United States Patent [19]

Beesley

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[45] **Oct. 23, 1973**

[54] **EXTRACTION APPARATUS**

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[73] Assignee: **Quantum Assays Corporation,** Fairfield, N.J.

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[52] **U.S. Cl.** ..... **23/269,** 23/270.5, 23/253 R, 23/259, 23/292, 259/13, 259/30, 259/73, 210/31

[51] **Int. Cl.** **B01d 11/04,** B01d 11/02

[58] **Field of Search** ..... 23/269, 270.5, 259, 23/253 R, 292, 267 R; 259/13, 30, 73, 75; 210/31, 37, 38

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Assistant Examiner—S. J. Emery

Attorney—Cyrus D. Samuelson et al.

[57] **ABSTRACT**

An extraction apparatus including an extraction device for facilitating the mixing of a predetermined volume of immiscible liquids and subsequently separating and dispensing a selected one of the liquids. The apparatus includes a tubular member with an extraction chamber which communicates with a collection chamber through a U-tube, the relative location of the extraction chamber, the collection chamber and the U-tube enabling such mixing and enabling the selected liquid to be passed subsequently from the extraction chamber to the collection chamber by manipulation of the tubular member. Further manipulation of the tubular member enables the collected selected liquid to be dispensed to a test tube while the remaining unwanted liquid is drained from the extraction chamber. A plurality of extraction devices enable multiple mixing and separating operations to be performed simultaneously in a single apparatus by a single operator.

8 Claims, 11 Drawing Figures

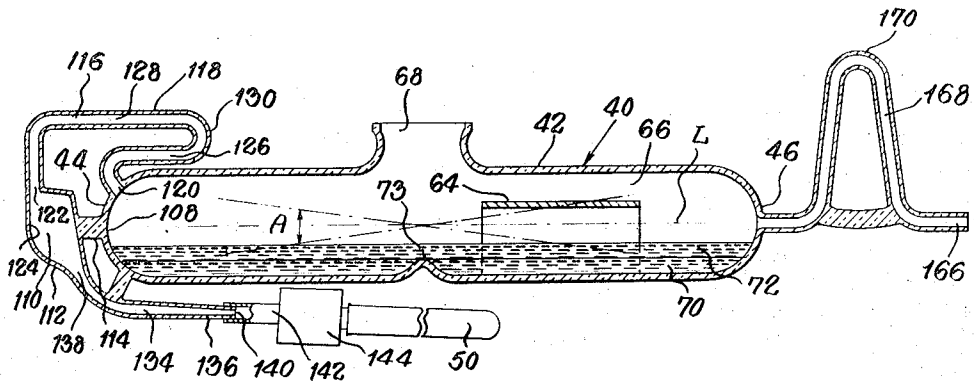


Fig. 1.

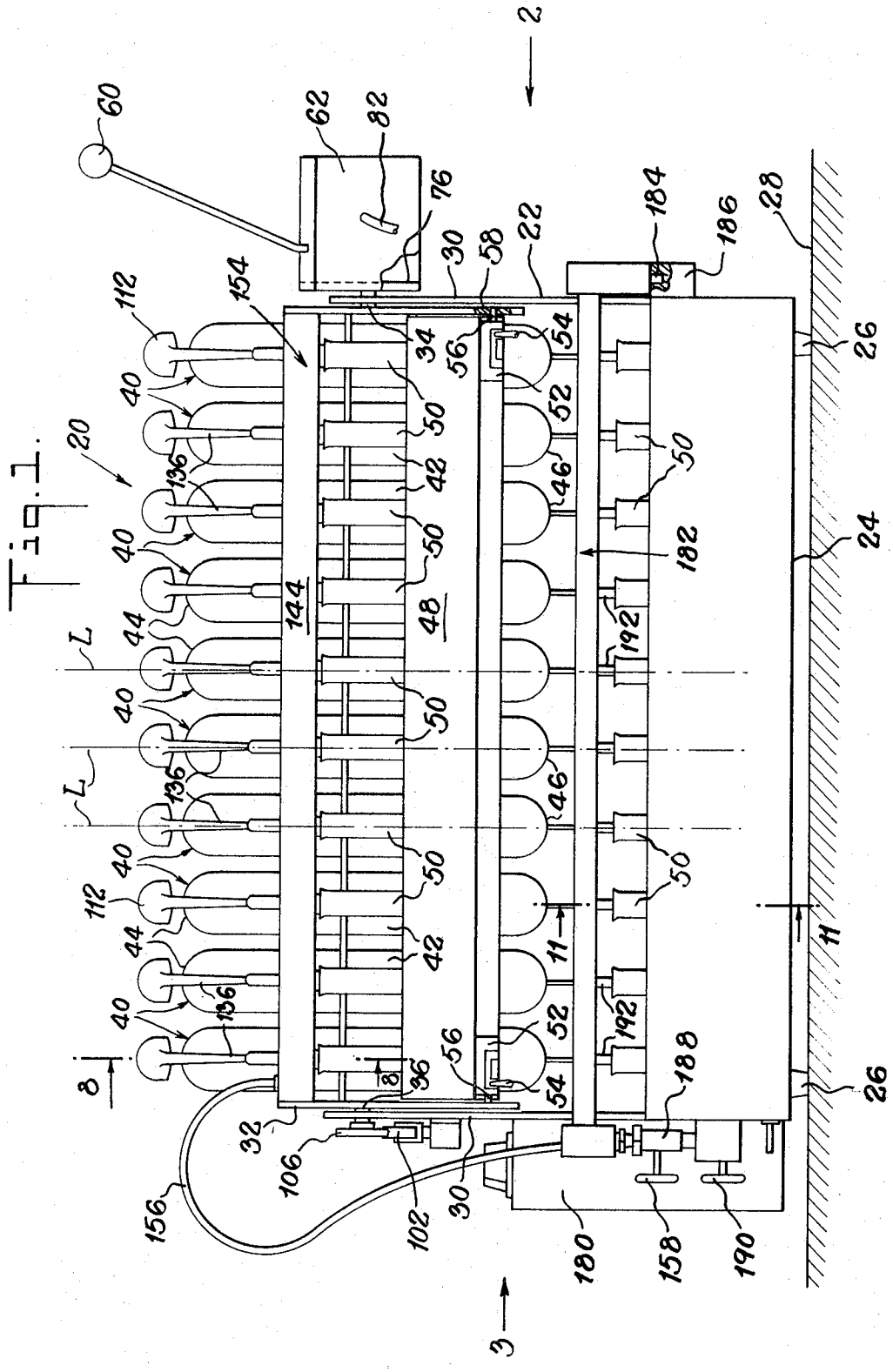
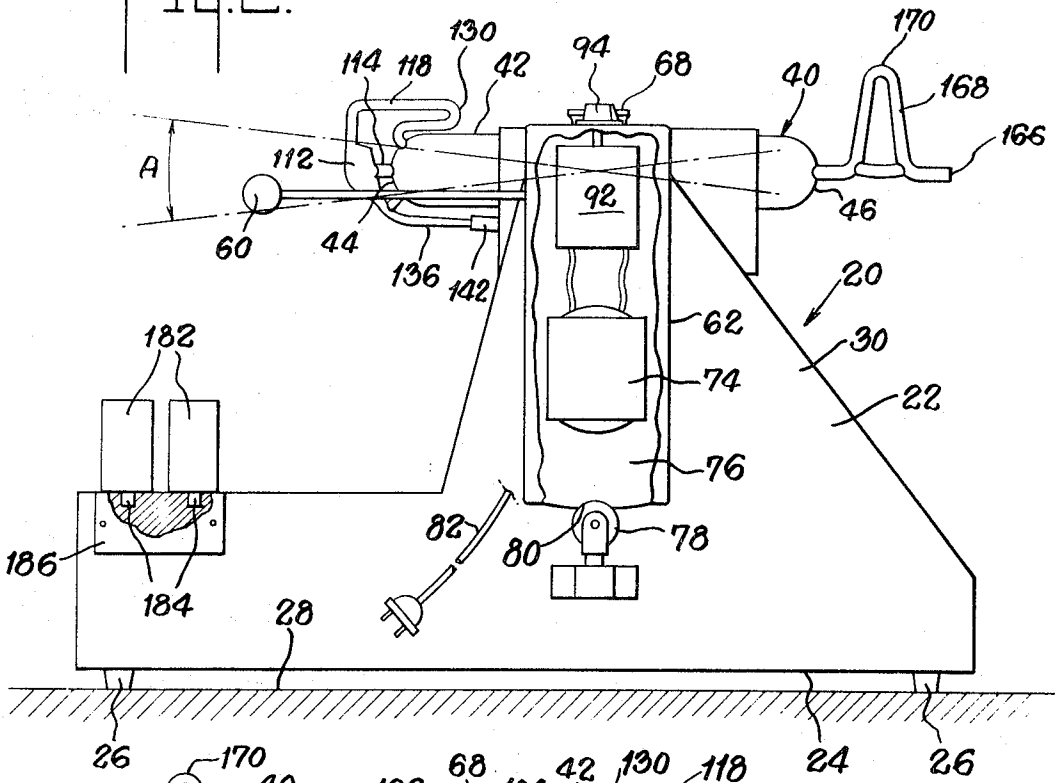

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Fig. 2.


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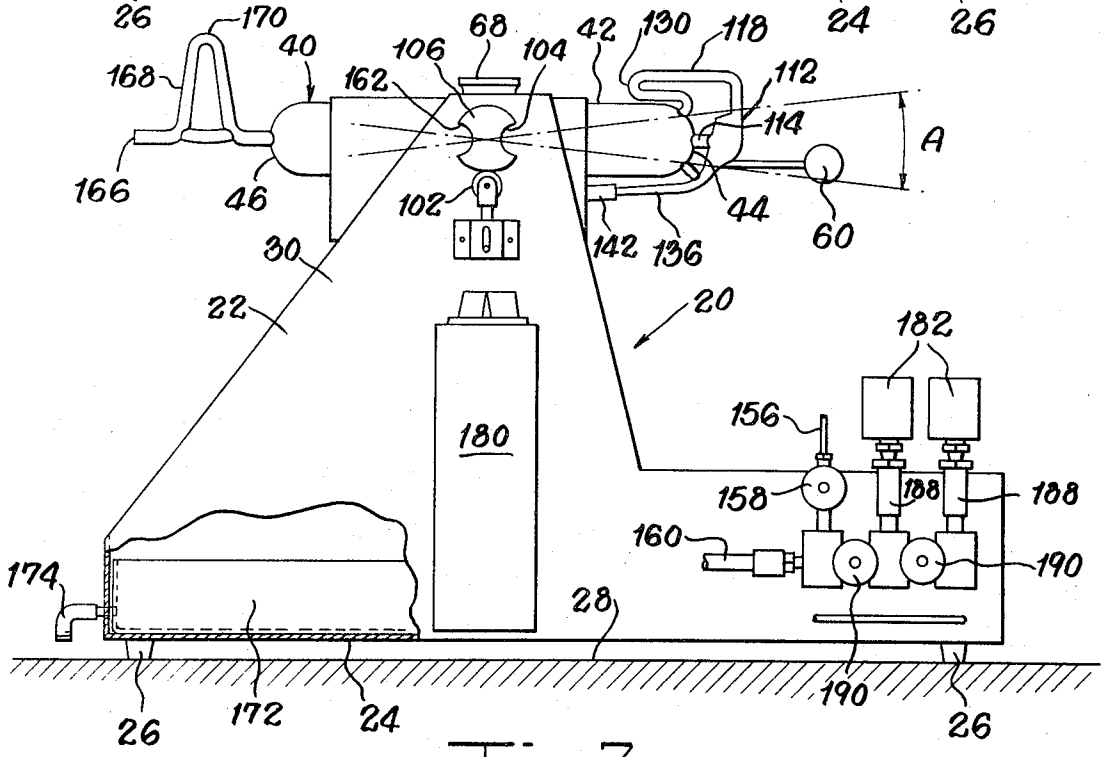

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Fig. 3.

Fig. 4.

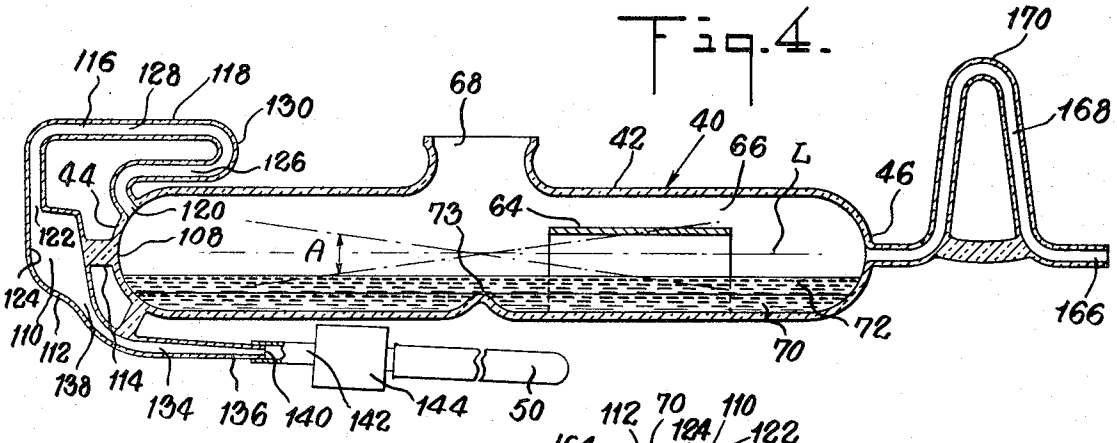
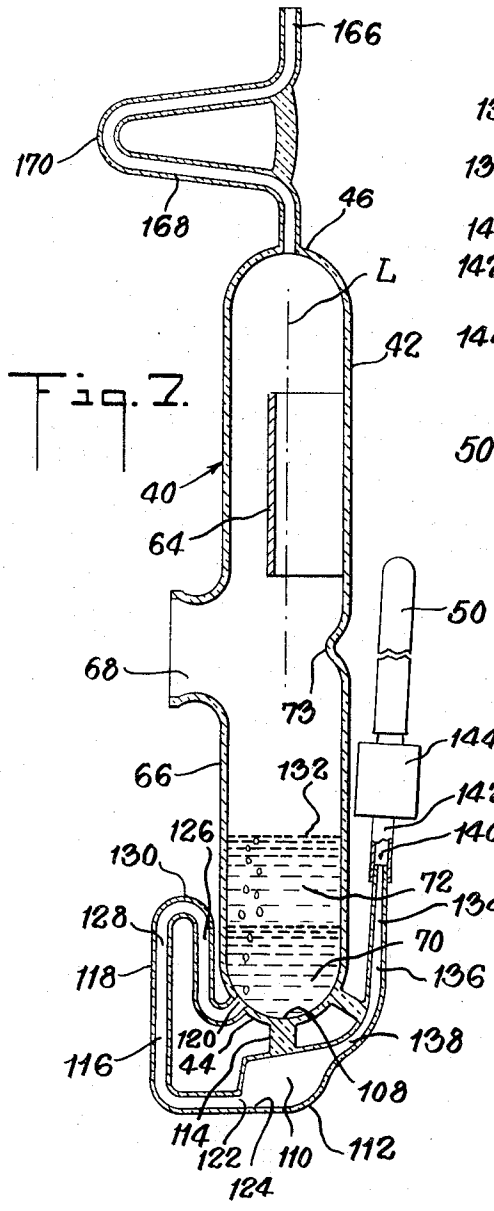


Fig. 7.



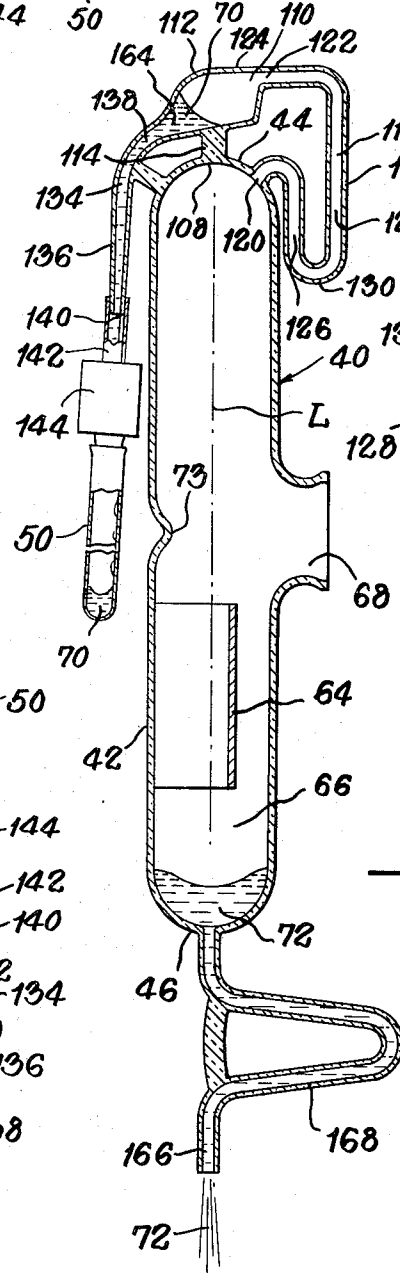


Fig. 9.

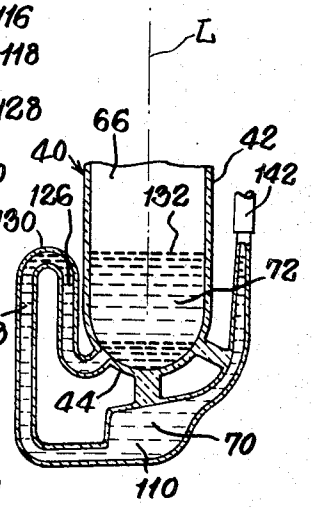


Fig. 10.

Fig. 5.

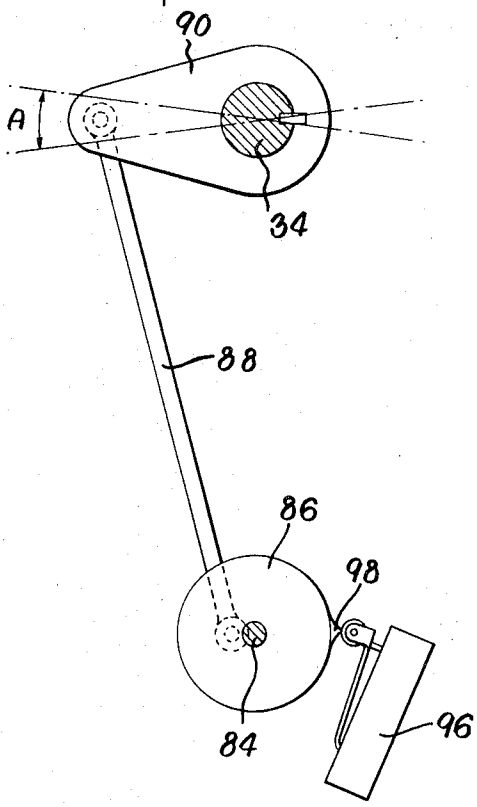


Fig. 8.

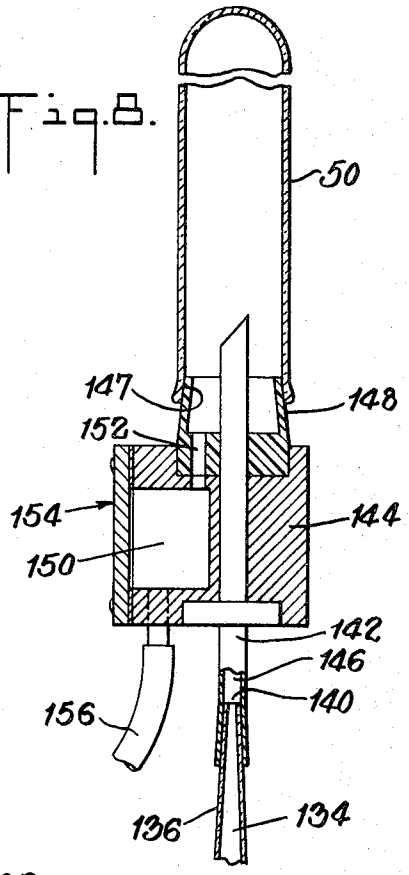


Fig. 6.

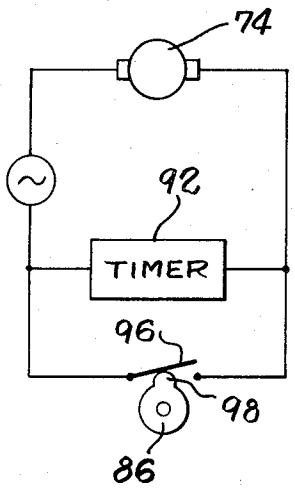
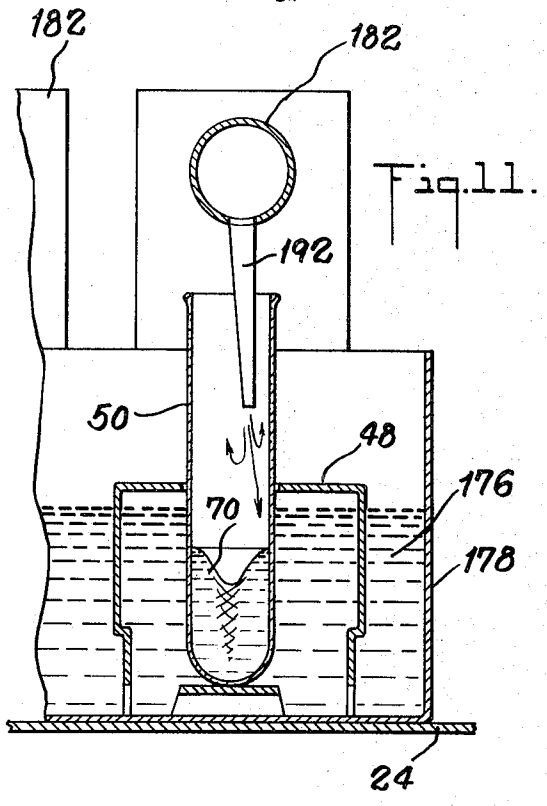


Fig. 11.



EXTRACTION APPARATUS

The present invention relates generally to extraction apparatus and pertains, more specifically, to apparatus for simplifying the mixing and subsequent aliquoting of immiscible liquids in the preparation of extracts from various biological fluid specimens.

The analysis of various biological fluid specimens such as urine, for example, has become an invaluable aid in detecting the presence and concentration of a variety of chemical compounds indicative of the physical condition of the donor of such a specimen.

More recently, the analysis of urine specimens for the detection of drug abuse has given rise to a requirement for the ability to handle a bourgeoning number of analyses quickly and effectively.

One method of analysis is to prepare extracts of the specimen suitable for spotting upon a thin layer chromatographic plate. In preparing such an extract, it has been the practice to soak a piece of cation paper in the specimen and then immerse the paper in a mixture of a buffer and a solvent. Agitation of the buffer and solvent, together with the immersed cation paper soaked with the specimen, enables the solvent to extact the desired constituents from the cation paper in the form of a solute dissolved in the solvent. Typical buffers are citrates, acetates, borates and the like, while the solvent may be chloroform, ethylene dichloride or a like solvent. The buffer serves the purpose of enabling more effective extraction of the solute by the solvent. The solvent and the buffer are usually immiscible and separation of the solvent from the buffer can be accomplished by merely allowing the mixture of solvent and buffer to stand for a short time and then drawing-off one from the other. The solvent is then evaporated, leaving behind the extracted solute which is to be analyzed.

The mixing and subsequent aliquoting, or separating, of the buffer and the solvent, together with the solute, require mechanical manipulation which could become time-consuming thereby resulting in the slow, inefficient processing of specimens to be analyzed.

It is an important object of the invention to provide extraction apparatus in which the extraction process can be performed in a rapid, simple and effective manner.

Another object of the invention is to provide extraction apparatus employing an extraction device enabling quick and effective mixing, aliquoting and dispensing of the solvent separated from the buffer in an extraction process.

Still another object of the invention is to provide an extraction apparatus in which multiple extractions can be performed simultaneously by a single operator thereby multiplying the number of extractions performed by an operator in any given period of time.

A further object of the invention is to provide extraction apparatus which can perform rapid extractions with increased control and accuracy and with lessened possibilities of error.

A still further object of the invention is to provide an extraction apparatus which is compact and relatively inexpensive, yet capable of performing rapid, multiple simultaneous extractions with ease.

The above objects, as well as still further objects and advantages, are attained by the invention which may be described as providing, in an extraction apparatus, an

extraction device for mixing a predetermined volume of immiscible liquids and subsequently separating and dispensing a selected one of the liquids, the device comprising an elongate generally tubular member extending along a longitudinal axis between opposite ends and including an extraction chamber for containing the predetermined volume of liquids when the tubular member is initially oriented with the longitudinal axis thereof in any position within a relatively small included angle about a horizontal position, means for admitting the liquids into the extraction chamber, a collection chamber adjacent one of the opposite ends of the tubular member and having a prescribed volume, the collection chamber being spaced longitudinally from the extraction chamber such that the collection chamber lies below the extraction chamber when the tubular member is oriented in a first alternate position wherein the longitudinal axis thereof is generally vertical and the one end is below the other of the opposite ends thereof, a filling conduit interconnecting the extraction chamber with the collection chamber, the filling conduit having an inlet communicating with the extraction chamber and an outlet communicating with the collection chamber, the filling conduit including means for permitting the selected liquid to pass from the extraction chamber into the collection chamber when the tubular member is in the aforesaid vertical orientation and for precluding the further flow of liquid through the filling conduit in response to the passage of a prescribed volume of the selected liquid from the extraction chamber into the collection chamber, and a dispensing conduit having an inlet communicating with the collection chamber and an outlet located such that liquid in the collection chamber will pass through the dispensing conduit to be dispensed at the outlet thereof when the tubular member is oriented in a second alternate position wherein the longitudinal axis thereof is generally vertical and the one end is above the other end thereof.

The invention will be more fully understood, while still further objects and advantages will become apparent, in the following detailed description of a preferred embodiment of the invention illustrated in the accompanying drawing, in which:

FIG. 1 is a front elevational view of an extraction apparatus constructed in accordance with the invention;

FIG. 2 is a side elevational view of the extraction apparatus viewed in the direction of the arrow at the right in FIG. 1; but with component parts in another operating position;

FIG. 3 is a side elevational view of the extraction apparatus viewed in the direction of the arrow at the left in FIG. 1, with the component parts in the same operating position as in FIG. 2;

FIG. 4 is a longitudinal cross-sectional view of an extraction device of the apparatus of FIG. 1;

FIG. 5 is an enlarged fragmentary view of a rocking mechanism of the apparatus of FIG. 1;

FIG. 6 is a schematic diagram illustrating means for operating the rocking mechanism for a timed interval;

FIG. 7 is a longitudinal cross-sectional view of the extraction device of FIG. 4 in another operating position.

FIG. 8 is an enlarged fragmentary cross-sectional view taken along line 8—8 of FIG. 1;

FIG. 9 is a fragmentary view of a portion of FIG. 7 illustrating the liquids in another position;

FIG. 10 is a longitudinal cross-sectional view of the extraction device of FIG. 4 in still another operating position; and

FIG. 11 is an enlarged, fragmentary cross-sectional view taken along line 11—11 of FIG. 1.

Referring now to the drawing, and especially to FIGS. 1 through 3 thereof, an extraction apparatus constructed in accordance with the invention is illustrated at 20 and is seen to have a frame 22 including a base 24 with depending feet 26 for supporting the extraction apparatus 20 upon a laboratory table 28 or the like. The frame 22 includes upright portions 30 which carry a bracket or carriage 32 supported by stub shafts 34 and 36 affixed to the carriage and journaled for rotation in upright portions 30 such that the carriage can rotate relative to the frame 22. The carriage 32 carries a plurality of extraction devices shown in the form of extraction tubes 40, in this instance ten such extraction tubes 40 being present, all of which are affixed to the carriage 32 for movement therewith.

Each extraction tube 40 includes a generally tubular member 42 which extends along a longitudinal axis L between opposite ends 44 and 46, the axes L all being essentially parallel.

At the outset of an extraction procedure, the carriage 32, and the extraction tubes 40 carried thereby, are in the position shown in FIG. 1. The extraction tubes 40 are clean and empty. A rack 48 carrying ten clean, empty test tubes 50, corresponding to the ten extraction tubes 40, is placed on the carriage 32 and affixed thereto by releasable latches 52, each of which includes an operating knob 54 connected to a slide bolt 56 carried by the rack 48 so that the slide bolt 56 can be engaged within a corresponding aperture 58 in the carriage 32 to hold the rack 48 in the place upon the carriage. At the same time, each of the test tubes 50 is coupled to an extraction tube 40 in a manner which will be more fully described below.

The entire carriage 32, together with the extraction tubes 40 and the rack 48 of test tubes 50, is then rotated by the operator by gripping a handle 60 carried by a housing 62, which rotates with stub shaft 34, and pulling the handle forward to rotate the carriage through 90° into an initial position illustrated in FIGS. 2 and 3. In this initial position of the carriage 32 and the extraction tubes 40, the axes L of the extraction tubes are oriented in a horizontal position.

As best seen in FIG. 4, when the carriage 32 is in the aforesaid initial position, each tubular member 42 is in a horizontal position. A piece of cation paper 64 is placed within an extraction chamber 66 of each tubular member 42 by passing the cation paper 64 through a charging port 68 located intermediate the ends 44 and 46 of that tubular member. The charging port 68 also serves as means for admitting into the extraction chamber a measured volume of solvent 70 and buffer 72. Preferably, the cation paper 64 is soaked in the biological fluid specimen, i.e., urine, prior to placement of the paper 64 into the extraction chamber 66. Once the extraction chamber 66 of each tubular member 42 is charged with cation paper, solvent and buffer, the carriage 32 is rocked about the initial horizontal position through a relatively small included angle A, causing all of the extraction tubes to likewise rock through an angle A. Preferably, angle A is no greater than approximately 15°.

Such rocking of the carriage 32 and the extraction tubes 40 agitates and mixes the liquids in the extraction chamber 66 and enables the solvent 70, in the presence of the buffer 72, to elute the solute from the cation paper 64. The agitation and mixing is enhanced by the provision of a baffle 73 within the extraction chamber 66.

Rocking of the carriage 32 is accomplished by the operation of an electric motor 74 mounted upon a motor board 76 which is part of the housing 62 carried by the stub shaft 34. When the housing 62 was rotated by the operator from the position shown in FIG. 1 to the position illustrated in FIG. 2, the motor board 76 was intercepted by a detent shown in the form of a locking roller 78 mounted upon the frame 22 and resiliently biased upwardly to engage a corresponding notch 80 in the motor board 76. The motor board 76 is thus fixed against movement relative to the frame 22.

Turning now to FIG. 5, energization of electric motor 74, through line cord 82, causes the motor shaft 84 to rotate a first crank 86 which causes a connecting rod 88 to reciprocate. The connecting rod 88, in turn, rocks a second crank 90 affixed to stub shaft 34 through angle A so that the carriage 32 rocks through angle A. As best seen in FIGS. 2 and 6, as well as in FIG. 5, a timing device 92 is provided for selecting a prescribed duration of operation of the motor 74. The operator selects the desired time by turning knob 94 of the timing device 92. As long as the timing device 92 is activated, the motor 74 will continue to operate. In order to assure that the carriage 32 will always come to rest at the initial horizontal position once the motor 74 stops, an electric switch 96 is connected in parallel with the timing device 92 and a lobe 98 is provided on the first crank 86 for activating the switch 96. The position of the lobe 98 assures that the switch 96 will remain in the "on" position and that the motor 74 will continue to operate until the carriage is returned to the horizontal position. If the timing device 92 is deactivated when the lobe 98 actuates the switch 96 to "off" position, the motor 74 will stop. When the motor is stopped, the cranks 86 and 90 and the connecting rod 88 serve to rigidly couple the stub shaft 34 to the motor board 76 so that the housing 62 and the carriage 32 can be rotated as a unit when the operator moves the handle 60.

In order to now separate and aliquote the solvent 70 from the buffer 72, the operator again grasps the handle 60 and moves it downwardly, as viewed in FIGS. 2 and 3, another 90° to bring the carriage 32 into a first alternate position where the extraction tubes 40 are oriented as shown in FIG. 7. In this position the longitudinal axes L of the tubular members 42 are vertical and end 44 is below end 46. The carriage 32 is retained in this position by the engagement of another resiliently biased detent roller 102 within a first notch 104 in a detent disk 106 affixed for rotation with stub shaft 36 (see FIGS. 1 and 3).

As best seen in FIG. 7, the solvent 70 and buffer 72 will drop to the end 108 of the extraction chamber 66 corresponding to end 44 of the tubular member 42. The solvent 70 and the buffer 72 are immiscible and, because the solvent is heavier, or more dense, than the buffer, the solvent will tend to gravitate to a lower layer while the buffer will tend to rise to an upper layer.

Adjacent the end 44 of the tubular member 42 is a collection chamber 110 shown within a bulb-like member 112 rendered integral with the tubular member 42

through a support 114. The collection chamber 110 has a prescribed volume, is spaced longitudinally from the extraction chamber 66 and lies below the extraction chamber when the tubular member 42 is in the position shown in FIG. 7. A filling conduit interconnects the extraction chamber 66 with the collection chamber 110 and is provided by a passage 116 in a U-shaped tube 118 having an inlet 120 adjacent the lowermost end 108 of the extraction chamber 66 and an outlet 122 at the lowermost end 124 of the collection chamber 110. The passage 116 in the U-shaped tube 118 includes generally axially oriented legs 126 and 128 spaced apart laterally by a bend 130 located axially above the inlet 120 and the outlet 122. The axial location of the bend 130 is chosen so that the level 132 of the liquids 70 and 72 lies above the bend 130 and the lowermost liquid 70 will tend to flow through the passage 116 into the collecting chamber 110. Such flow is precluded by means which will now be explained.

A dispensing conduit is provided by means of a passage 134 in a dispensing tube 136 having an inlet 138 communicating with the collection chamber 110 and an outlet 140 coupled with a corresponding test tube 50 by means of a fitting 142 fixed within a bar 144 of the carriage 32 and providing an open passage 146 between the dispensing conduit passage 134 and the interior of the test tube 50, as seen in FIG. 8. The mouth 147 of each test tube 50 engages a stopper 148 which is affixed to the bar 144 so that ordinarily the interior of the test tube 50 is largely closed to the ambient atmosphere, but not necessarily tightly sealed. In this instance, the stoppers 148 are fabricated of a fluoroplastic material, such as Teflon, and are not seated within the mouths 147 of the test tubes 50 so tightly that the test tubes are sealed. The bar 144 is provided with a chamber 150 which communicates with the interior of the test tube 50 via a further passage 152. The chamber 150 runs the length of the bar 144 and communicates in a like manner with each test tube 50, thus establishing a manifold 154. Gas under pressure is selectively supplied to the manifold 154 through flexible tubing 156 connected to a source of gas under pressure through a valve 158 and supply hose 160. The gas is preferably air, but may be nitrogen or another gas where required. Assuming that the gas is air, it will be apparent that as long as the passage 116, the collection chamber 110, the dispensing conduit 134, the test tube 50 and the manifold 154 are kept filled with air under pressure, the liquid in the extraction chamber 66 will not flow into the collection chamber 110. If air is supplied under pressure to the manifold 154, it will pass from the manifold 154 through the collection chamber 110 and U-tube 118 into the extraction chamber 66 thereby not only serving to retain the liquids in the extraction chamber 66, but aiding the separation of the buffer 72 from the solvent 70 by the gentle agitation produced as a result of the bubbling of the air through the liquids. In this matter the complete separation of the buffer 72 and the solvent 70 into two layers, as illustrated in FIG. 7, can take place within about 10 to 15 seconds.

Once separation of the liquids into the upper layer and the lower layer (as illustaated in FIG. 7) is complete, the air valve 158 may be operated to stop the flow of air and, since the test tubes 50 are not completely sealed from the ambient atmosphere by the stoppers 148, air can escape from the test tubes to enable the lower liquid or solvent 70 to begin flowing through the U-tube 118 into the collection chamber 110. However, it is noted that should it be found desirable to provide a seal between each stopper 148 and a corresponding test tube 50, a similar effect can be attained by opening the manifold 154 to the ambient atmosphere when the air is shut off. When the level of the liquid in the extraction chamber 66 reaches the level of the liquid in the dispensing tube 136, as seen in FIG. 9, the flow of liquid from the extraction chamber 66 into the collection chamber 110 will stop. Thus, the volume of the collection chamber 110, the passage 134 of the dispensing tube 136 and the passage 116 of the U-tube 118 determines the volume of liquid remaining in the extraction chamber 66 and by initially charging the extraction chamber with the proper volume of solvent 70 and buffer 72 it can be assured that only solvent will enter the collection chamber. In addition, by holding the diameter of passage 116 in the U-tube 118 to a relatively small dimension, it has been found that the flow of buffer through passage 116 can be precluded, without precluding passage of the solvent into the collection chamber 110, by virtue of the difference in the surface tension of the different liquids. Thus, the diameter of passage 116 can be made such that the surface tension of buffer 72 is great enough to preclude the flow of buffer through inlet 120 of passage 116 while the surface tension of solvent 70 is not as great and will permit the solvent to flow. Furthermore, a small diameter passage 116 throttles the flow of solvent 70 somewhat and enables a better regulated, controlled flow of solvent from the extraction chamber 66 into the collection chamber 110. In any event, the retention of both the solvent and the buffer within the extraction chamber and the subsequent passage of solvent from the extraction chamber into the collection chamber is accomplished simultaneously in all of the extraction devices 40 by operation of a single control.

Once the collection chamber 110 is filled with solvent 70, the operator again grasps the handle 60 and rotates the carriage 32 through 180° to bring the carriage into a second alternate position where the extraction tubes 40 are oriented as shown in FIG. 10. In this position the longitudinal axes L of the tubular members 42 are vertical and end 44 is above end 46. The carriage 32 is retained in this position by the engagement of detent roller 102 within a second notch 162 in the detent disk 106. In this position of the tubular member 42, the inlet 138 of the dispensing conduit passage 134 is located at the lowermost end 164 of the collection chamber 110 and the solvent 70 will flow out of the collection chamber into the test tube 50, as illustrated in FIG. 10. Again, draining of the collection chambers of all of the extraction devices 40 into corresponding test tubes 50 is accomplished simultaneously.

At the same time, buffer 72 will pass through a drain conduit 166 provided by a drain tube 168 at the end 46 of each tubular member 42, thereby simultaneously emptying each extraction chamber 66. The drain tube 168 is provided with a configuration including a lateral elbow 170 to preclude draining of the buffer 72 and the solvent 70 during agitation and mixing when the tubular member 42 is being rocked about the horizontal position. The dumped buffer 72 will drop into a drain pan 172 located on the base 24 of the frame 22 and pass out of the apparatus 20 through a drain fitting 174 (see FIG. 3).

Turning now to FIG. 11, once the test tubes 50 are filled with solvent 70 carrying the eluted solute, the rack 48 is removed from the carriage 32 by releasing the latches 52, and the rack 48 of test tubes 50 is placed in one of two locations povided in a heated water bath 176 in a tank 178 placed upon the base 24 of the frame 22. The temperature of the water bath 176 may be regulated by an adjustable thermostat 180 (see FIG. 3). A blow-down manifold 182 is snapped into place over the rack 48 in the water bath 176 by means of a pin 184 carried by the manifold and inserted into a support block 186 and a quick-disconnect air fitting 188. An air valve 190 is then opened to permit air to flow through the interior of the manifold 182, as seen in FIG. 11, and through individual nozzles 192 to establish a vortex in the solvent 70 in each test tube 50. In this manner vapors are purged from the solvent 70 and the solvent is evaporated, leaving behind the solute. The solute can then be dissolved in another solvent suited for spotting a thin layer chromatographic plate.

Two locations are illustrated for racks 48 to be placed within the water bath so that further extractions can be performed while evaporation of solvent is taking place in those test tubes already used in an earlier extraction operation. The blow-down manifolds 182 assure that the evaporation capacity of the apparatus 20 is sufficient to keep pace with the extraction cycle so that the proper number of basic extractions can be performed.

Once all of the extraction cycles are complete, cation paper 64 is removed from the extraction chamber 66 of each extraction tube 40. The carriage 32 is rotated to the first alternate position and a cleaning solvent such as methanol is injected through each drain tube 168. The carriage is then rotated 180° to the second alternate position and the cleaning solvent is dumped through the drain tubes 168 to the drain pan 172. The apparatus is then ready for another extraction operation.

It will be apparent that the ability to manipulate a plurality of extraction tubes with only a minimal number of controls to perform a plurality of simultaneous extractions greatly multiplies the effectiveness of a single operator.

The above detailed description of a preferred embodiment of the invention is provided by way of example only. Various details of design and construction may be modified without departing from the true spirit and scope of the invention as set forth in the appended claims.

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

1. In an extraction apparatus of the type wherein a selected material is to be eluted from a cation paper, an extraction device for mixing a predetermined volume of immiscible liquids, while exposing the cation paper to the liquids, and subsequently separating and dispensing a selected one of said liquids, said device comprising:

an elongate generally tubular member extending along a longitudinal axis between opposite ends and including an extraction chamber for containing said predetermined volume of liquids when the tubular member is initially oriented with the longitudinal axis thereof in any position within a relatively small included angle about a horizontal position;

a charging port located intermediate the opposite ends of the tubular member for admitting said liquids into the extraction chamber and providing an opening to the extraction chamber large enough to admit said cation paper;

a collection chamber adjacent one of said opposite ends of the tubular member and having a prescribed volume, said collection chamber being spaced longitudinally from the extraction chamber such that the collection chamber lies below the extraction chamber when the tubular member is oriented in a first alternate position wherein the longitudinal axis thereof is generally vertical and said one end is below the other of the opposite ends thereof;

a filling conduit interconnecting the extraction chamber with the collection chamber, said filling conduit having an inlet located adjacent the end of the extraction chamber corresponding to said one end of the tubular member and communicating with the extraction chamber, an outlet located at the lowermost end of the collection chamber, when viewed with the tubular member in said first alternate position, and communicating with the collection chamber, and a generally U-shaped passage between the inlet and the outlet, said U-shaped passage including generally axially oriented legs spaced apart laterally and interconnected by a bend, said bend being located axially above the inlet and outlet when the tubular member is in the first alternate position;

said filling conduit normally permitting said selected liquid to pass from the extraction chamber into the collection chamber when the tubular member is in the first alternate position;

means for selectively passing a gas under pressure into the collection chamber and into the filling conduit to selectively preclude said liquids from passing through the filling conduit into the collection chamber while the tubular member is in said first alternate position;

a dispensing conduit communicating with the collection chamber;

the volumetric relationship among said predetermined volume of liquids, the collection chamber, the filling conduit and the dispensing conduit, and the relative location of the collection chamber, the filling conduit and the dispensing conduit serving to preclude the further flow of liquid through said filling conduit in response to the passage of a prescribed volume of said selected liquid from the extraction chamber into the collection chamber;

said dispensing conduit having an inlet located at the lowermost end of the collection chamber, when viewed with the tubular member in a second alternate position wherein the longitudinal axis thereof is generally vertical and said one end is above said other end thereof, and communicating with the collection chamber, and an outlet located such that liquid in the collection chamber will pass through the dispensing conduit to be dispensed at the outlet thereof when the tubular member is oriented in the second alternate position; and

a drain conduit at said other of the ends of the tubular member and communicating with the extraction chamber such that any liquid in the extraction chamber will be drained therefrom when the tubu-

lar member is in said second alternate position, said drain conduit having a configuration precluding draining of said liquids when the tubular member is in said initial orientation.

2. The extraction device of claim 1 wherein the relatively small included angle is no greater than approximately 15°.

3. An extraction apparatus of the type wherein a selected material is to be eluted from a cation paper by mixing a predetermined volume of immiscible liquids while exposing the cation paper to the liquids and subsequently separating and dispensing a selected one of said liquids, said apparatus comprising:

a frame;

a carriage mounted upon said frame for selective location in any one of an initial position, a first alternate position and a second alternate position;

a plurality of elongate generally tubular members carried by the carriage each extending along a longitudinal axis between opposite ends, said tubular members each including an extraction chamber for containing said predetermined volume of liquids when each tubular member is oriented with the longitudinal axis thereof in any position within a relatively small included angle about a horizontal position, each tubular member being oriented with the longitudinal axis thereof horizontal when the carriage is in said initial position;

a charging port located intermediate the opposite ends of each tubular member for admitting said liquids into each extraction chamber and providing an opening to each extraction chamber large enough to admit said cation paper;

means for selectively rocking the carriage and the tubular members carried thereby through said included angle about the horizontal position;

a collection chamber adjacent one of said opposite ends of each tubular member and having a prescribed volume, each said collection chamber being spaced longitudinally from each corresponding extraction chamber such that each collection chamber lies below the corresponding extraction chamber when each tubular member is oriented in a first alternate position wherein the longitudinal axis thereof is generally vertical and said one end is below the other of the opposite ends thereof, each said tubular member being oriented in said first alternate position thereof when the carriage is in the first alternate position thereof;

a filling conduit interconnecting each extraction chamber with each corresponding collection chamber, each said filling conduit having an inlet located at the end of the corresponding extraction chamber corresponding to said one end of each tubular member, and communicating with the corresponding extraction chamber, an outlet located at the lowermost end of the corresponding collection chamber, when viewed with each tubular member in said first alternate position, and communicating with the corresponding collection chamber, and a U-shaped passage between the inlet and the outlet, said U-shaped passage including generally axially oriented legs spaced apart laterally and interconnected by a bend, said bend being located axially above the inlet and outlet when the tubular members are in the first alternate position;

each said filling conduit including means for permitting said selected liquid to pass from each extraction chamber into each collection chamber when each tubular member is in the first alternate position;

means for selectively passing a gas under pressure simultaneously into each collection chamber and into each corresponding filling conduit to preclude said liquids from passing through each filling conduit into the corresponding collection chamber while the tubular members are in the first alternate position thereof;

a dispensing conduit for each collection chamber;

the volumetric relationship among said predetermined volume of liquids, the collection chamber, the filling conduit and the dispensing conduit, and the relative location of the collection chamber, the filling conduit and the dispensing conduit serving to preclude the further flow of liquid through said filling conduit in response to the passage of a prescribed volume of said selected liquid from the extraction chamber into the collection chamber;

each said dispensing conduit being located at the lowermost end of the corresponding collection chamber, when viewed with each tubular member in a second alternate position wherein the longitudinal axis thereof is generally vertical and said one end is above said other end thereof, and communicating with each collection chamber, and an outlet located such that liquid in each collection chamber will pass through the corresponding dispensing conduit to be dispensed at the outlet thereof when each tubular member is oriented in the second alternate position, each said tubular member being oriented in said second alternate position thereof when the carriage is in the first alternate position thereof;

a drain conduit at said other of the ends of each tubular member and communicating with the corresponding extraction chamber such that any liquid in the extraction chamber will be drained simultaneously therefrom when the tubular members are in said second alternate position, each said drain conduit having a configuration precluding draining of said liquids when the tubular members are in said initial orientation; and

means for selectively locating the carriage in the initial position thereof, the first alternate position thereof, or the second alternate position thereof.

4. The extraction apparatus of claim 3 wherein said means for selectively rocking the carriage and the tubular members carried thereby rocks the carriage through an included angle no greater than approximately 15°.

5. The extraction apparatus of claim 3 including means for providing a selected duration of operation of the rocking means.

6. The extraction apparatus of claim 3 wherein the selected liquid from each collection chamber is to be dispensed into a corresponding test tube, said means for simultaneously selectively precluding said liquids from passing through each said filling conduit including:

means for coupling each test tube with a corresponding conduit such that the interior of each test tube communicates with the corresponding dispensing conduit; and

means for simultaneously selectively passing gas under pressure into the test tube.

7. The extraction apparatus of claim 6 including:

a manifold carried by said carriage;

a plurality of stopper members affixed to said carriage for engaging one stopper member with each test tube;

means for selectively locating each test tube on the carriage and in engagement with a stopper member;

a first passage through each stopper member communicating with the corresponding dispensing conduit;

a second passage through each stopper member communicating with the manifold; and

means for selectively supplying gas under pressure to said manifold.

8. The extraction apparatus of claim 6 wherein each test tube when coupled with each dispensing conduit is located below the inlet of the corresponding dispensing conduit when the tubular members are in the second alternate position thereof.

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