United States Patent [19]

Hendry

[11] **3,911,749**

[45] **Oct. 14, 1975**

[54] **SAMPLING PROBES**

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[73] Assignee: **ChemLab Manufacturing Limited**, London, England

[22] Filed: **Oct. 15, 1974**

[21] Appl. No.: **514,510**

[30] **Foreign Application Priority Data**

Oct. 16, 1973 United Kingdom 48116/73
Feb. 7, 1974 United Kingdom 5710/74

[52] **U.S. Cl.** ..... **73/423 A**
[51] **Int. Cl.**[2] **G01N 1/14**
[58] **Field of Search** 73/423; 23/259

[56] **References Cited**

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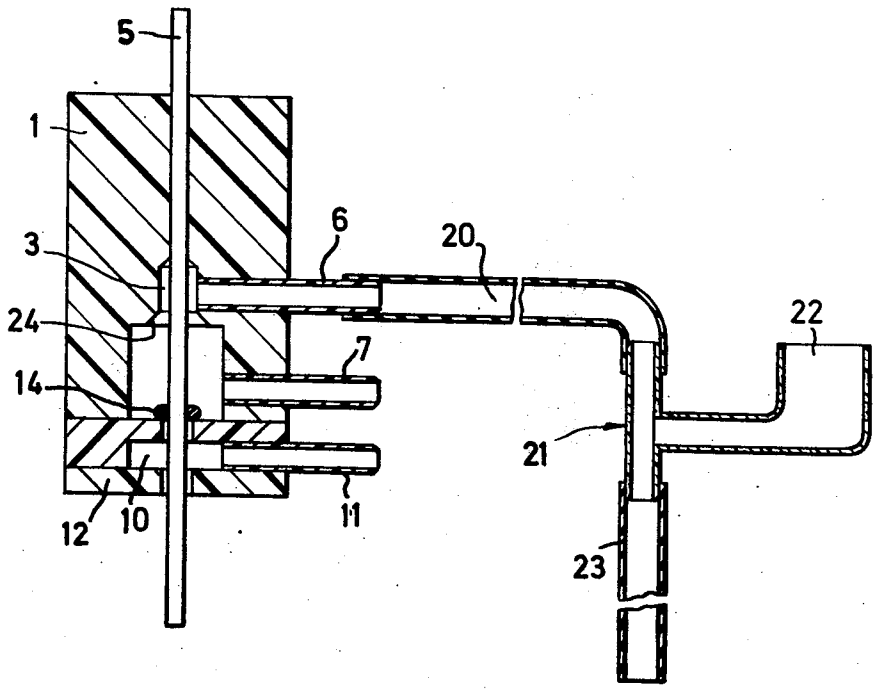
Primary Examiner—S. Clement Swisher
Attorney, Agent, or Firm—Parmelee, Miller, Welsh & Kratz

[57] **ABSTRACT**

A sampling probe comprising a small bore cannula axially reciprocable through a wash chamber between upper and lower positions. Suction is applied at the upper end of the cannula and the lower end has its upper part in the wash chamber and its lower position projecting out of a lower outlet therefrom into a sample cup. The wash chamber has a wash liquid inlet and upper and lower outlets to drain and suction respectively. The cannula using a sealing device for sealing the upper and lower outlets respectively when in the upper and lower positions.

8 Claims, 4 Drawing Figures



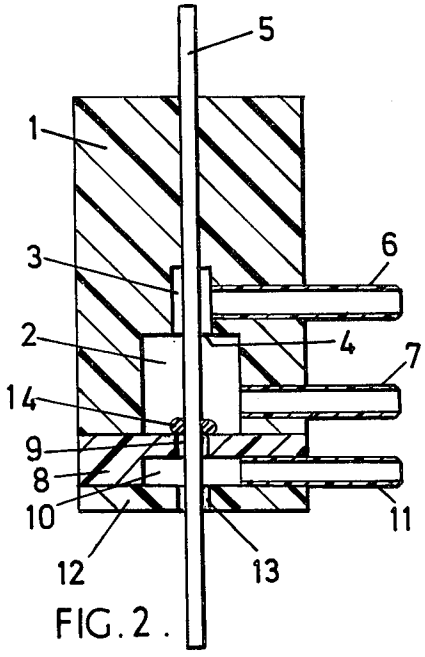
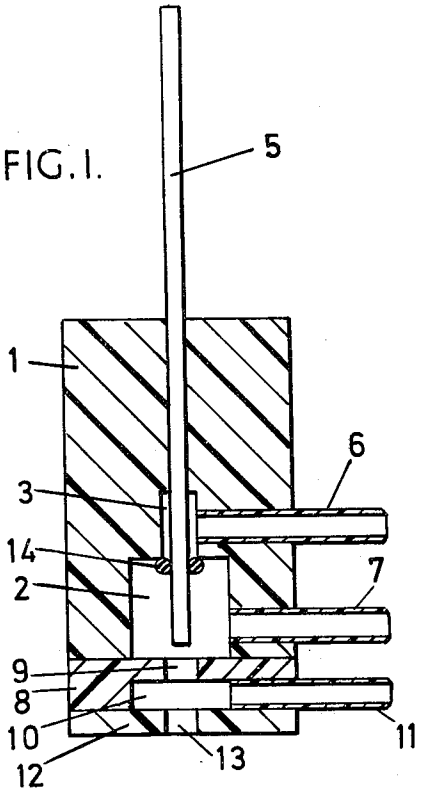


FIG. 2.

FIG. 1.



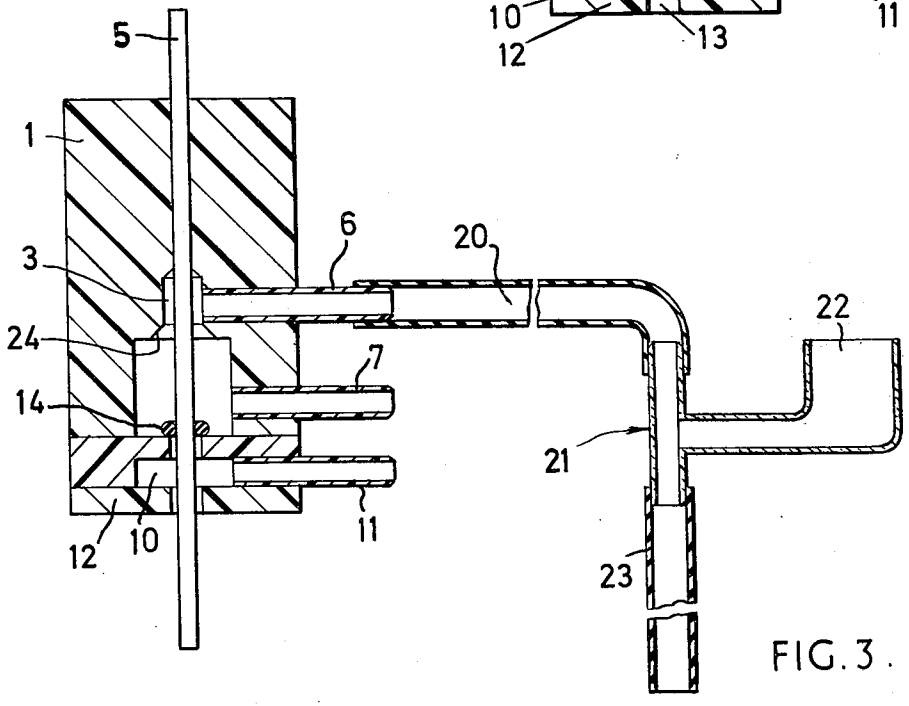


FIG. 3.

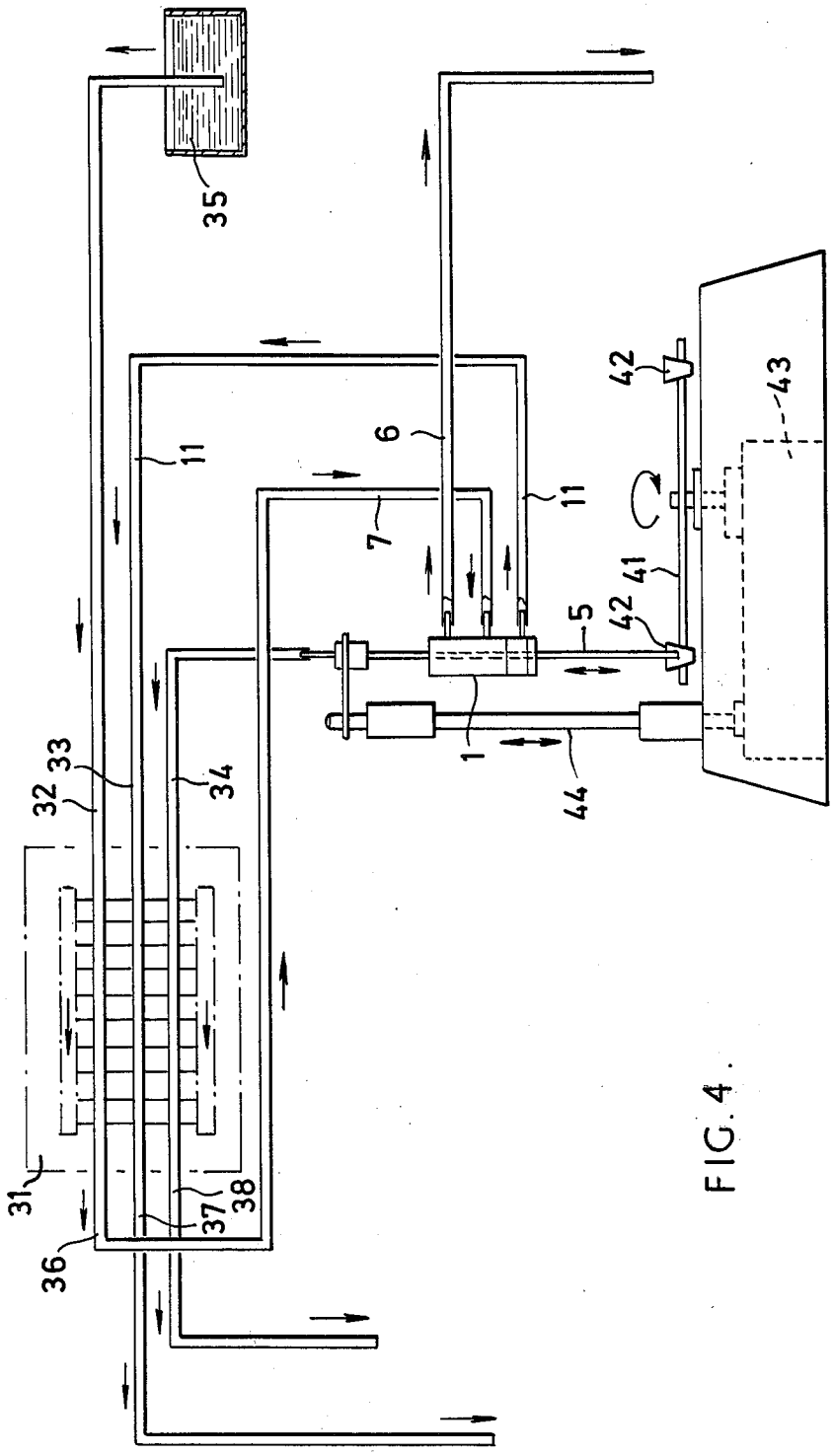


FIG. 4.

SAMPLING PROBES

This invention relates to sampling probes of the type comprising a small bore tube or cannula intended to have a suction applied at one end and to have the other end dipped alternatively into a sample cup and into a wash container filled with water or other cleaning medium so that sample and cleaning medium are drawn alternately through the cannula. This prevents intermixing or cross contamination of the samples. The successive samples are subjected to analysis or testing, e.g. by testing with reagents and subsequent colorimetry to assess the results of the tests. In one type, the results are recorded graphically and continuously.

One prior form of such a sampling probe has included mechanism for reciprocating the cannula axially to dip into the sample cup or wash container and also to swing bodily around an axis to translate it between the sample cup and the wash container. Such a motion requires a complex mechanical drive to produce the required rotary and axial reciprocation, particularly if the movements have to be synchronised with an indexing sample cup holder. Also, there is a comparatively long transfer time between successive sampling actions.

According to the present invention, a sampling probe of the type described has the wash container in the form of a reservoir chamber having an inlet for washing liquid and opposed upper and lower outlets, the cannula extending through the upper outlet and being axially reciprocable between a wash position in which its lower end is within the reservoir chamber and a sample position in which the lower end extends through the lower outlet so as to extend into a sample cup when such is located below the said lower outlet, a sealing member being carried by the cannula to seal the upper outlet in the wash position and the lower outlet in the sample position of the cannula, and a suction zone being provided below the lower outlet adapted to be connected to a source of vacuum to prevent washing liquid passing from the lower outlet into a sample cup below the lower outlet.

Preferably, the sealing member is sealingly slidable on the outer surface of the cannula whereby the axial stroke of the cannula between the wash and sample positions may exceed the axial distance between the upper and lower outlets.

The action of the cannula is thus purely axial and therefore much simpler to drive and the time interval between successive samples can be reduced.

The invention will be further described with reference to the drawing accompanying the provisional British specification No. 48116/73 and the accompanying drawing.

In the drawing accompanying the provisional British specification No. 48116/73:

FIG. 1 is a sectional view of a preferred form of sampling probe according to the invention in one operating position; and

FIG. 2 is a view similar to FIG. 1 showing the other operating position.

In the accompanying drawing:

FIG. 3 is a diagrammatic sectional view showing some modification, and

FIG. 4 is a diagram illustrating a complete sampling system.

The FIGS. 1 and 2 of the drawing show a body 1, e.g. of polymethyl methacrylate, formed with an internal

reservoir chamber 2 of cylindrical shape leading at its upper end into a reduced diameter outlet zone 3, with a shoulder 4 at the junction, the said zone 3 forming an upper outlet from the chamber 2. Above the zone 3 there is a bore within the body 1 which accommodates a small bore tube or cannula 5 for free sliding motion. A drain or overflow outlet 6 communicates with the zone 3, and a water inlet 7 communicates with the reservoir chamber 2.

Below the lower end of the body 1, there is a ring 8 having a central aperture 9 opening out into an annular suction chamber 10 communicating with a suction line 11 and partly closed by an end cap 12 having a central aperture 13 through which the cannula 5 extends in the position shown in FIG. 2.

The cannula 5 has an O ring 14 slidably received thereon and which closes the upper outlet from the reservoir chamber 2 when in the FIG. 1 position and the lower exit when in the FIG. 2 position.

The sample probe illustrated is intended to be used with an integrated testing apparatus of the type illustrated in FIG. 4.

The apparatus of FIG. 4 includes a peristaltic pump 31 with inlets or suction lines 32, 33 and 34 from a water reservoir 35, the line 11 and the cannula 5 respectively. The corresponding outlets 36, 37 and 38 lead respectively to the line 7, waste or drain and an analysis system. The apparatus is further shown as comprising a sample tray 41 having equally circumferentially spaced sample cups 42 and arranged to be indexed about its axis in steps equal to the angular pitching of the cups 42. A drive unit 43 co-ordinates this motion with the reciprocation of the cannula 5 by means of a rod 44 also driven from the unit 43.

In operation, the assembly of the body 1, the ring 8, and the end cap 12 is located above the indexing sample tray 41 which presents the cup 42 seriatim beneath the assembly.

In the position illustrated in FIG. 1, the O ring 14 is cooperating with the shoulder 4 to seal the oulet from the top of the reservoir chamber 2. Washing water is being fed in by the peristaltic pump through the line 7 to the reservoir chamber and part of this is being drawn up through the cannula 5 by the peristaltic pump, and the surplus water passes through the central aperture 9 in the ring 8 to the suction chamber 10 from where it is drawn by the peristaltic pump into the line 11. By maintaining a sub-atmospheric pressure within the suction chamber 10, leakage through the central aperture 13 of the end cap 12 is prevented, and in fact a certain amount of air is drawn upwards through this aperture into the suction chamber.

In this mode of operation, the outside of the cannula 5 is to a certain extent washed in the flow of water, and water is also drawn up through the cannula to flush the inside of it and to separate successive samples. After a suitable washing period, during which the next succeeding sample cup will be indexed to its position below the central aperture 13 of the end cap 12, the cannula will be moved axially downwardly from the position of FIG. 1 to that of FIG. 2, by the rod 44 suitably synchronised with the indexing mechanism.

During this motion, the O ring 14 first clears the shoulder 12 to open the upper exit from the reservoir chamber 2, and then passes downwardly until it engages the shoulder formed at the lower end of the reservoir chamber 2 by the ring 8, and it thus seals the en-

trance to the central aperture 9 of this ring. In general, the required stroke of the cannula 5 will be somewhat longer than the length of the reservoir chamber 2 itself, and in order to accommodate this, the cannula is arranged so it can continue to slide within the O ring 14 until it projects sufficiently far through the aperture 13 to extend into the sample cup. At this point, the sample will be sucked through the cannula by the pump. The supply of water through the line 7 will pass through the upper outlet from the reservoir chamber 2 and out through the overflow line 6. This flow washes out the reservoir chamber so as to free it from contamination by the previous sample.

When sampling has been continued for a sufficiently long period, the cannula 5 is once more moved upwardly, initially carrying the O ring 14 with it so as to open the lower outlet from the reservoir chamber 2 and subsequently reseal the upper outlet. The additional motion of the cannula 5 is once more absorbed by its sliding through the O ring 14.

This sliding of the cannula 5 within the O ring 14 eliminates any necessity for accurate adjustment of the motion of the cannula 5 in relation to the chamber 2, and ensures that there is always a positive seal by the O ring.

Since the cannula 5 passes through the suction chamber 10 on its way from the sampling cup to the inside of the reservoir chamber, there is a tendency for any sample adhering to the outside of the cannula 5 to be drawn off during this movement, which speeds up the washing process, thereby reducing the delay between successive sampling operations.

It will be appreciated that a peristaltic pump applies pulsating pressure and vacuum to the lines 7 and 11 respectively, and consequently in the washing position illustrated in FIG. 1, there is generally a pulsating bubble of air within the suction chamber 10, and tending to pass up the aperture 9 into the reservoir chamber itself. By careful choice of the washing position of the cannula, it can be arranged that this bubble will in fact reach the cannula and be induced into the flow therein, so that a series of air bubbles will enter the cannula 5 during the washing process. Such air bubbles create an efficient scavenging within the cannula by breaking up the continuous stream of washing water. This scavenging action continues along the line through the peristaltic pump.

By using apparatus as illustrated, and in the manner described there is achieved a clearer definition between the samples and the succeeding wash modes, and within the cannula and succeeding lines, there is a clear distinction between successive samples themselves. This means that it is easier to distinguish between results of low value and between successive samples in the normal graphical presentation of results on the continuous recorder.

It has been found that when the cannula moves from the "sampling" position of FIG. 2 to the "wash" position of FIG. 1, there is a tendency for excessive amounts of air to be drawn into the lower outlet due to the siphoning effect caused by the weight of water present in the overflow tube 20 connected to the overflow outlet 6.

It has been found that there is an optimum length of overflow tube with which the sampler works most efficiently; too short a tube does not provide sufficient "drag" to prevent the tendency for the water in the reservoir chamber to drop when the cannula 5 starts its downwards movement. Conversely too long a tube leads to the siphoning effect mentioned earlier.

Accordingly, it is advantageous to provide a flexible overflow tube 20 from the overflow outlet 6 which is of adequate length to provide drag to maintain the wash liquid level in the reservoir chamber. FIG. 3 shows such a tube 20 leading to a vent fitting 21, provided with an upstanding, open topped, wide vent tube 22 to prevent liquid overflow through the vent tube, the vent fitting being adapted to take an exhaust line or waste pipe 23 of any desired length.

This vent fitting 21 prevents siphoning occurring beyond the fitting and thus the user is not restricted to the length of actual waste pipe 23 he may use.

Furthermore, because of the absence of siphoning, little or no air is drawn into the reservoir on its upward movement, thus maintaining a virtually full reservoir chamber.

FIG. 3 also shows the provision of a taper 24 instead of a shoulder 4 between the reservoir chamber 2 and the outlet zone 3 to provide a better seat for the O ring 14. A similar taper may be provided at the lower outlet.

Various modifications may be made within the scope of the invention.

I claim:

1. In a sampling probe of the type comprising a small bore cannula intended to have a suction applied at one end and to have the other end dipped alternately into a sample cup and into a wash container filled with water or other cleaning medium so that sample and cleaning medium are drawn alternately through the cannula: the improvement that the wash container is in the form of a reservoir chamber having an inlet for washing liquid and opposed upper and lower outlets, the cannula extending through the upper outlet and being axially reciprocable between a wash position in which its lower end is within the reservoir chamber and a sample position in which the lower end extends through the lower outlet so as to extend into a sample cup when such is located below the said lower outlet, a sealing member being carried by the cannula to seal the upper outlet in the wash position and the lower outlet in the sample position of the cannula, and a suction zone being provided below the lower outlet adapted to be connected to a source of vacuum to prevent washing liquid passing from the lower outlet into a sample cup below the lower outlet.

2. A sampling probe as claimed in claim 1, in which the sealing member is sealingly slidable on the outer surface of the cannula.

3. A sampling probe as claimed in claim 2, in which the sealing member is an O ring.

4. A sampling probe as claimed in claim 1, in which at least one of the outlets is provided in a taper surface to provide a seat for the sealing member.

5. A sampling probe as claimed in claim 1, in which an overflow tube leading from the upper outlet to a vent fitting is provided siphoning back.

6. A sampling probe as claimed in claim 5, in which the overflow tube is flexible.

7. A sampling probe as claimed in claim 5, in which the overflow tube is of a length sufficient to provide drag to maintain the liquid level in the reservoir chamber.

8. A sampling probe as claimed in claim 5, in which the vent fitting is provided with an upstanding vent tube to prevent overflow through the vent tube and has an outlet connection adapted to take an outlet of any desired length.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : **3,911,749**

DATED : **October 14, 1975**

INVENTOR(S) : **Robert John Hendry**

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 5, line 3, after "is provided" insert

--to prevent--.

Signed and Sealed this

sixth Day of *January 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks