May 17, 1966 J. ISREELI ETAL 3,251,229

LIQUID-SAMPLE SUPPLY APPARATUS

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FIG. 1

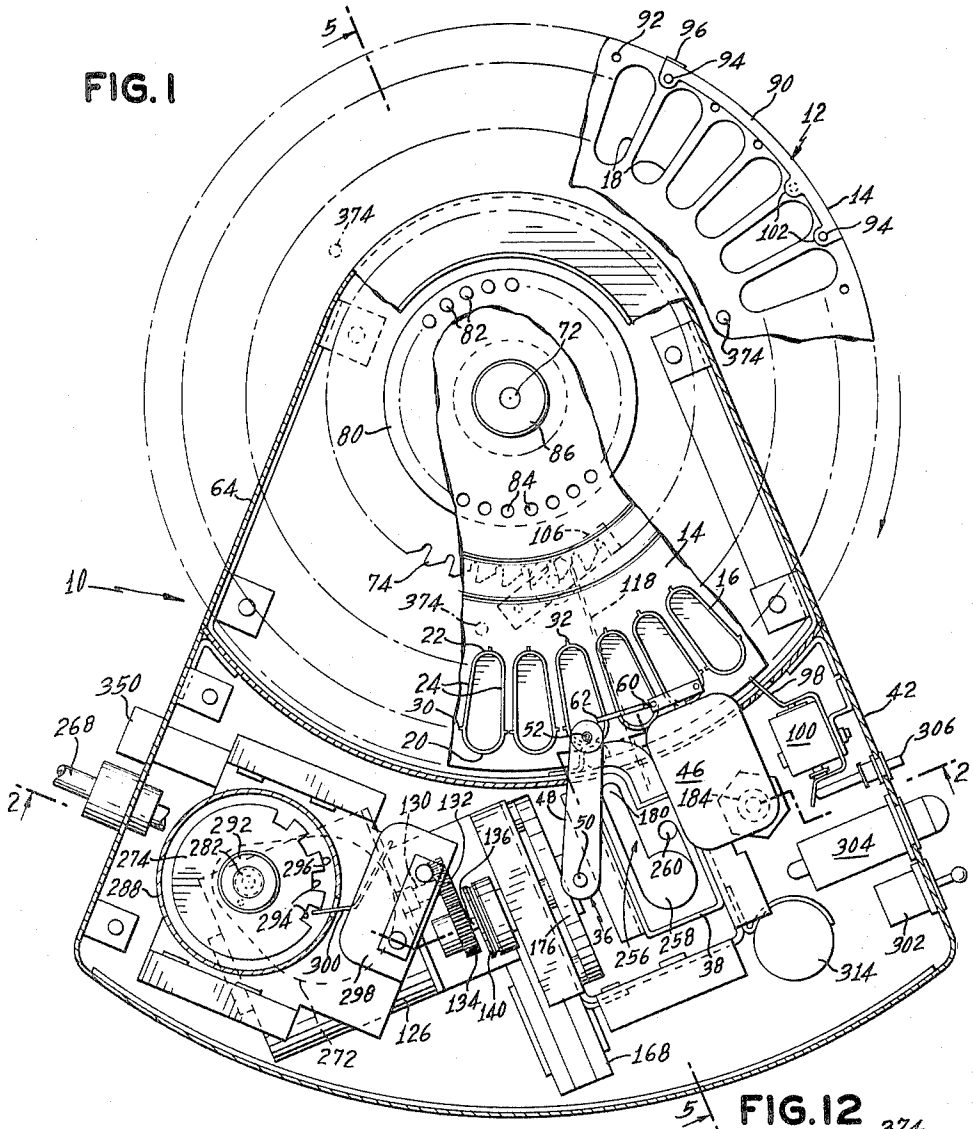


FIG. 11

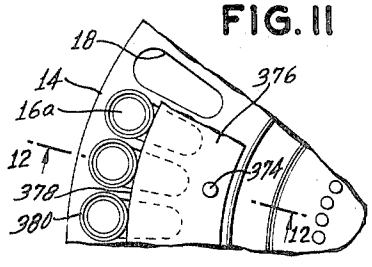
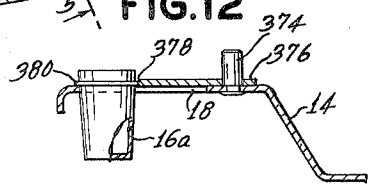


FIG. 12



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LIQUID-SAMPLE SUPPLY APPARATUS

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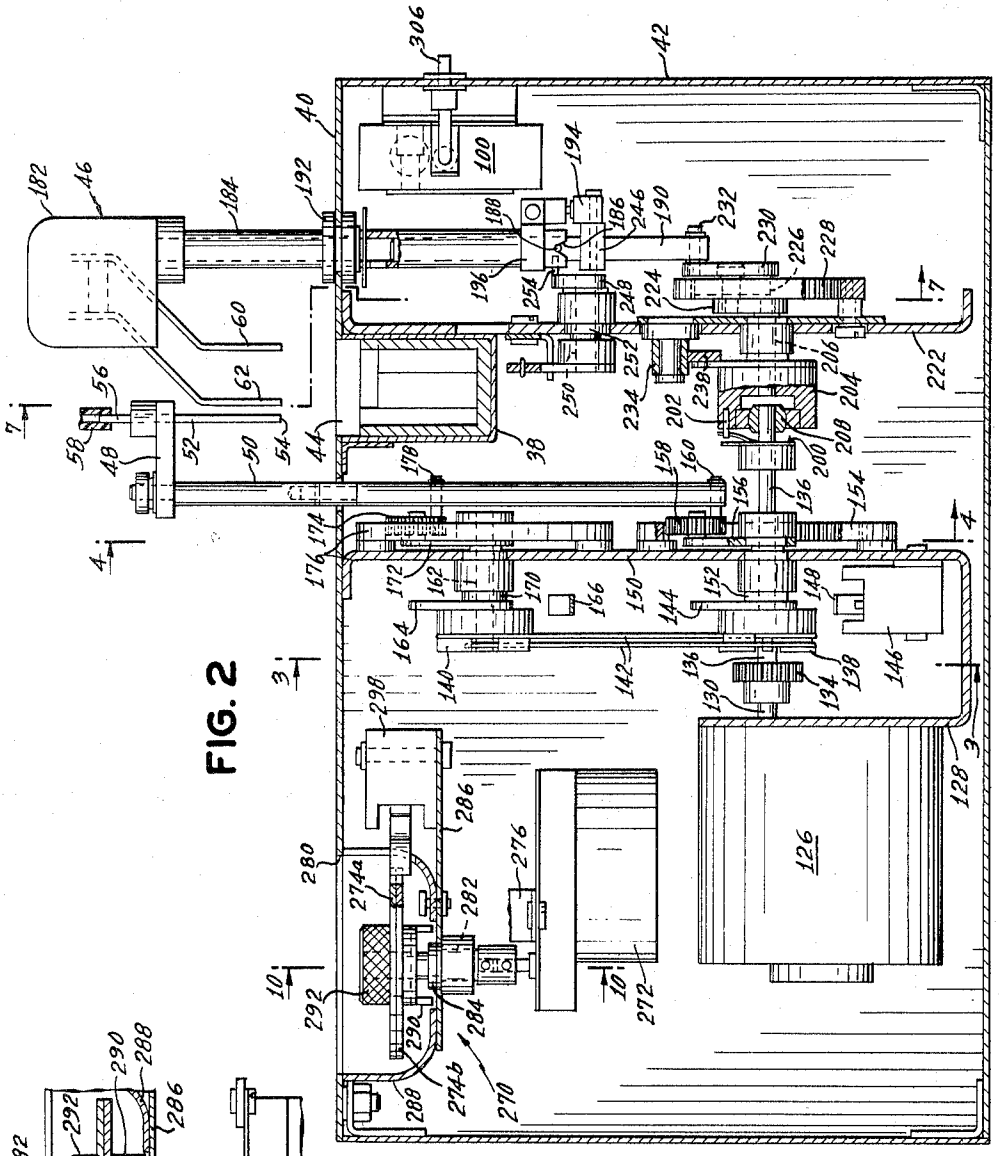


FIG. 2

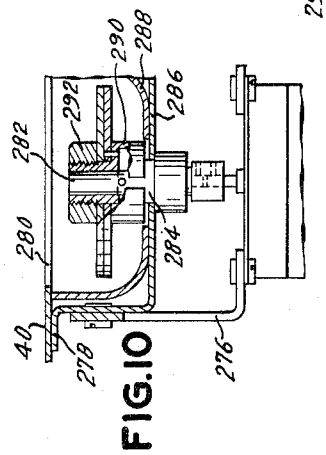


FIG. 10

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LIQUID-SAMPLE SUPPLY APPARATUS

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FIG. 4

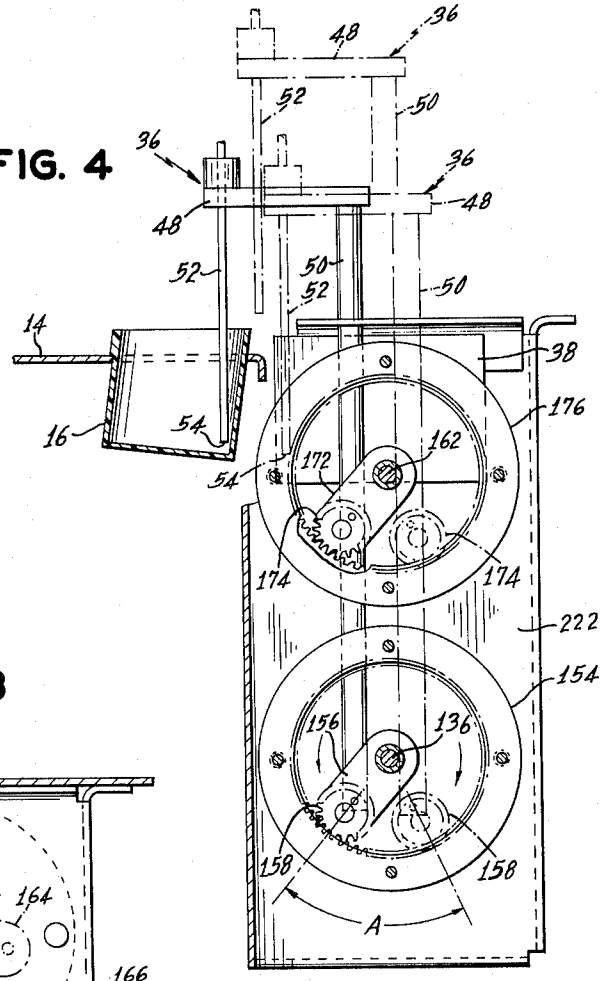
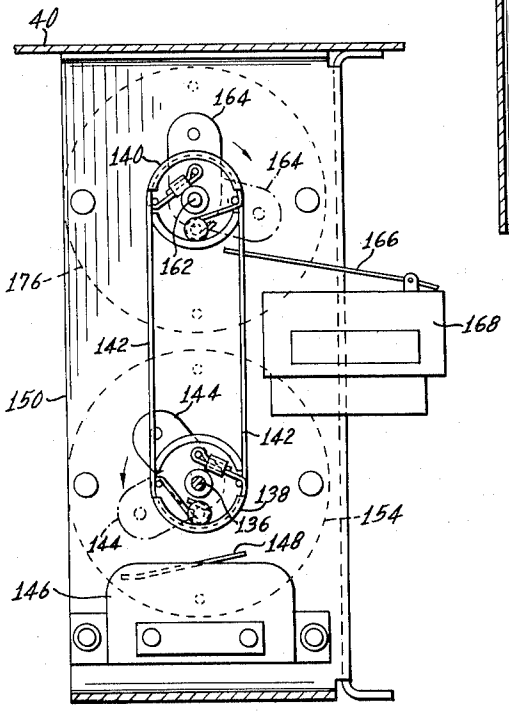


FIG. 3



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LIQUID-SAMPLE SUPPLY APPARATUS

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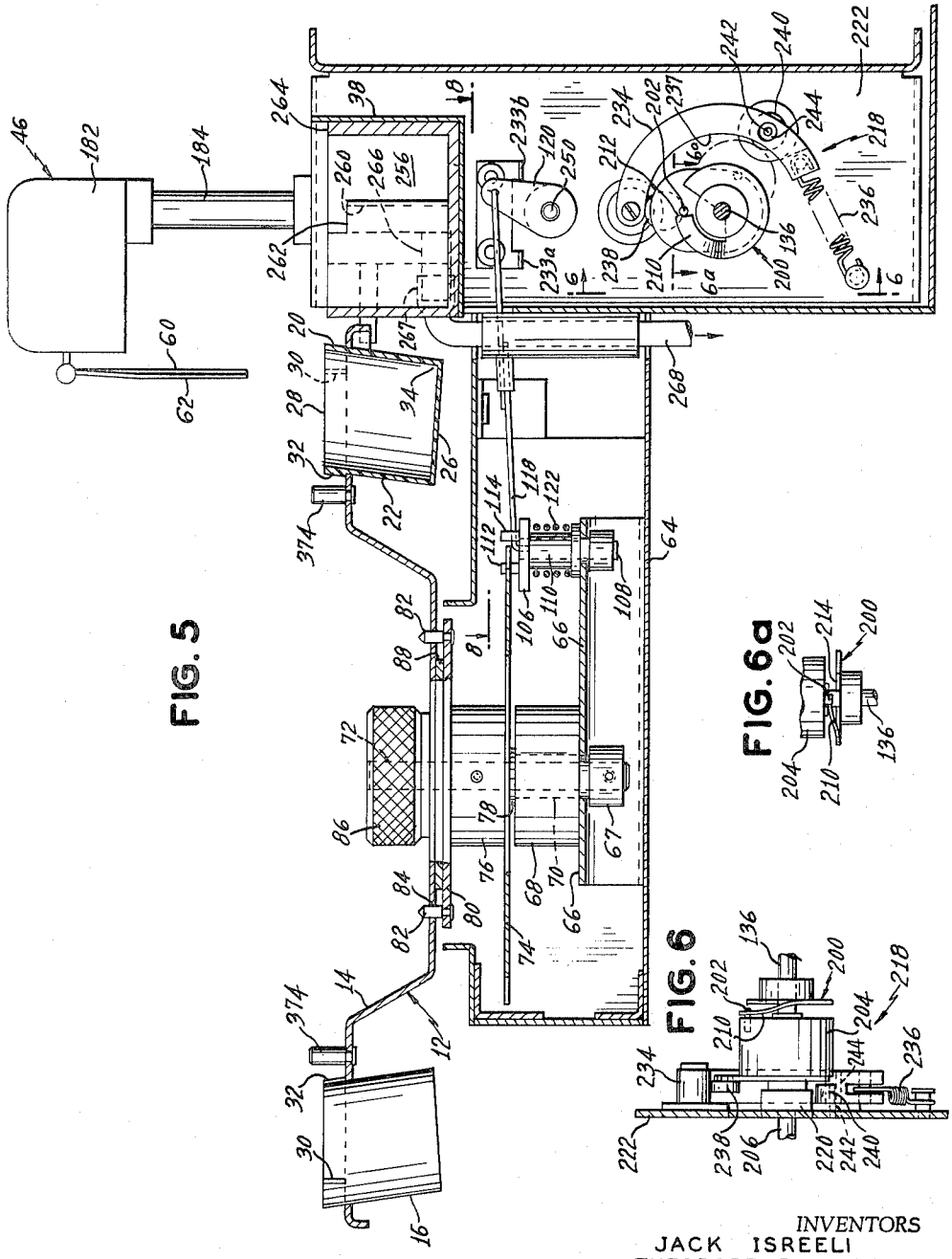


FIG. 5

FIG. 6a

FIG. 6

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LIQUID-SAMPLE SUPPLY APPARATUS

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FIG. 8

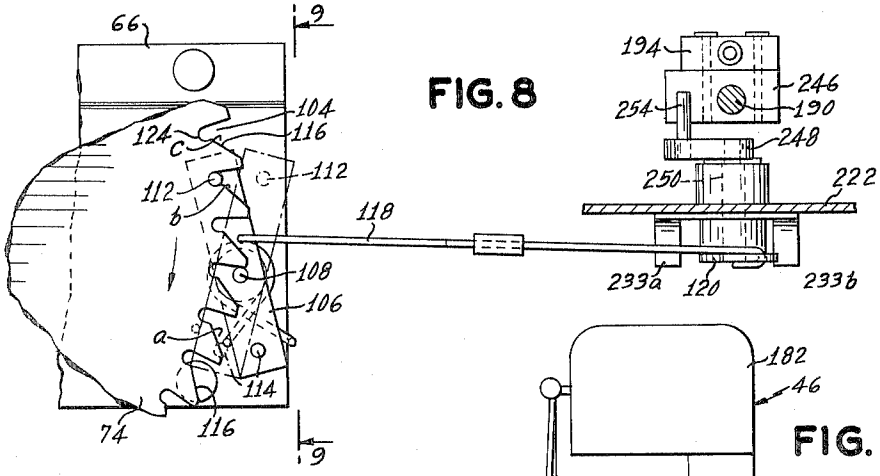


FIG. 7

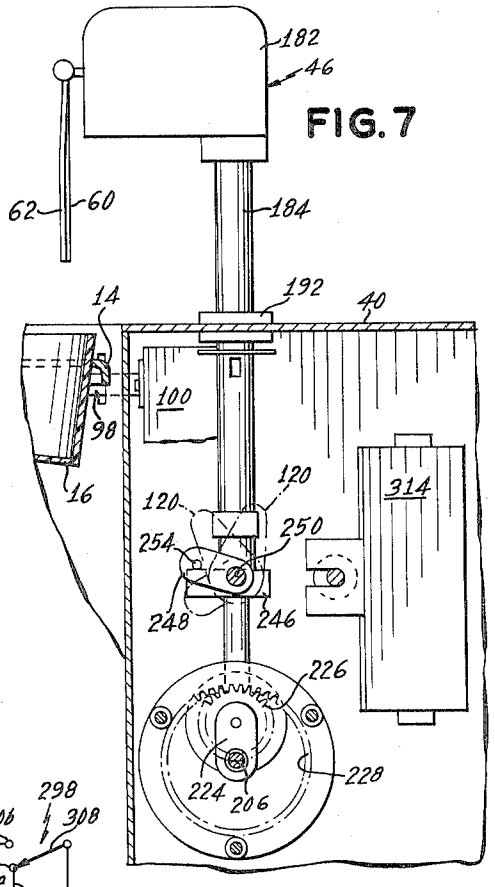


FIG. 9

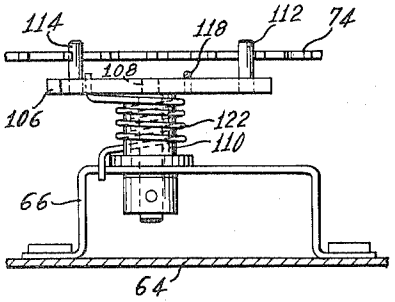
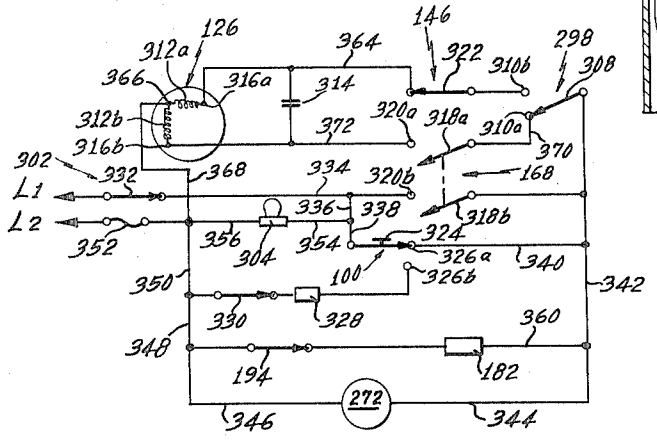


FIG. 13



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United States Patent Office 3,251,229 Patented May 17, 1966

3,251,229

LIQUID-SAMPLE SUPPLY APPARATUS

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Filed Dec. 26, 1962, Ser. No. 246,967
16 Claims. (Cl. 73—423)

This invention relates to liquid-sample supply apparatus for supplying a series of liquid-samples, in succession, to an automatic liquid analysis apparatus.

One of the objects of the invention is to provide a sample supply apparatus of the indicated type with improved means for supplying a wash-liquid between successive samples, separated from adjacent samples by segments of air, in a manner whereby a relatively large number of samples can be supplied per unit of time than was possible heretofore.

Another object is to provide a sample supply apparatus with improved means for supplying different quantities of the sample and wash-liquid.

A further object is to supply a sample supply apparatus with improved means for selecting and supplying quantities of sample and wash-liquid in various predetermined ratios of sample to wash-liquid.

Another object is to provide a sample supple apparatus with improved means for stirring the sample during substantially the entire period in which it is at the take-off position for withdrawal of the sample, so that the sample is continuously mixed before and during withdrawal.

A further object is to provide a sample supply apparatus of generally improved construction and which is especially useful for supplying predetermined quantities of different blood or blood serum samples to an automatic liquid analysis apparatus for the quantitative analysis of each of the samples with respect to one or more constituents thereof.

The above and other objects, features and advantages of the invention will be apparent from the following description of the presently preferred embodiment of the invention considered in connection with the accompanying illustrative drawings:

FIG. 1 is a top plan view, partly in section and with parts cut away, of the apparatus of the present invention;

FIG. 2 is a vertical sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is a vertical sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a vertical sectional view taken on line 4—4 of FIG. 2;

FIG. 5 is a vertical sectional view taken on line 5—5 of FIG. 1;

FIG. 6 is a vertical sectional view taken on line 6—6 of FIG. 5;

FIG. 6A is a horizontal sectional view taken on line 6A—6A of FIG. 5;

FIG. 7 is a vertical sectional view taken on line 7—7 of FIG. 2;

FIG. 8 is a horizontal sectional view taken on line 8—8 of FIG. 5;

FIG. 9 is a vertical sectional view taken on line 9—9 of FIG. 8;

FIG. 10 is a vertical sectional view taken on line 10—10 of FIG. 2;

FIG. 11 is a plan view of part of the apparatus, showing a modification thereof;

FIG. 12 is a vertical sectional view taken on line 12—12 of FIG. 11; and

FIG. 13 is a wiring diagram illustrating the automatic controls for the apparatus.

Referring now to the drawings in detail, the liquid-sample supply apparatus 10 comprises a sample cup carrier, here shown as a turntable 12 which is intermittently rotated by a mechanism which will be more particularly described hereinafter. The turntable comprises a circular plate 14 which carries a series of removable open-top oblong shaped cups 16 for the liquid-samples and the cups are positioned laterally of each other in a circular row. For this purpose, plate 14 is provided with a series of oblong openings 18 arranged in a circular row. Each cup has semicircular end walls and outer end wall 20 has a larger diameter than inner end wall 22. The end walls are connected to each other by side walls 24 which, as shown in FIG. 1, converge slightly toward each other in a direction toward the center of plate 14. End wall 20 (FIG. 5) is longer than end wall 22 so that when the bottom 26 of the cup is placed on a horizontal support, the open top 28 extends upwardly from wall 22 to wall 20. A pair of laterally spaced ribs 30 extend from the side walls 24 of each cup, near end wall 20, and a rib 32 extends from end wall 32 of each cup. These ribs support the cup in the companion opening 18 of the cup support plate 14 so that the cup is positioned as shown by FIG. 5 whereby bottom 26 extends downwardly in a direction toward the outer edge of the plate with the top 28 of the cup horizontal. The downwardly inclined bottom insures that substantially all, if not all of the liquid in the cup can be withdrawn from the cup, since any remaining minute quantities of liquid will flow toward the lower front end 34 of the cup for easy withdrawal thereof from the cup.

A movable liquid take-off device 36 is mounted laterally outwardly of plate 14 and laterally of a stationary open-top receptacle 38 for supplying a wash-liquid. The wash-liquid receptacle is also mounted laterally outwardly of plate 14, as shown in FIG. 1, and as best seen in FIG. 2, the receptacle is secured to the bottom surface of the top 40 of the housing 42 of the apparatus. The top of the housing is provided with an opening 44 to permit access to the open top of the receptacle. Take-off device 36 is mounted for lateral movement to position it above the cups 16 and receptacle 38, respectively, and is also movable up and down in said positions out of and into the cups and receptacles, respectively, for withdrawing portions of the sample and wash-liquid.

A stirrer 46 is mounted for movement up and down, out of and into a pair of adjacent cups 16, one of which is at the take-off position for withdrawal of a sample therefrom by said take-off device, and that the stirrer is operative to stir the sample during substantially the entire period in which it is at the position of the take-off device and is also operable to stir the same sample when it is at the position immediately before it is moved into the take-off position for the sample withdrawal operation. In this manner, each sample is stirred immediately before any portion thereof is withdrawn from its cup and the sample is also stirred during the period in which portions of the sample are withdrawn from the cups.

Take-off device 36 (FIGS. 2 and 4) comprise an arm 48 mounted on the upper end of a rod 50. Arm 48 carries a take-off tube 52 and the inlet end 54 of the tube is adapted to be inserted in the liquid sample in the sample cup and in the wash-liquid in receptacle 38, respectively, for withdrawing liquid therefrom by suction. The opposite end 56 of the tube is adapted to be connected to a suction tube 58 of a pump (not shown) of an analyzing apparatus, for example, apparatus of the type shown in U.S. Patent No. 2,797,149 issued June 25, 1957, for aspirating the liquids from their respective containers and transmitting them, in the form of a stream, to the analysis apparatus.

In the operation of the apparatus, turntable 12 is operated intermittently to position the samples, in succes-

sion, at the position of the take-off device **36** for withdrawing at least a portion of each sample. During the indexing movement of the turntable, the take-off device and stirrer **46** are in retracted positions above the sample cups **16** and out of the way of the moving cups and plate **14** to permit said indexing movement of the plate. The take-off device moves laterally into position above receptacle **38** and then downwardly into the receptacle so that its take-off tube **52** is immersed in the wash-liquid. After the turntable has come to rest for its dwell period between successive indexing movements, with a sample cup **16** at the position of the take-off device, the stirrer moves downwardly to immerse its stirrer members **60** and **62** (FIGS. 1 and 2) in the liquid sample in the cup immediately before the take-off position and in the cup at the take-off position.

During the movement of the take-off tube **52** from its sample aspirating position to its wash-liquid aspirating position, its inlet end **54** is exposed to the atmosphere. Since the pump of the analysis apparatus is continuously operating during the operation of the sample supply apparatus, air is asirated into the take-off tube during the period in which its inlet end is exposed to the atmosphere.

After a predetermined period of aspirating wash-liquid, the take-off device is operated and moves upwardly out of receptacle **38** and, thereafter, laterally back to its sample aspirating position above a cup **16** which was previously moved into said position by the previous indexing movement of the turntable. The take-off tube is then moved downwardly so that its inlet end **54** is immersed in the liquid sample for aspirating a portion thereof from the cup. During this movement of the take-off tube from the wash receptacle to the sample cup, the stirrer **46** does not move and stirrer member **60** and **62** remain in the samples of the adjacent cups. It is to be observed that during this return movement of the take-off device, the inlet end of the take-off tube is again exposed to the atmosphere and aspirates air.

After a predetermined period of aspirating sample from the cups, which may be the same or different from the wash-liquid aspirating period, the stirrer and take-off device are operated and move together upwardly out of the sample cups. As the inlet end **54** of the take-off tube and the lower ends of the stirrer members **60** and **62** move above the upper edge of the sample cups, the turntable is again operated to carry the next sample cup into the position of the take-off device and the coordinated relative movements of the stirrer, take-off device and turntable are again repeated as described above.

The above described movements result in the supply of predetermined quantities of each of the samples, in succession, to the analysis apparatus in the form of a stream of longitudinally spaced liquid samples separated from each other by intervening segments of a wash-liquid positioned between a pair of air segments. The wash-liquid segments are effective to cleanse the inner walls of the tubular passages of the analysis apparatus and prevent contamination of a sample by a preceding sample which might be caused by the deposits of a portion of said preceding sample on the inner walls of the tubular passages. This cleansing action provided by the wash-liquid is, in addition to the cleansing action provided by the intervening air segments, which also function to separate the wash-liquid segments from the liquid samples. The non-rotational movement of the take-off device may be described as a translation in a plane which includes the instant sample cup and the wash liquid receptacle.

The mechanism for operating take-off device **36** and stirrer **46** is positioned in housing **42** and the mechanism for operating the turn table in position in another housing **64** that is secured to housing **42**, as illustrated by FIGS. 1 and 5, so that the two housings together resembly a sector of a circle in plan view. Referring to FIGS. 1 and 5, the mounting for the sample cup support plate **14** will now be described in detail. An inverted

U-shaped support bracket **66** is secured to the bottom of housing **64**. A bearing block **68** having a bearing **70** mounted therein is suitably secured to the top of bracket **66** and a vertical rotary shaft is journaled in the bearing. The lower end of the shaft extends below the top of bracket **66** and a collar **67** is secured to said end, and the upper end of the shaft extends above plate **14**. A ratchet **74** is connected to a collar **76** which is secured to shaft **72** and the collar is mounted for rotation on the shoulder end **78** of bearing **70**. A drive plate **80** is secured to the upper end of collar **76** and is provided with a pair of diametrically opposed drive pins **82** which engage holes **84** provided in plate **14** for driving the latter. Plate **14** is provided with an apertured hub **86** which is conected to the upper part of the plate and a stiffener plate **88** is connected to the underside of plate **14**, so that the latter can be readily mounted in the apparatus by merely positioning it over the upwardly extending end of shaft **72** with holes **84** in alignment with pins **82**, and, thereafter, moving the plate downwardly for engagement of pins **82** in holes **84**. To remove the sample plate and the cups it is merely necessary to lift the plate vertically upwardly by grasping hub **86**. It is to be noted that no clamping devices are necessary for maintaining the driving connection between pins **82** and holes **84** since the weight of the sample cups and its contents insures the maintenance of the driving connection.

Holes **84** in conjunction with an indexing spring strip **90** and a switch provide means by which the apparatus is automatically shut off after a predetermined number of samples are supplied by the apparatus. Referring especially to FIG. 1, holes **84** are arranged in a circular row and correspond in number to the number of openings **18** for the sample supply cups **16**. The marginal edge portion of plate **14** is also provided with a circular row of indexing apertures **92** which correspond in number to the number of openings **18** provided in the plate and the apertures are positioned between adjacent openings. Each end of the indexing strip is provided with a pin **94** whereby the strip can be placed in any position along the marginal edge of the plate. One end of the strip is provided with a downwardly extending tab **96** and the operating arm **98** of a switch **100** is in the path of movement of the tab for operation thereby to stop the operation of the supply apparatus after a predetermined number of samples have been supplied. The other end of the strip, opposite its tab end, is provided with parts **102** that are adapted to straddle an opening **18** in the plate, said opening being the one for the last sample cup.

In using the indexing mechanism just described, as for example for supplying ten different samples, the procedure is as follows: The different sample cups are placed in adjacent openings **18** and the plate is positioned on shaft **72** with the cup containing the first sample in position at the take-off device **36** for withdrawal of a predetermined quantity of said sample. The indexing strip **90** is positioned on plate **14** so that parts **102** straddle the last sample cup which would be cup No. 10 in the illustrative example. Positioning of the strip in this manner automatically positions tab **96** so that after sample from cup **10** has been aspirated, further indexing movement of plate **14** results in the engagement of tab **96** with operating arm **98** of switch **100** to operate the switch and stop the operation of the apparatus.

The indexing drive mechanism for plate **14** comprises the previously mentioned ratchet **74** which is provided with a series of slots **104** (FIGS. 8 and 9) along the circumferential edge of the ratchet. The ratchet is driven by pawl **106** which is in the form of a bar. The pawl is connected to a pin **108** which is journaled in a bearing **110** that is secured to bracket **66**, as best seen in FIG. 9. One end of the pawl is provided with a drive pin **112** and its opposite end is provided with a similar drive pin **114**. Each pin is adapted to engage a cam edge **116**

of slot **104** for intermittently rotating the ratchet and thereby operating plate**14**.

The number of slots **104** in the ratchet is the same as the number of openings **18** for the sample cups **16**. The distance between the axis of pin **114** and the center of rotation of the pawl is slightly less than the distance between the axis of pin **112** and the center of rotation of the pawl. The pawl is operated by a link **118** which is connected at one of its ends to the pawl between pivot pin **108** and drive pin **112** and the opposite end of the link is connected to a lever **120** (FIGS. 5 and 8) which is operated in response to the up and down movement of stirrer **46**, in a manner which will be more clearly understood hereinafter. A torsion spring **122** is coiled around bearing **110** and one end of the spring engages pawl **106** and the opposite end of the spring is connected to bracket **66**.

As best seen in FIGS. 8 and 9, when link **118** is moved to the right, as viewed in FIG. 8, pin **114** engages cam edge **116** of the adjacent slot "*a*" rotating the ratchet **74** and plate **14** in a clockwise direction, as viewed in FIG. 8. Simultaneously, pin **112** moves out of slot "*b*" and the succeeding slot "*c*" moves into position where its cam edge **116** is in the path of return movement of pin **112**. The movement of link **118** results in the tightening and tensioning of spring **122**, and the return movement of the link is effected by the force of tightened spring **122**. During this return movement, pin **112** moves into slot "*c*" and engages its cam edge for completion of the indexing movement of plate **14**. It is to be noted that due to the different spacing of the pins **112** and **114** with respect to the center of rotation of the pawl **106**, pin **114** does not move fully into slot "*a*," but pin **112** moves fully into slots "*b*" and "*c*" and engages the circular bottom **124** of each of these slots during the intermittent dwell periods of plate **14**, between indexing movements thereof, to thereby lock the plate in position during said dwell periods.

The mechanism for operating take-off device **36** and stirrer **46** comprises a reversible motor **126** which is suitably supported in housing **42** by a support bracket **128** (FIG. 2). The drive shaft **130** of the motor is connected to a gear **132** (FIG. 1) which is in mesh with another gear **134** which drives a rotary shaft **136**. A groove pulley **138** is secured to shaft **136** and a similar pulley **140** is provided directly above the first mentioned pulley and is driven by the latter through a steel wire belt **142**. A switch actuating arm **144** is connected to pulley **138** and a motor control switch **146**, having its operating arm **148** in the path of movement of arm **144**, is suitably mounted on vertical part **150** of bracket **128**. Shaft **136** is journaled in a bearing **152** that is suitably supported in part **150**. A stationary internal gear **154** is suitably secured to part **150** and a link **156** is connected to shaft **136** and carries a rotary spur gear **158** which is in mesh with gear **154**. A pin **160** is connected to gear **158** at a position laterally offset from the center of rotation of the gear and the pin extends therefrom. The lower end of rod **50** of take-off device **36** is pivotally connected to pin **160**.

A similar drive connection is provided for the upper part of rod **50** of the take-off device. More particularly, pulley **140** is connected to a rotary shaft **162** and a switch operating arm **164** is connected to pulley **140** for operating arm **166** (FIGS. 2 and 3) of another motor control switch **168** which is suitably mounted on part **150**. Shaft **162** is suitably journaled in a bearing **170** that is mounted in part **150**. A link **172** is connected to the shaft and carries a rotary spur gear **174** which meshes with a stationary internal gear **176** that is suitably mounted on part **150**. Spur gear **174** carries a pin **178** which is positioned laterally of the center of rotation of the gear and rod **50** is pivotally mounted to the pin.

The pitch diameters of spur gears **158** and **174** are the same and the pitch diameters of internal gears **154** and **176** are the same. The relation between the pitch diameters of the spur gears and the pitch diameters of the companion meshing internal gears is such that upon clockwise rotation of shaft **162** and **136**, as viewed in FIG. 4, rod **50** of take-off device **36** moves first upwardly so that take-off tube **52** is removed from the sample cups **16**, then radially outwardly, as viewed in FIG. 1, away from the sample cup until take-off tube **52** is positioned above end **180** of the wash-liquid receptacle **38**, and thereafter downwardly so that the inlet end **54** of the take-off tube is positioned in the wash liquid whereby the transfer of the take-off tube from the sample cup to the wash-liquid receptacle is completed. The return of the take-off tube from the wash-liquid receptacle to the next succeeding sample cup is accomplished in the same manner during reverse rotation of shafts **162** and **136**.

The stirrer **46** comprises a housing **182** containing a vibratory stirring mechanism actuated by an electric solenoid (not shown) and is preferably of the type shown and described in our co-pending U.S. patent application, Serial No. 149,673, filed November 2, 1961, now Patent 3,107,537, assigned to the assignee of the present application. The stirrer members **60** and **62** are connected to the vibrating mechanism positioned in housing **182** and vibrate back and forth to mix the samples in the cups.

Housing **182** is mounted at the upper end of a hollow tube **184** which is provided with diametrically opposite and inverted V-shaped grooves **186** at its lower end. A pin **188** (FIG. 2) which is connected to the upper end of a rod **190** has its opposite ends positioned in slots **186** for moving tube **184** vertically upwardly. The tube is journaled in a bearing **192** which is mounted in the top **40** of housing **42**. A stirrer control switch **194** is connected to rod **190** and tube **184** is provided with a switch actuating member **196** which is operative to operate switch **194** when the stirrer tube is mounted on rod **190**, whereby the vibrating mechanism within housing **182** is operated. In other words, the vibrating mechanism only operates when switch **194** is engaged by operating member **196**.

The mechanism for moving stirrer **46** up and down is best illustrated in FIGS. 2, 5, 6 and 6A, and comprises a driver ring **200** which is secured to shaft **136** and which operates a pin **202** that extends from a member **204** which is mounted on a rotary shaft **206**. Member **204** carries a self-aligning bearing **208** which supports the adjacent end of shaft **136**. As best seen in FIGS. 5 and 6A, driver ring **200** resembles a split lock washer and is operative to drive pin **202**, during clockwise rotation of shaft **136** as viewed in FIG. 5, from a lower position of the pin, indicated by dash lines, to an upper position of the pin, indicated by solid lines. In the uppermost position of pin **202**, it is automatically released and falls downwardly to its lower position indicated by the dash lines. As best seen in FIG. 6A, the pin is released by the driver ring because the ring has an offset part **210** having an inclined end **212** which is operative to engage the side of the pin for lifting it into its upper position. End **212** is laterally offset from the remaining part **214** of the ring an amount equal to at least the thickness of the ring so that in the upper position of pin **202**, its end **216** is clear of the side of part **214** and is, therefore, free to fall vertically downwardly. During movement of the pin from its lowermost position to its uppermost position, it is not free to fall because of the lifting engagement of ring end **212** and the pin. The driver ring and pin arrangement just described is utilized for lifting the stirrer vertically upwardly out of the sample cups for the indexing operation. After the sample plate **14** is indexed, the stirrer falls freely downwardly into the succeeding cups. The free falling movement of the stirrer is restrained by a brake device **218** which will be described shortly.

Shaft **206** (FIG. 2) is journaled in a bearing **220** which is supported in a member **222** that is secured to

housing 42. A lever 224 is secured to shaft 206 and carries a rotary spur gear 226 which meshes with a stationary internal gear 228 that is suitably supported on member 222. A circular plate 230 is connected to the side of gear 226 and carries a pin 232 which is laterally offset from the center of rotation of the gear a distance equal to one-half of the pitch diameter of the gear. The lower end of rod 190 is rotatably connected to pin 232. The pitch diameter of spur gear 226 is one-half the pitch diameter of internal gear 228 so that rod 190 moves vertically up and down. Clockwise rotation of shaft 136, as viewed in FIG. 5, lifts the stirrer up and out of the sample cups, in the manner just described, but counterclockwise rotation of shaft 136 does not operate the stirrer as will be readily apparent from FIG. 6A. The pivotal movement of lever 120 is limited by stops 233*a* and 233*b*.

Brake device 218 (FIGS. 2 and 5) comprises an arcuate arm 234 which is pivotally connected at its upper end to support member 222 and the opposite end of the arm is connected to one end of a tension spring 236 for biasing the inner edge 237 of the arm against a friction pad 238 which is connected to rotary member 204, whereby the brake device is operative to slow down the rotation of said member and thereby slow down the rotation of shaft 206 during the downward movement of the stirrer so that its downward movement is cushioned. The brake is provided with a stop 240 which consists of a pin 242 secured to support member 222 and which extends into an aperture 244 provided in arm 234. The diameter of aperture 244 is slightly greater than the diameter of pin 242 whereby the stop is operative to limit the swinging movement of the brake arm.

As indicated previously, the indexing movement of plate 14 is controlled by the up and down movement of the stirrer. As best seen in FIGS. 2, 5, 7 and 8, a bar 246 is pinned to stirrer rod 190 so that it is movable up and down with the rod. A lever 248 is connected to a rotary shaft 250 which is journaled in a bearing 252 that is supported in member 222 and the previously mentioned lever 120 is secured to shaft 250. A pin 254 extends from the side of lever 248 and is in the path of movement of bar 246 for operation by the latter. Accordingly, during upward movement of rod 190, lever 248 is rotated in a clockwise direction, as viewed in FIG. 7 and lever 120 is thereby rotated clockwise to retract link 118 to operate pawl 106 and initiate the indexing movement of plate 14. Upon downward movement of the stirrer, the force of torsion spring 122 rotates lever 120 in a counterclockwise direction and link 118 is moved into an extended position, as viewed in FIG. 8, to complete the indexing movement of plate 14.

As best seen in FIGS. 1, 2 and 5, receptacle 38 for the wash-liquid has a chamber 256 in the form shown in FIG. 1 for holding the wash-liquid. The wash-liquid is preferably transmitted continuously to the enlarged portion 258 of the chamber by suitable means (not shown), it being understood that the opposite end 180 of the chamber is the area in which the take-off tube 52 of the take-off device is inserted for aspirating the wash-liquid. An overflow outlet opening 260 of the receptacle has its inlet end 262 below the open top 264 of the receptacle so that liquid which rises above the level of inlet end 262 flows downwardly through outlet opening 260 into a connecting passage 266 provided with a nipple 267. A drain outlet tube 268 is connected to the nipple for transmitting the excess wash-liquid from the apparatus. It is to be noted that the receptacle provides a constant level of wash-liquid.

As indicated previously, provision is made for controlling and varying the ratio of the wash aspirating period and the sample aspirating period. For this purpose, a timer 270 is provided which is illustrated in FIGS. 1, 2 and 10. The timer comprises a timer motor 272 which drives a timer disk 274 consisting of a pair of superimposed timer disk plates 274*a* and 274*b*. The timer motor is supported from the top 40 of housing 42 by brackets 276 and 278, respectively, and the top of the housing is provided with an opening 280 to permit access to the timer disk. The timer motor operates a rotary shaft 282 which is journaled in a bearing 284 that is supported in a horizontal plate 286 which is suspended from the top of the housing by a bracket 288. A rotary timer disk support member 290 is pinned to shaft 282 and the bottom timer disk plate 274*b* is supported on member 290 and is connected thereto. The upper timer disk plate 274*a* rests on the top of disk 274*b* and is mounted for adjustable rotary movement with respect thereto to adjust and change the aspirating period of the wash-liquid and the aspirating period of the sample with respect to each other. For this purpose, the upper end of member 290 is threaded and a nut 292 is provided for tightening disk plate 274*a* in its adjusted position against disk plate 274*b*.

The circumferential edge of each timer disk plate (FIG. 1) is provided with a series of circumferentially spaced depressions 294 which are separated from each other by the intervening raised parts 296. The circumferential length of each depression determines the length of time of the take-off tube 52 in the wash-receptacle 38, and the circumferential length of raised parts 296 determines the length of time of the take-off tube in the sample cups 16. It is to be observed that the length of depressions 294 and raised parts 296 can be varied by rotation of timer disk 274*a* with respect to timer disk 274*b*, whereby the ratio of the time periods of the wash-liquid aspirating operation to the sample aspirating operation can be varied, as desired or as required.

The timer disk 274 operates a timer switch 298 which is mounted on plate 286 and controls motor 126 in a manner which will be more clearly understood hereinafter. The operating arm 300 of the switch is in the path of movement of the circumferential edge portion of the timer disk for operation by the depressions 294 and raised parts 296 of the disk.

In addition to the previously mentioned switches, a switch 302 (FIG. 1) is provided on housing 42 and controls the main power supply to the apparatus. A light 304 (FIG. 1) is also mounted on housing 42 and is energized when switch 302 is closed. Switch 100 is provided with a reset button 306 mounted on the side of housing 42 for resetting the switch after the automatic termination of the operation of the apparatus. The operation of the apparatus will now be described in detail with reference to FIG. 13 and the other figures of the drawing.

Assume that the take-off device 36 is in its wash-liquid withdrawing position so that the inlet end 54 of take-off tube 52 is immersed in the wash-liquid in receptacle 38 for withdrawing wash-liquid therefrom. With the take-off device in its wash-liquid aspirating postion, stirrer 46 is also in its operative position with stirrer members 60 and 62 immersed in the sample cups 16, one of which is at the take-off position, having been moved into said position during the transfer movement of the take-off device from the sample aspirating position to the wash-liquid aspirating position. Since the take-off device is in the wash-liquid receptacle, the timer disk is positioned so that operating arm 300 of switch 298 is in a depression 294 and movable contact 308 of the switch is engaged with stationary contact 310*a* of the switch, and motor 126 is de-energized, as illustrated by FIG. 13.

Reversible motor 126 is a permanent split capacitor motor having its stator coils 312*a* and 312*b* arranged at 90° with respect to each other. The capacitance for the motor is indicated at 314. As is well known, this type of motor is self-starting and its output shaft 130 rotates in a counterclockwise direction, as one faces said shaft, when its output terminal 316*a* is connected to line L_2. The output shaft rotates in an opposite and clock-

wise direction when the output terminal 316*b* of the motor is connected to line L_2.

Switch 168 is operative to stop the operation of motor 126 when take-off tube 52 is in its proper position in wash-liquid receptacle 38. The switch is provided with a pair of ganged movable contacts 318*a* and 318*b* which are operated by the movable arm 166 of the switch, as previously mentioned. In the immersed position of the take-off tube in the wash-liquid receptacle, operating arm 166 is engaged by arm 164 so that the normally closed movable contacts 318*a* and 318*b* are disengaged from the companion stationary contacts 320*a* and 320*b* of the switch.

Switch 146 is operative to stop motor 126 when take-off tube 52 is in its proper position in the sample cup 16. The switch has a normally closed movable contact 322 that is operated by the operating arm 148 of the switch. As indicated previously, arm 148 is operated by arm 144 and in the position of the take-off device in the wash-liquid receptacle, arm 144 is disengaged from arm 148 of the switch.

Switch 100 has a movable contact 324 which is normally closed and is operated by movable arm 98 of the switch, as previously indicated, to stop the operation of the apparatus after a predetermined number of samples are supplied by the apparatus. The switch is provided with a pair of stationary contacts 326*a* and 326*b* so that operation of movable contact 324 of the switch stops the operation of the apparatus and energizes a buzzer 328 through the normally closed buzzer switch 330 to audibly indicate to the operator or technician that the apparatus has completed its cycle of operation. Switch 302 which controls the supply of power to the apparatus has a manually operated movable contact 332 which is closed to supply power to the apparatus.

As illustrated by FIG. 13 and with take-off tube 52 in the wash-liquid receptacle and stirrer members 60 and 62 in a pair of sample cups 16, motor 126 is de-energized because its energization circuit is open at contact 310*b* of switch 298 and contact 320*a* of switch 168. Timer motor 272 is energized through a circuit which can be traced as follows: Line L_1, closed contact 332 of switch 302, leads 334, 336 and 338, closed contacts 324 and 326*a* of switch 100, leads 340, 342 and 344, timer motor 272, leads 346, 348, 350 and line L_2 which is provided with a fuse 352. Light 304 is energized through a circuit which can be traced as follows: Line L_1, closed contact 332 of switch 302, leads 334, 336 and 354, light 304, lead 356 and line L_2. Stirrer members 60 and 62 of the stirrer are vibrating because the vibrating mechanism within housing 182 of the stirrer is energized through a circuit which can be traced as follows: Line L_1, closed contact 332 of switch 302, leads 334, 336 and 338, closed contacts 324 and 326*a* of switch 100, leads 340, 342 and 360, the vibrating mechanism within housing 182 of the stirrer, closed switch 194, leads 348 and 350, and line L_2.

As the timer continues to operate, the timer disk 274 continues to rotate and a raised part 296 of the disk engages operating arm 300 of the timer switch 298 to begin the transfer operation of the take-off device from the wash-liquid position to the sample position and, thereafter, the liquid sample aspirating period. Movement of arm 300 of the switch causes movable contact 308 of the switch to engage stationary contact 310*b* of the switch to complete an energization circuit through motor 126 which causes shaft 130 of the motor to rotate counterclockwise as one faces the shaft. The energization circuit for the motor can be traced as follows: Line L_1, closed contact 332 of switch 302, leads 334, 336 and 338, closed contacts 324 and 326*a* of switch 100, leads 340 and 342, closed contacts 308 and 310*b* of timer switch 298, closed contact 322 of switch 146, lead 364, terminals 316*a* and 366 of motor 126, and lead 368 to line L_2. Counterclockwise rotation of shaft 130 causes shafts 136 and 162 to rotate in a counterclockwise direction, as viewed in FIG. 4, whereby take-off tube 52 moves upwardly out of the wash-liquid receptacle 38, laterally over to a position above the sample cup 16 which is at the take-off position, and then downwardly into said cup as illustrated by FIG. 4. When the take-off tube is correctly positioned in the sample cup, arm 144 engages the operating arm 148 of switch 146 to open contact 322 thereof and stop motor 126, whereby the transfer operation of the take-off device from the wash-liquid receptacle to the sample cup is completed. During the initial movement of the take-off device out of the wash-liquid receptacle, arm 164 disengages operating arm 166 of switch 168 so that its movable contacts 318*a* and 318*b* close and engage stationary contacts 320*a* and 320*b*, respectively. Counterclockwise rotation of shaft 136 rotates driver ring 200 in a counterclockwise direction, as viewed in FIG. 5, so that end 212 thereof is moved into position for engaging pin 202 to lift the latter, and thereby lift the stirrer from the sample cups, upon clockwise rotation of the ring.

The take-off tube remains in the sample cup for the sample aspirating period as determined by timer 270. When timer disk 274 rotates a sufficient amount, corresponding to the sample aspirating period, operating arm 300 of the timer switch 298 is released by the raised part 296 of the timer disk and falls into the adjacent depression 294 for commencement of the transfer of the take-off tube from the sample cup to the wash-liquid receptacle 38. Operation of arm 300 of the timer switch results in the movement of movable contact 308 from stationary contact 310*b* of the switch to stationary contact 310*a* to complete an energization circuit to motor 126 which causes shaft 130 of the motor to rotate in a clockwise direction as one faces said shaft. The energization circuit for the motor can be traced as follows: Line L_1, closed contact 332 of switch 302, lead 334, now closed contacts 318*b* and 320*b* of switch 168, lead 342, closed contacts 308 and 310*a* of the timer switch 298, lead 370, now closed contacts 318*a* and 320*a* of switch 168, leads 372, terminals 316*b* and 366 of motor 128, lead 368 and line L_2. Energization of the motor rotates shafts 136 and 162 in a clockwise direction, as viewed in FIG. 4, and take-off tube 52 is moved upwardly out of the sample cup, then laterally over to the position of receptacle 38, and then downwardly into the receptacle. When the take-off tube reaches its proper position in the receptacle, arm 164 engages the operating arm 166 of switch 168 to open movable contacts 318*a* and 318*b* of the switch and thereby stop the motor. Initial upward movement of the take-off device, results in the release of operating arm 148 of switches 146 by arm 144 so that contact 322 of the switch closes. The various components of the electrical circuit are now in the positions shown in FIG. 13.

The clockwise rotation of shaft 136, as viewed in FIG. 5, lifts stirrer 46 upwardly and the stirrer members 60 and 62 are raised from the sample cups. When both the take-off tube and stirrer members are above plate 14, continued upward movement of the stirrer results in the engagement of bar 246 with pin 254 for rotating plate 14, in the manner described above, to position the succeeding sample cup at the take-off position. When the stirrer reaches its uppermost position and pin 202 is at or near its uppermost position, the latter is released by end 212 of the driver ring 200, as described previously, and the stirrer falls downwardly under the restraint of brake device 218. The stirrer members 60 and 62 enter the next pair of succeeding sample cups, which have been previously moved into position before the lower ends of the stirrer members enter the sample cups. An operating cycle of the apparatus has now been completed.

After a predetermined number of operating cycles have been completed, switch 100 is operated by tab 96 of

the indexing strip **90** and the movable contact **324** of the switch engages stationary contact **326***b* to complete a circuit through buzzer **328** which advises the operator that the operating period of the apparatus has been completed. At this time the operator opens switch **330** to shut off the buzzer and opens switch **332** to de-energize the apparatus. If the operator fails to open switch **332**, further aspirating of sample from the sample cups does not occur because motor **126** is again activated to transfer the take-off tube to the wash receptacle, and at the completion of the transfer period, contact **318***b* opens and the motor cannot again be energized while contacts **324** and **326***a* of switch **100** are open. The apparatus will merely continue to supply wash-liquid.

FIGS. 11 and 12 illustrate a modification wherein the apparatus can be readily changed for carrying sample supply cups **16***a* which are circular in horizontal section and of the type shown in our co-pending U.S. patent application, Serial No. 184,005 filed April 2, 1962 now abandoned. For this purpose, plate **14** is provided with upstanding pins **374** for retaining a ring **376** on the surface of the outer marginal edge of plate **14**. The outer diameter of ring **376** is such that its outer edge **378** is positioned adjacent the circumferential rib **380** provided on the upper part of the outside of each cup so that half of the rib of each cup is supported on the semicircular edge of opening **18**, and the inner edge of the rib is against edge **378** of the plate, for retaining the cups in openings **18** of plate **14**.

Certain features shown herein but not claimed are shown and claimed in our copending application, Serial No. 184,005 filed April 2, 1962 now abandoned.

While we have shown and described the preferred embodiment of the invention, it will be understood that the invention may be embodied otherwise than as herein specifically illustrated or described, and that certain changes in the form and arrangement of parts and in the specific manner of practicing the invention may be made without departing from the underlying idea or principles of this invention within the scope of the appended claims.

What is claimed is:

1. Liquid-sample supply apparatus for supplying a stream of a series of longitudinally spaced liquid samples and another liquid between successive samples, said apparatus comprising means for holding a series of said liquid samples, receptacle means positioned adjacent said holding means for supplying said other liquid, liquid take-off means movable into and out of each of said samples and said receptacle means, respectively, for withdrawing at least a portion of each of said samples and said other liquid between withdrawals of sample, means mounting said holding means and said take-off means for movement relative to each other for positioning said samples, in succession, at the position of said take-off means for withdrawal of sample, sample stirring means mounted for movement into and out of each of said samples, respectively, for mixing each of said samples, means for moving said take-off means into and out of each of said samples and said receptacle means, respectively, for said withdrawing operation, said take-off moving means comprising a stationary internal gear and a meshing spur gear operatively connected to said take-off means, and motor means operatively connected to said spur gear for operating the latter, and means operatively connecting said stirring means to said take-off moving means only during movement of said take-off means out of said samples, whereby said stirring means is moved out of said samples during the movement of said take-off means out of said samples.

2. Liquid-sample supply apparatus for supplying a stream of a series of longitudinally spaced liquid samples and another liquid between successive samples, said apparatus comprising means for holding a series of said liquid samples, receptacle means positioned adjacent said holding means for supplying said other liquid, liquid take-off means movable into and out of each of said samples and said receptacle means, respectively, for withdrawing at least a portion of each of said samples and said other liquid between withdrawals of sample, means mounting said holding means and said take-off means for movement relative to each other for positioning said samples, in succession, at the position of said take-off means for withdrawal of sample, sample stirring means mounted for movement into and out of each of said samples, respectively, for mixing each of said samples, means for moving said take-off means into and out of each of said samples and said receptacle means, respectively, for said withdrawing operation, and means operatively connecting said stirring means to said take-off moving means only during movement of said take-off means out of said samples, whereby said stirring means is moved out of said samples during the movement of said take-off means out of said samples, said last mentioned means comprising a rotary member connected to said take-off moving means and having a laterally off-set part, said stirring means having a member engageable by said offset part for lifting said member and thereby lifting said stirring means from a lower position, corresponding to the position of said stirring means in said samples, to an upper position corresponding to the position of said stirring means out of said samples, said rotary member and laterally offset part being positioned with respect to each other and said stirring means member so that the latter is automatically released in its upper position, whereby said stirring means falls downwardly into said samples.

3. Liquid-sample supply apparatus for supplying a stream of a series of longitudinally spaced liquid samples and another liquid between successive samples, said apparatus comprising means for holding a series of said liquid samples, receptacle means positioned adjacent said holding means for supplying said other liquid, liquid take-off means movable into and out of each of said samples and said receptacle means, respectively, for withdrawing at least a portion of each of said samples and said other liquid between wtihdrawals of sample, means mounting said holding means and said take-off means for movement relative to each other for positioning said samples, in succession, at the position of said take-off means for withdrawal of sample, sample stirring means mounted for movement into and out of each of said samples, respectively, for mixing each of said samples, means for moving said take-off means into and out of each of said samples and said receptacle means, respectively, for said withdrawing operation, said take-off moving means comprising a stationary internal gear and a meshing spur gear operatively connected to said take-off means, and motor means operatively connected to said spur gear for operating the latter, and means operatively connecting said stirring means to said take-off moving means only during movement of said take-off means out of said samples, whereby said stirring means is moved out of said samples during the movement of said take-off means out of said samples, said last mentioned means comprising a rotary member connected to said take-off moving means and having a laterally offset part, said stirring means having a member engageable by said offset part for lifting said member and thereby lifting said stirring means from a lower position, corresponding to the position of said stirring means in said samples, to an upper position corresponding to the position of said stirring means out of said samples, said rotary member and laterally offset part being positioned with respect to each other and said stirring means member so that the latter is automatically released in its upper position, whereby said stirring means falls downwardly into said samples.

4. Liquid-sample supply apparatus for supplying a stream of a series of longitudinally spaced liquid samples and another liquid between successive samples, said apparatus comprising means for holding a series of said

liquid samples, receptacle means positioned adjacent said holding means for supplying said other liquid; liquid take-off means movable into and out of each of said samples and said receptacle means, respectively, for withdrawing at least a portion of each of said samples and said other liquid between withdrawals of sample, means mounting said holding means and said take-off means for movement relative to each other for positioning said samples, in succession, at the position of said take-off means for withdrawal of sample, sample stirring means mounted for movement into and out of each of said samples, respectively, for mixing each of said samples, means for moving said take-off means into and out of each of said samples and said receptacle means, respectively, for said withdrawing operation, and means operatively connecting said stirring means to said take-off moving means only during movement of said take-off means out of said samples, whereby said stirring means is moved out of said samples during the movement of said take-off means out of said samples, said last mentioned means comprising a rotary member connected to said take-off moving means and having a laterally offset part, said stirring means having a member engageable by said offset part for lifting said member and thereby lifting said stirring means from a lower position, corresponding to the position of said stirring means in said samples, to an upper position corresponding to the position of said stirring means out of said samples, said rotary member and laterally offset part being positioned with respect to each other and said stirring means member so that the latter is automatically released in its upper position, whereby said stirring means falls downwardly into said samples, and brake means for restraining the downward movement of said stirring means.

5. Liquid-sample supply apparatus for supplying a stream of a series of longitudinally spaced liquid samples and another liquid between successive samples, said apparatus comprising means for holding a series of said liquid samples, receptacle means positioned adjacent said holding means for supplying said other liquid, liquid take-off means movable into and out of each of said samples and said receptacle means, respectively, for withdrawing at least a portion of each of said samples and said other liquid between withdrawals of sample, means mounting said holding means and said take-off means for movement relative to each other for positioning said samples, in succession, at the position of said take-off means for withdrawal of sample, sample stirring means mounted for movement into and out of each of said samples, respectively, for mixing each of said samples, means for moving said take-off means into and out of each of said samples and said receptacle means, respectively, for said withdrawing operation, said take-off moving means comprising a stationary internal gear and a meshing spur gear operatively connected to said take-off means, and motor means operatively connected to said spur gear for operating the latter, and means operatively connecting said stirring means to said take-off moving means only during movement of said take-off means out of said samples, whereby said stirring means is moved out of said samples during the movement of said take-off means out of said samples, said last mentioned means comprising a rotary member connected to said take-off moving means and having a laterally offset part, said stirring means having a member engageable by said offset part for lifting said member and thereby lifting said stirring means from a lower position, corresponding to the position of said stirring means in said samples, to an upper position corresponding to the position of said stirring means out of said samples, said rotary member and laterally offset part being positioned with respect to each other and said stirring means member so that the latter is automatically released in its upper position, whereby said stirring means falls downwardly into said samples, and brake means for restraining the downward movement of said stirring means.

6. Liquid-sample supply apparatus for supplying a series of liquid samples one after the other, in succession, said apparatus comprising means for holding a series of said liquid samples, liquid take-off means movable into and out of each of said samples, in succession, for withdrawing at least a portion of each of said samples, sample stirring means movable up and down, out of and into said samples for the stirring thereof, and means for moving said stirring means up and down comprising a rotary member having a laterally offset part, said stirring means having a member engageable by said offset part for lifting said member and thereby lifting said stirring means from a lower position, corresponding to the position of said stirring means in said samples, to an upper position corresponding to the position of said stirring means out of said samples, said rotary member and laterally offset part being positioned with respect to each other and said stirring means member so that the latter is automatically released in its upper position, whereby said stirring means falls downwardly into said samples.

7. Liquid-sample supply apparatus for supplying a series of liquid samples one after the other, in succession, said apparatus comprising means for holding a series of said liquid samples, liquid take-off means movable into and out of each of said samples, in succession, for withdrawing at least a portion of each of said samples, sample stirring means movable up and down, out of and into said samples for the stirring thereof, and means for moving said stirring means up and down comprising a rotary member having a laterally offset part, said stirring means having a member engageable by said offset part for lifting said member and thereby lifting said stirring means from a lower position, corresponding to the position of said stirring means in said samples, to an upper position corresponding to the position of said stirring means and out of said samples, said rotary member and laterally offset part being positioned with respect to each other and said stirring means member so that the latter is automatically released in its upper position, whereby said stirring means falls downwardly into said samples, and brake means for restraining the downward movement of said stirring means.

8. Liquid-sample supply apparatus for supplying a series of liquid samples one after the other, in succession, said apparatus comprising movable means for holding a series of said liquid samples, liquid take-off means movable into and out of each of said samples, in succession, for withdrawing at least a portion of each of said samples, sample stirring means movable up and down, out of and into said samples for the stirring thereof, means for moving said stirring means up and down, and mechanical means having a part in the path of upward movement of said stirring means for moving said holding means to position each of said samples, in succession, at the position of said take-off means.

9. Liquid-sample supply apparatus for supplying a series of liquid samples one after the other, in succession, said apparatus comprising movable means for holding a series of said liquid samples, liquid take-off means movable into and out of each of said samples, in succesison, for withdrawing at least a portion of each of said samples, sample stirring means movable up and down, out of and into said samples for the stirring thereof, means for moving said stirring means up and down, and mechanical means having a part in the path of upward movement of said stirring means for moving said holding means to position each of said samples, in succession, at the position of said take-off means, said last mentioned means comprising a ratchet secured to said holding means, pawl means for operating said ratchet, and means interconnecting said pawl means and said part for operation of said pawl means in response to said upward movement of said stirring means.

10. Liquid-sample supply apparatus for supplying a liquid series of liquid samples one after the other, in succession, said apparatus comprising a plate having a series of oblong apertures for holding a series of oblong shaped sample cups, each of said apertures having at least one semi-circular end, means for closing a portion of said apertures for holding a series of circular open-top cups having supporting ribs in the resulting partially closed apertures, said closing means comprising another plate removably mounted on said first mentioned plate and having a peripheral edge spaced from said one end of each aperture a predetermined distance so that said rib of each cup is supported on the adjacent part of said first mentioned plate and the opposite part of each cup is in engagement with said peripheral edge, and liquid take-off means movable into and out of each of said sample cups, in succession, for withdrawal of sample therefrom.

11. Liquid-sample supply apparatus for supplying a series of liquid samples one after the other, in succession, said apparatus comprising a removable rotary plate having a series of openings therein arranged in an annular row for supporting a series of open top sample cups, a rotary support member having at least a pair of drive pins, said plate having an inner annular row of holes corresponding in number to said openings for engagement by said pins in a predetermined position of said plate on said support member for rotation of said plate by said support member, said plate having another series of holes arranged in an outer peripheral annular row and corresponding in number to the number of openings in said plate, a switch actuating member adapted to be positioned in any one of said last mentioned holes for stopping the operation of said plate after a predetermined number of samples have been supplied, and liquid take-off means movable into and out of said cups for withdrawing sample therefrom.

12. Liquid sample supply apparatus for supplying a stream of alternately interspaced sample liquid segments and another liquid segments, comprising: carrier means for supporting a plurality of first receptacles for sample liquid and for presenting each of said first receptacles seriatim to a take-off position; a second receptacle for another liquid mounted adjacent said take-off position; liquid take-off means for alternately withdrawing liquid from one said first receptacle disposed at said take-off position and from said second receptacle; means coupled to said take-off means for translating said take-off means in a given plane alternately to, into and out of said first receptacle and to, into and out of said second receptacle; said take-off means including an elongated member; said translating means including two fixed internal gears disposed in spaced apart relationship and having axes perpendicular to said given plane, two shafts, each journaled for rotation through one of said internal gears, two spur gears, each meshed with one of said internal gears, two radial links, each coupled between one of said shafts and the respective one of said spur gears, two pivotal means, each coupling one of said spur gears with said elongated member; and motive means coupled to said shafts for rotating said shafts and thereby rotating said links and said spur gears and thereby translating said elongated member.

13. Liquid sample supply apparatus for supplying a stream of alternately interspaced sample liquid segments and another liquid segments, comprising: carrier means for supporting a plurality of first receptacles for sample liquid and for presenting each of said first receptacles seriatim to a take-off position; a second receptacle for another liquid mounted adjacent said take-off position; liquid take-off means for alternately withdrawing liquid from one said first receptacle disposed at said take-off position and from said second receptacle; means coupled to said take-off means for translating said take-off means in a given plane alternately to, into and out of said first receptacle and to, into and out of said second receptacle; said take-off means including an elongated member; said translating means including two fixed internal gears disposed in spaced apart relationship and having axes perpendicular to said given plane, two shafts, each journaled for rotation through one of said internal gears, two spur gears, each meshed with one of said internal gears, two radial links, each coupled between one of said shafts and the respective one of said spur gears, two pivotal means, each coupling one of said spur gears with said elongated member; and motive means coupled to said shafts for alternately rotating said shafts in one direction and in the other direction and thereby rotating said links and said spur gears and thereby translating said elongated member.

14. Liquid sample supply apparatus for supplying a stream of alternately interspaced sample liquid segments and another liquid segments, comprising: carrier means for supporting a plurality of first receptacles for sample liquid and for presenting each of said first receptacles seriatim to a take-off position; a second receptacle for another liquid mounted adjacent said take-off position; liquid take-off means for alternately withdrawing liquid from one said first receptacle disposed at said take-off position and from said second receptacle; means coupled to said take-off means for translating said take-off means in a given plane alternately to, into and out of said first receptacle and to, into and out of said second receptacle; said take-off means including an elongated member; said translating means including two fixed internal gears disposed in spaced apart relationship and having axes perpendicular to said given plane, two shafts, each journaled for rotation through one of said internal gears, two spur gears, each meshed with one of said internal gears, two radial links, each coupled between one of said shafts and the respective one of said spur gears, two pivotal means, each coupling one of said spur gears with said elongated member; motive means coupled to said shafts for alternately rotating said shafts in one direction and in the other direction and thereby rotating said links and said spur gears and thereby translating said elongated member; and control means coupled to said carrier means and said motive means for causing said motive means to rotate in said one direction for a predetermined period of time, to halt for a predetermined period of time, to rotate in said other direction for a predetermined period of time, and to halt for a predetermined period of time, whereby said take-off means is translated through a cycle for withdrawing liquid from one said sample receptacle at said take-off position and liquid from said second receptacle, and for causing said carrier means to position another first receptacle at said take-off position for each said cycle.

15. Liquid sample supplying appartus for supplying a stream of alternately interspaced sample liquid segments and another liquid segments, comprising: carrier means for supporting a plurality of first receptacles for sample liquid and for presenting each of said first receptacles seriatim to a take-off position; a second receptacle for another liquid mounted adjacent said take-off position; liquid take-off means for alternately withdrawing liquid from one said first receptacle disposed at said take-off position and from said second receptacle; and motive means coupled to said take-off means for providing solely in a given plane said take-off means with motion whereby said take-off means move alternately to, into and out of said first receptacle disposed at said take-off position and to, into and out of said second receptacle; said motive means including adjustable control means for adjustably predetermining the duration of the interval during which said take-off means remains in said first receptacle at said take-off position, and for adjustably predetermining the duration of the interval during which said take-off means remains in said second receptacle.

16. Liquid sample supplying apparatus for supplying a stream of alternately interspaced sample liquid seg-

ments and another liquid segments, comprising: carrier means for supporting a plurality of first receptacles for sample liquid and for presenting each of said first receptacles seriatim to a take-off position; a second receptacle for another liquid mounted adjacent said take-off position; liquid take-off means for alternatively withdrawing liquid from one said first receptacle disposed at said second receptacle; and motive means coupled to said take-off means for providing solely in a given plane said take-off means with motion whereby said take-off means moves alternately to, into and out of said first receptacle disposed at said take-off position and to, into and out of said second receptacle; said motive means including adjustable control means for adjustably predetermining the ratio of durations of the intervals during which said take-off means remains in said first receptacle at said take-off position and remains in said second receptacle.

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