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Lemieux et al.

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[45] **Sept. 2, 1975**

[54] **APPARATUS FOR MULTIPLE SAMPLE APPLICATION**

[75] Inventors: **Bernard Lemieux,** Sherbrooke; **Dennis Shapcott,** Lennoxville; **Apostolos Sahapoglu,** Brossard, all of Canada

[73] Assignee: **Universite de Sherbrooke,** Sherbrooke, Canada

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[52] **U.S. Cl.** ..... **23/259;** 23/253 R; 73/425.6; 73/425.4 R; 141/130

[51] **Int. Cl.** **G01n 1/14**

[58] **Field of Search** ..... 23/230 R, 253 R, 259, 292; 73/425.6, 425.4 R; 141/130

[56] **References Cited**

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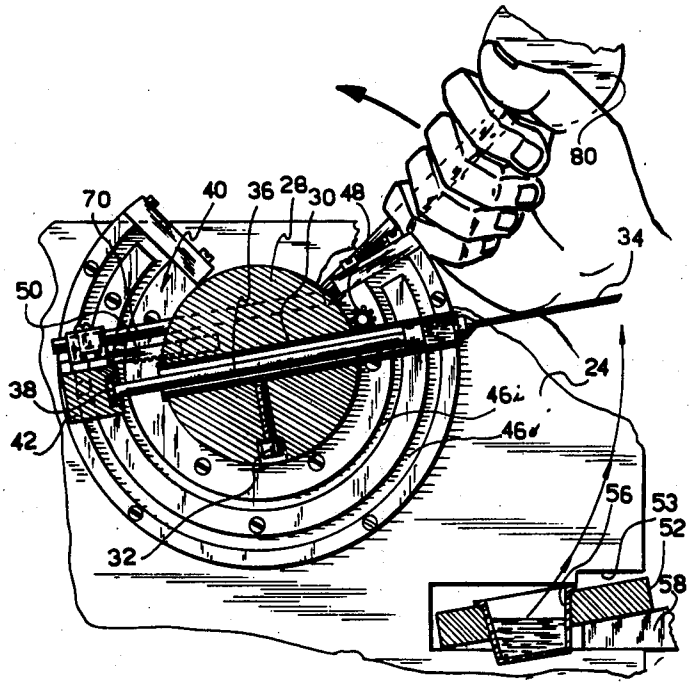
Primary Examiner—R. E. Serwin

Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

A plurality of laterally spaced apart syringes are carried on a rotatable rod, their plungers being fixedly secured in a drive bar so that the plungers are simultaneously displaceable in one position to aspirate a predetermined quantity of sample and in another position to deliver a given quantity of the sample. Drive means are provided for simultaneously displacing the drive bar in the sample delivery direction and horizontally displacing the sample delivery station.

9 Claims, 10 Drawing Figures



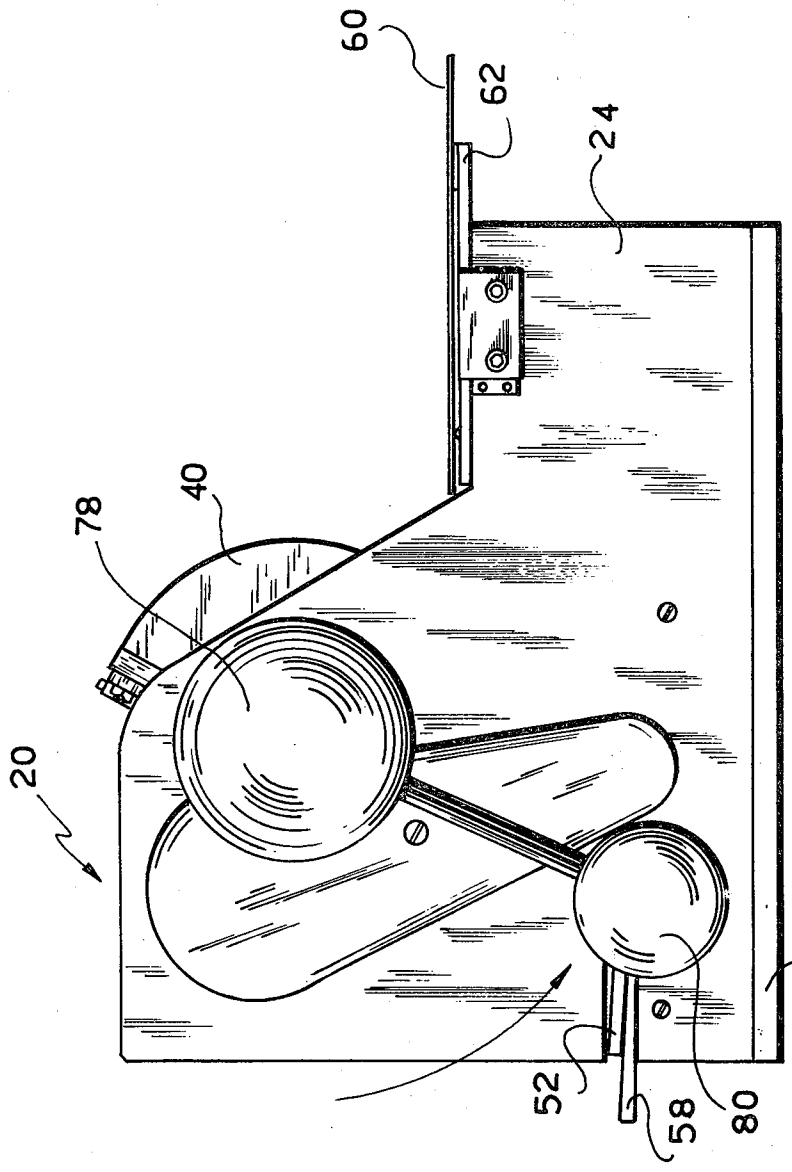


FIG.1

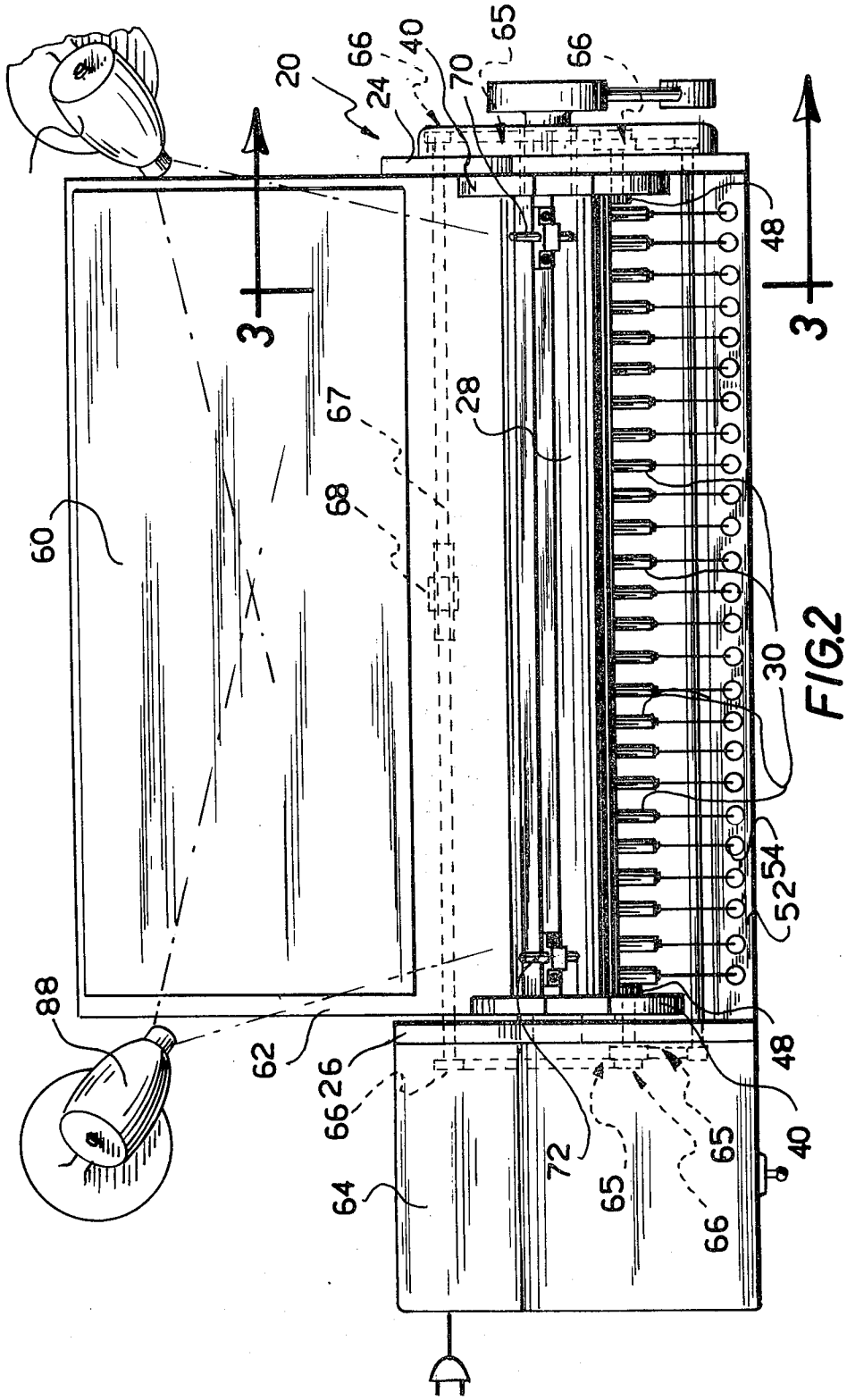

20
66
40
24
70
65
66
3
3
48
67
28
68
60
30
54
52
88
62
26
66
48
40
72
65
65
64
66

FIG.2

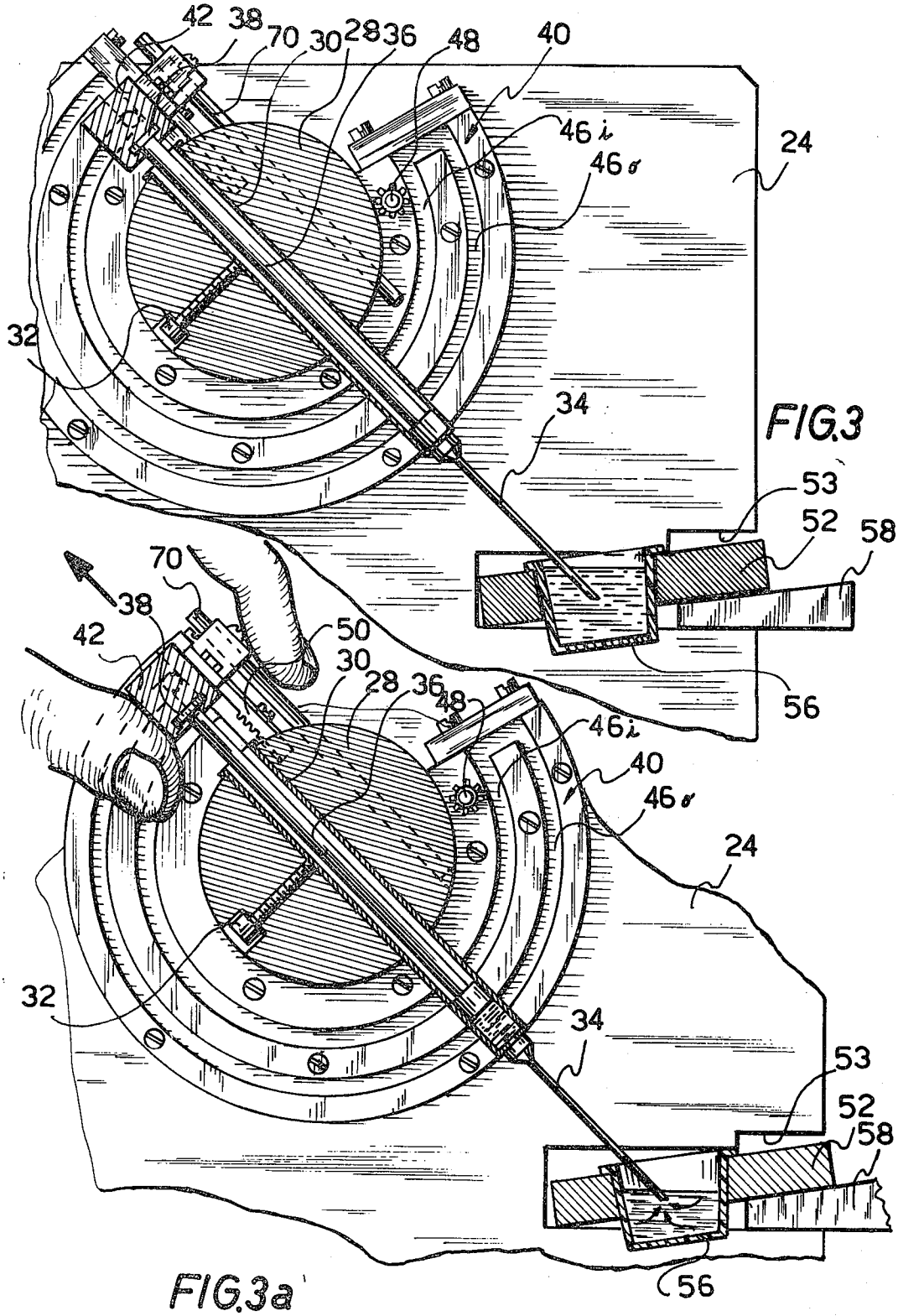

42
38
70
30
28
36
48
40
46i
46o
24
32
34
53
52
58
56
70
38
42
50
30
28
36
48
46i
40
46o
24
32
34
53
52
58
56

FIG.3

FIG.3a

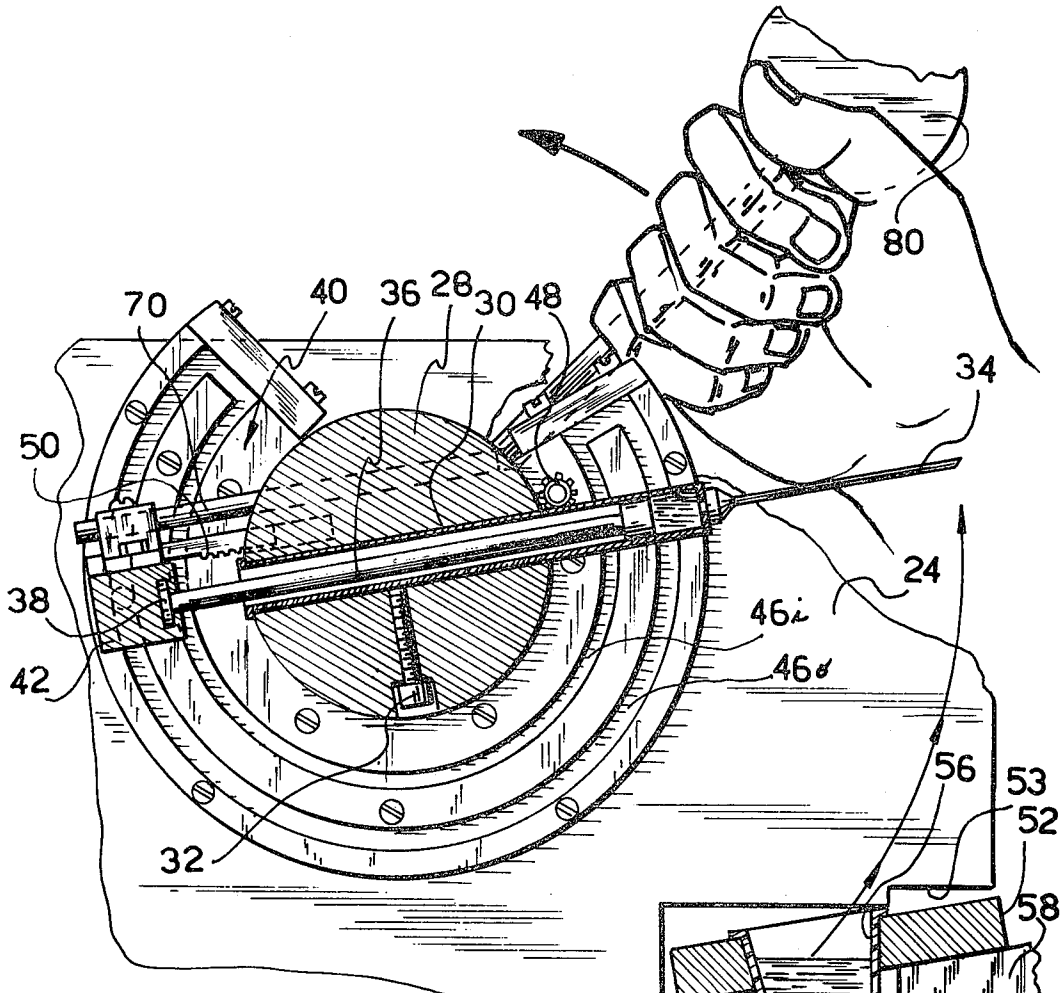

80
70
40
36
28
30
48
34
50
24
38
46i
42
46o
56
53
52
32
58

FIG.4

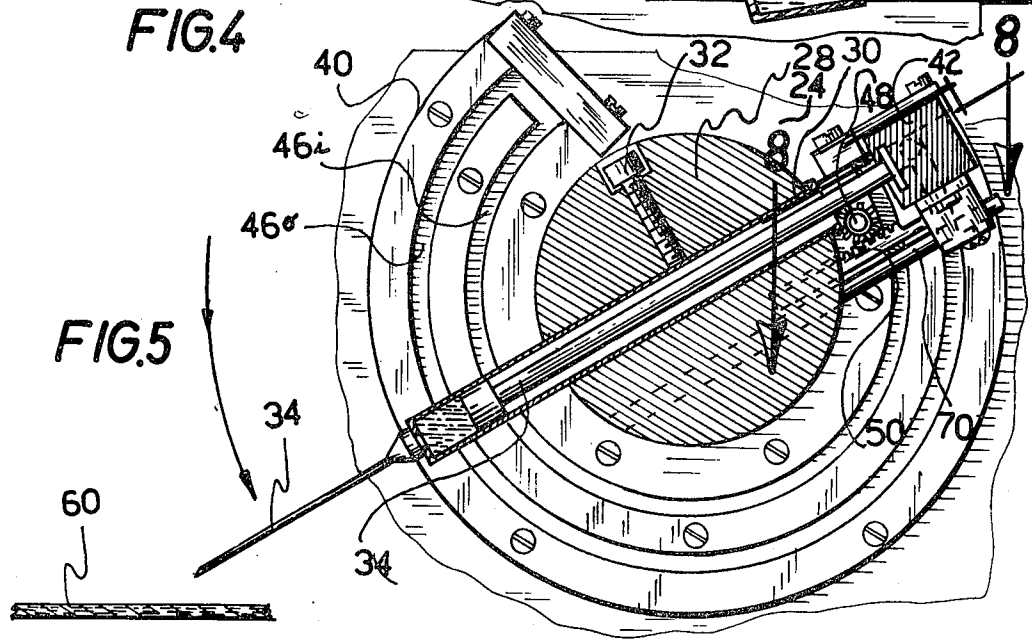

40
32
28
30
42
24
48
8
46i
46o
50
70
34
60
34

FIG.5

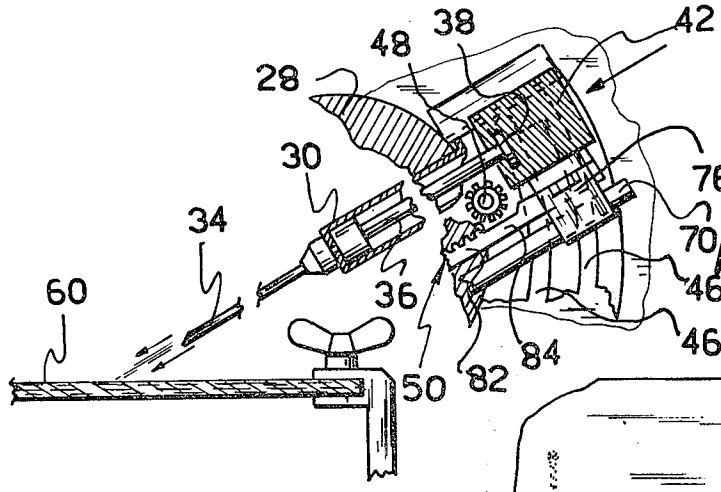


FIG.6

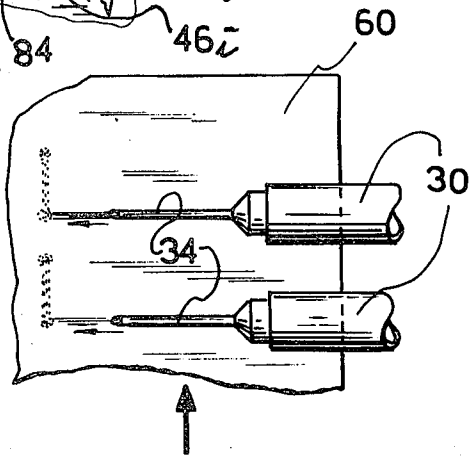


FIG.7

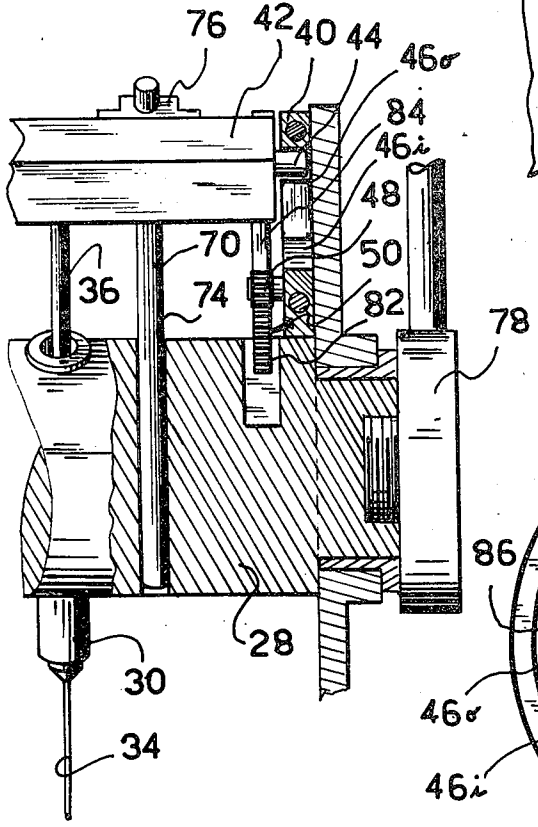


FIG.8

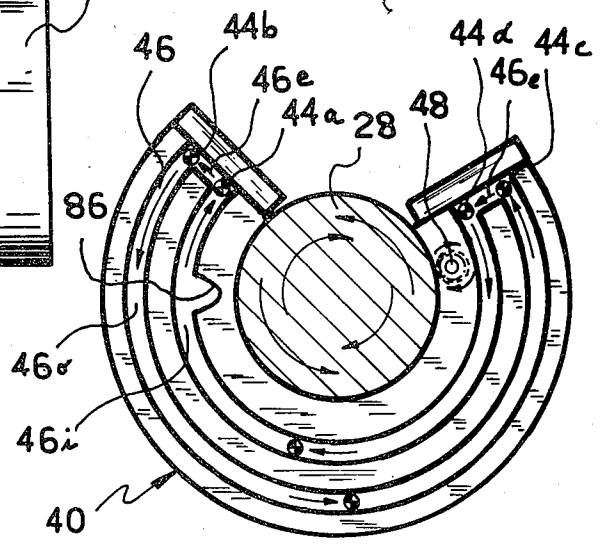


FIG.9

APPARATUS FOR MULTIPLE SAMPLE APPLICATION

This invention relates generally to laboratory apparatus and more particularly to a sampling and discharging apparatus capable of withdrawing into a plurality of syringes predetermined quantities of liquid and of delivering same on a liquid separating paper or plate for examination purposes.

In the laboratory, it is often necessary to perform analytical tests on a large number of samples. It is therefore desirable that such tests be performed within a minimum amount of time and with extreme accuracy and precision to eliminate error. For example, on dimensional chromatography of amino acids in biological sample has become established as a standard technique for the screening of metabolic disorders of the newborn. Thin layer chromatography (often referred to as TLC) has been used which offers the advantages of reduced development time, a homogeneous medium giving improved separation, and the possibility of varying the separating medium. Until now, the application of samples has usually been performed manually and has required a great deal of time. Some tests involve the examination of hundreds of thousands of samples annually for abnormalities of amino acid excretion, organic acid excretion, keto acid excretion and other metabolites. In recent years, there has been developed a tremendous need for rapid screening of body fluids for drug abuse. Because of the rapidity and superiority of separation, thin layer chromatography has been used largely for these purposes. Because of the relatively small fluid capacity of the TLC plates, the application of samples remains a time-consuming procedure. Several spotting devices have been designed to deliver predetermined quantities of samples to plates, but these are designed to apply aliquots of the same sample in a highly reproducible fashion and not to deliver simultaneously a large number of different samples.

It is therefore an object of this invention to provide an apparatus which delivers samples in an automated manner rapidly and reproducibly.

Another object of the present invention resides in the provision of a compact laboratory apparatus for multiple sample application capable of simultaneously withdrawing from a series of sample containers a predetermined reproducible quantity of the sample and of dispensing simultaneously the same onto a separation plate or paper.

A further object of the present invention resides in the provision of a novel semi-automatic apparatus for multiple sample application to thin layer chromatography plates.

The present invention relates to an apparatus for multiple sample application to a sample separation means which comprises a horizontally-mounted rotatable rod means, a plurality of laterally-spaced apart syringes carried on the rod means, each syringe including a plunger and a needle, a horizontally-mounted displaceable drive bar means fixedly receiving each plunger whereby the plungers are simultaneously displaceable relative to the rod means, first station means disposed adjacent one side of the rod means and including a plurality of laterally-spaced apart samples receiving means, each receiving means being aligned with an associated needle, second station means disposed adjacent the opposite side of said rod means for receiving a sample separation means; the rod means is rotatable from the first station means, where the drive bar means is displaced in one direction to aspirate in each syringe a predetermined quantity of the sample, to the second station means where the drive bar means is displaced in the opposite direction to deliver a given quantity of the sample on the sample separation means.

In one preferred form of the invention, the apparatus includes drive means for simultaneously displacing the drive bar means in the sample delivery direction and for horizontally displacing the sample separation means to provide a uniform sample application line thereon.

Having thus generally described the nature of the present invention, particular reference will now be made to the accompanying drawings showing by way of illustration the preferred embodiment thereof, and in which:

FIG. 1 is a side elevational view of the apparatus made in accordance of the present invention;

FIG. 2 is a top plan view of the apparatus shown in FIG. 1;

FIG. 3 is a cross-sectional view taken along lines 3—3 of FIG. 2 and showing one syringe needle in one associated sample;

FIG. 3a is a cross-sectional view taken along lines 3—3 of FIG. 2 and showing the syringe being filled with the sample;

FIG. 4 is a cross-sectional view illustrating the syringe carrying rod being rotated in a counter-clockwise manner;

FIG. 5 is a cross-sectional view showing the syringe needle over the sample separation means;

FIG. 6 is a broken-apart view similar to FIG. 5 but illustrating the sample being discharged on the separation means;

FIG. 7 shows two sample application lines of two adjacent syringes;

FIG. 8 is a cross-sectional view taken along lines 8—8 of FIG. 5; and

FIG. 9 is a schematic representation of the travel of the drive bar means.

Referring to FIGS. 1 and 2, the novel pick-up and dispensing apparatus 20 comprises a base plate 22 and two vertically upstanding side walls 24 and 26 fixed to the base plate 22 and supporting therebetween for rotation a horizontally extending circular rod 28 carrying a plurality of syringes 30 equidistantly placed along the rod at right angles to the longitudinal axis thereof. The syringes are retained within the rod by bolts 32 (see FIGS. 3–5) and may be adjusted and removed by releasing the bolts. Each syringe includes a needle 34 and a plunger 36 with its head 38. Rod 28 is supported in a pair of U-shaped members 40 screwed or otherwise secured to side walls 24 and 26 but is free to rotate therein. The head 38 of each plunger is held within a drive bar 42, the ends of which are equipped with lugs 44 (one of which is shown in FIG. 8). The lugs are received in grooves 46 provided in each plate 40 and defining an endless track in which the lugs may travel. Each groove includes an outer portion 46*o*, an inner portion 46*i*, and two end portions 46*e*.

Also secured on each plate 40, is a pinion 48 which is adapted to engage a toothed rack 50 mounted on the drive bar 42, the function of which will hereinafter be described. Rack 50 is mounted parallel to the syringes 30.

Mounted at the front portion of the apparatus **20** and disposed longitudinally along one side of the rod **28** is a first station means which includes a rack **52** having a series of wells **54** to receive therein a series of containers **56** containing the liquid sample to be tested. Rack **52** is removably supported in openings **53** provided in side walls **24** and **26** and is also adjustable to receive therebeneath a tapered member **58** which inclines the containers in a proper aspirating position for the needles **34.** Mounted at the rear portion of the apparatus **20** and disposed longitudinally along the opposite side of rod **28** is a second station means which includes a sample separation means **60,** which is preferably a thin layer chromatography plate, supported on a longitudinally moveable base **62.** The constituents of the thin layer chromatography plate are well known to those skilled in the art and include silica gel and cellulose.

A motor **64** is provided adjacent side wall **26** to drive appropriate means, such as shafts **65** and gears **66** represented in dotted lines in FIG. **2,** which cooperate to actuate pinions **48** and the mechanism for advancing the base **62** with its plate **60.** An example of such advancing mechanism may include a threaded bar **67** carring a spring-release catch **68** for the base so that once the base has moved a predetermined distance it may be disengaged and returned manually to its starting position.

Drive bar **42** is manually displaceable relative to rod **28** and this movement is assisted by means of two guide means **70** and **72** which slide into two openings excentrically located in rod **28,** one of which is shown as **74** in FIG. **8.** These guide means are fixedly secured to the drive bar means **42** by appropriate securing means **76.**

The description of the operation of the apparatus will now be described.

Referring to FIG. **3,** the apparatus is shown in its starting position. All needles **34** have their extremities immersed in the samples to be analyzed. As explained above, the angled member **58** pivots rack **52** to ensure that the extremities of the needles are well immersed in the containers **56.** In this position, the lugs **44** are located at **44***a* (see FIG. **9**) in groove **46***i* and the syringe plunger retaining drive bar **42** is in its closest position to rod **28.** Drive bar **42** is then manually withdrawn thereby aspirating the samples into all the needles and partly into the barrel of the syringes. Lugs **44** are now in a position **44***b*. Then, by means of a handle **78,** rod **28** is rotated counter-clockwise (see FIG. **4**) causing lugs **44** to follow groove **46***o* until they reach the position **44***c*. There, racks **50,** which are integral with the drive bar **42** engages pinions **48.** Motor **64** is then started and the syringe plunger retaining drive bar **42** is driven toward rod **28** thereby displacing the fluid from the syringes while the chromatography plate is moved laterally simultaneously (see FIGS. **5, 6** and **7**). For a vibration-free delivery, handle **78** is provided with a weighted extension **80;** other means of securing the rod **28** during delivery will be evident to those skilled in the art. Lugs **44** are in position **44***d*. The quantity of sample being delivered is determined by the toothed portion **82** of rack **50** which includes a straight non-toothed portion **84** (see FIG. **6**) where pinion **48** is no longer engaged with rack **50** and rotates freely until the motor is stopped. After delivery is completed, the drive bar **42** is manually returned to its starting position with lugs **44** in grooves **46***i*. The process is then repeated for other samples on other chromatography plates.

Although not illustrated in the drawings, the process may be slightly modified so that only a fraction of the volume aspirated in the syringe is delivered on each occasion to avoid contamination between the specimens. Referring to FIG. **9,** as the lugs **44** move from position **44***c*, they may be made to stop by proper pinion and rack arrangement before reaching position **44***d*, say half-way therebetween thereby delivering half the quantity aspirated. The chromatography plate is then removed and the drive bar is then displaced to position **44***d* for discharging the remaining portion of the samples in the syringes.

In cases where the aspirating trajectory **44***a*–**44***b* equals the delivering trajectory **44***c*–**44***d*, an additional groove **86** (see FIG. **9**) may be cut into the inner groove **46**i so that when the drive bar is pushed fully into this groove **86** the syringe is emptied completely.

Heating means **88** (FIG. **2**) may be provided to accelerate the drying process of the sample on the chromatography plate.

The invention has provided a tremendous improvement in the number of samples which can be applied within an hour by a technician. It has been found that with an apparatus having **23** syringes, **600** samples may be applied within an hour while the same technician can only apply manually **25** samples per hour.

Although the invention has been described above in relation to one specific form of the invention, it will be evident to those skilled in the art that it may be modified and refined in various ways. For example, for other types of samples, it may be necessary to provide a different quantity of delivery; for so doing, plates **40** may be replaced with other plates having differently spaced grooves or with syringes having different barrel volume. It is therefore wished to have it understood that the present invention is not limited in interpretation except by the terms of the following claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An apparatus for the simultaneous collecting of multiple samples and for the simultaneous dispensing thereof onto a sample separation means comprising, in combination:

a. a horizontally mounted rotatable support means;

b. a plurality of laterally spaced apart syringes carried on said support means, each said syringe including a plunger and a needle;

c. a horizontally mounted displaceable drive bar means fixedly receiving each said plunger for simultaneously displacing said plungers relative to said support means;

d. first station means disposed adjacent one side of said support means and including a plurality of laterally spaced apart sample receiving means, each said receiving means being aligned with an associated needle;

e. second station means disposed adjacent the opposite side of said support means for receiving the sample separation means; said support means being rotatable from said first station means, where said drive bar means is displaced in one direction to simultaneously aspirate in each said syringe a predetermined quantity of said samples, to said second station means where said drive bar means is dis-

placed in the opposite direction to simultaneously deliver a given quantity of said samples on the sample separation means.

2. An apparatus as defined in claim **1** further comprising drive means for simultaneously displacing said drive bar means in the sample delivery direction and horizontally displacing said second station means.

3. An apparatus as defined in claim **2** further comprising guide means for guiding the displacement of said drive bar means.

4. An apparatus as defined in claim **1** wherein said first station means is tiltable to ensure immersion of the extremities of the needles in said samples.

5. An apparatus as defined in claim **2** further comprising pinion means operatively connected to said drive means and a toothed rack fixedly mounted on said drive bar means whereby when said rack and said pinion are in gear engagement, said drive bar means is automatically displaced by said drive means.

6. An apparatus as defined in claim **1** wherein said drive bar means includes lug means at each extremity thereof; said apparatus further comprising vertically upstanding side walls each provided with grooves for receiving said lug means of said drive bar means, said grooves defining an endless track for said lug means.

7. An apparatus as defined in claim **1** further comprising means for drying the sample when delivered on the sample separation means.

8. An apparatus as defined in claim **1** wherein said support means includes handle means for rotating said support means, said handle means including weight means for providing vibration-free delivery of said sample on the sample separation means.

9. An apparatus as defined in claim **6** wherein said side walls include an additional groove for receiving said lug means to thereby completely discharge the sample from each said syringe.

* * * * *