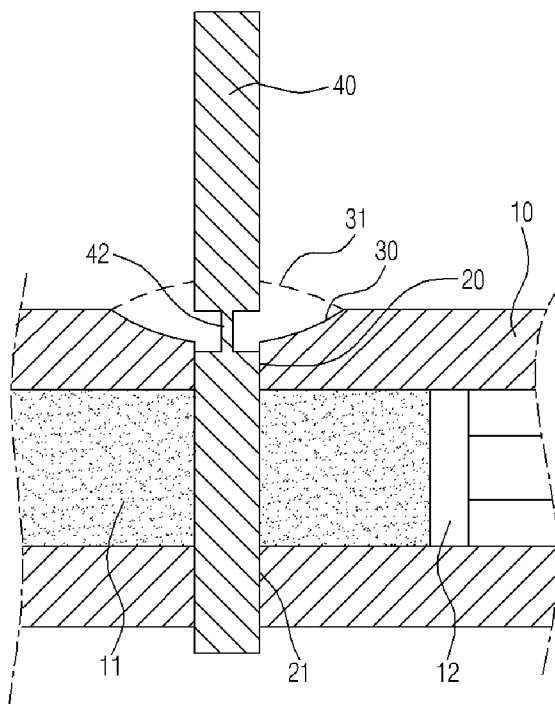
[Fig. 7]



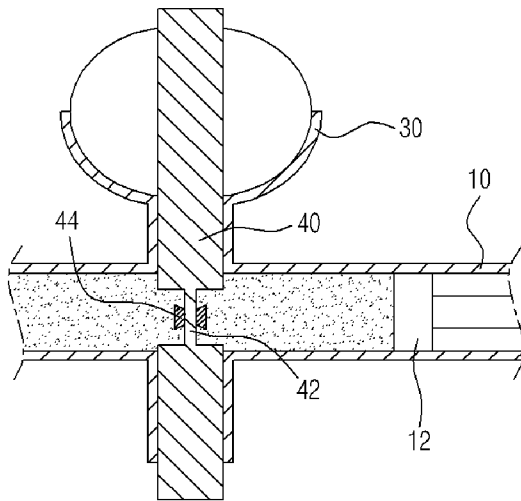
[Fig. 8]



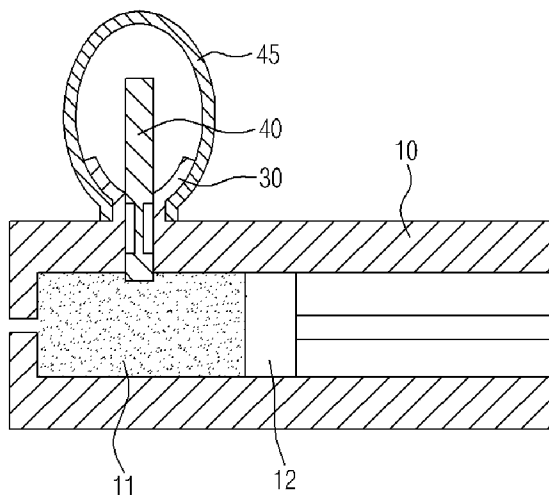
[Fig. 9]



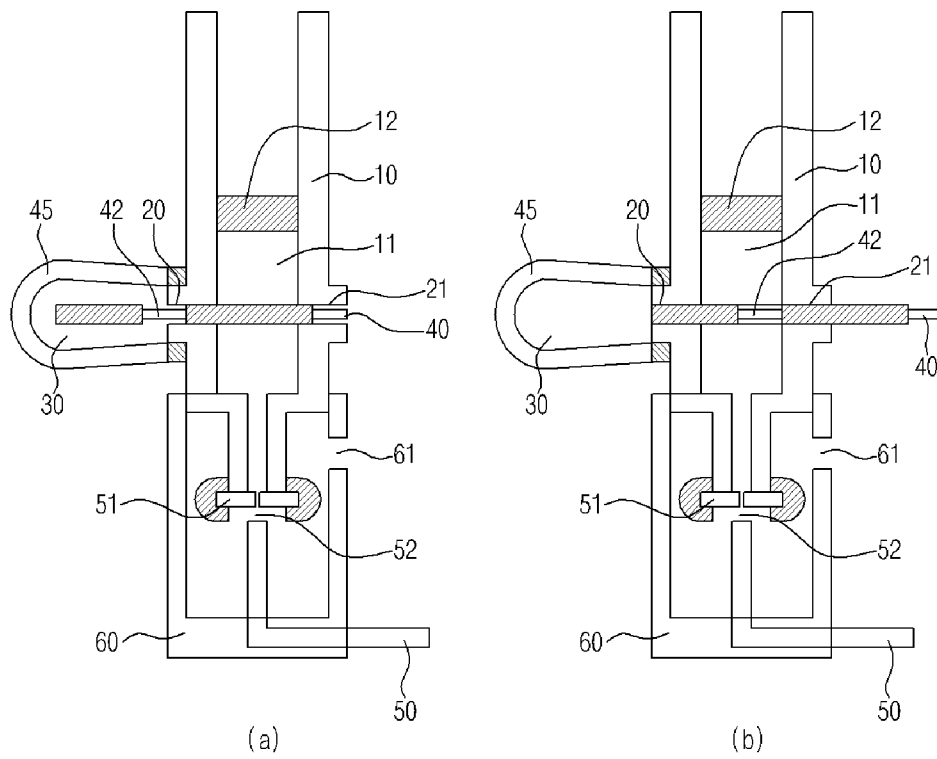
[Fig. 10]



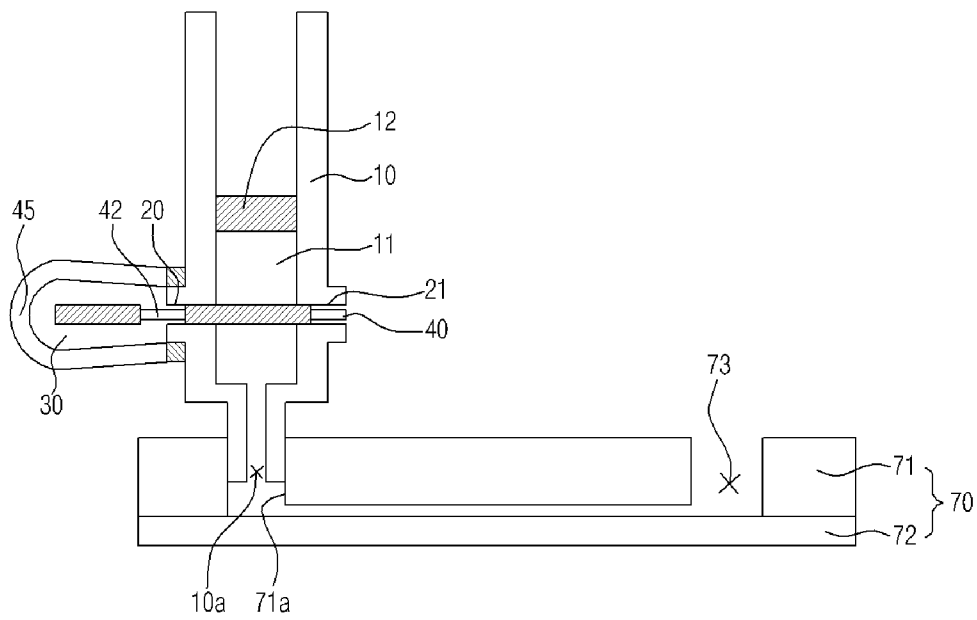
[Fig. 11]



[Fig. 12]



[Fig. 13]



## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/KR2007/006482**

| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                       |                                                                                                                                                             |
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| <i>G01N 1/10(2006.01)i</i>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                       |                                                                                                                                                             |
| According to International Patent Classification (IPC) or to both national classification and IPC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                       |                                                                                                                                                             |
| <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                       |                                                                                                                                                             |
| Minimum documentation searched (classification system followed by classification symbols)<br>IPC 8 G01N 1/20 , G01N 1/22, G01N 33/50, G01N 1/14                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                       |                                                                                                                                                             |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched<br>Korean utility models and applications for utility models since 1975<br>Japanese utility models and applications for utility models since 1975                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                       |                                                                                                                                                             |
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| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                       |                                                                                                                                                             |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Citation of document, with indication, where appropriate, of the relevant passages                    | Relevant to claim No.                                                                                                                                       |
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| <p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> |                                                                                                       |                                                                                                                                                             |
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