Aug. 22, 1961 J. J. RODRIGUES, JR 2,997,077

FRACTION COLLECTOR

Filed April 6, 1959

4 Sheets-Sheet 1

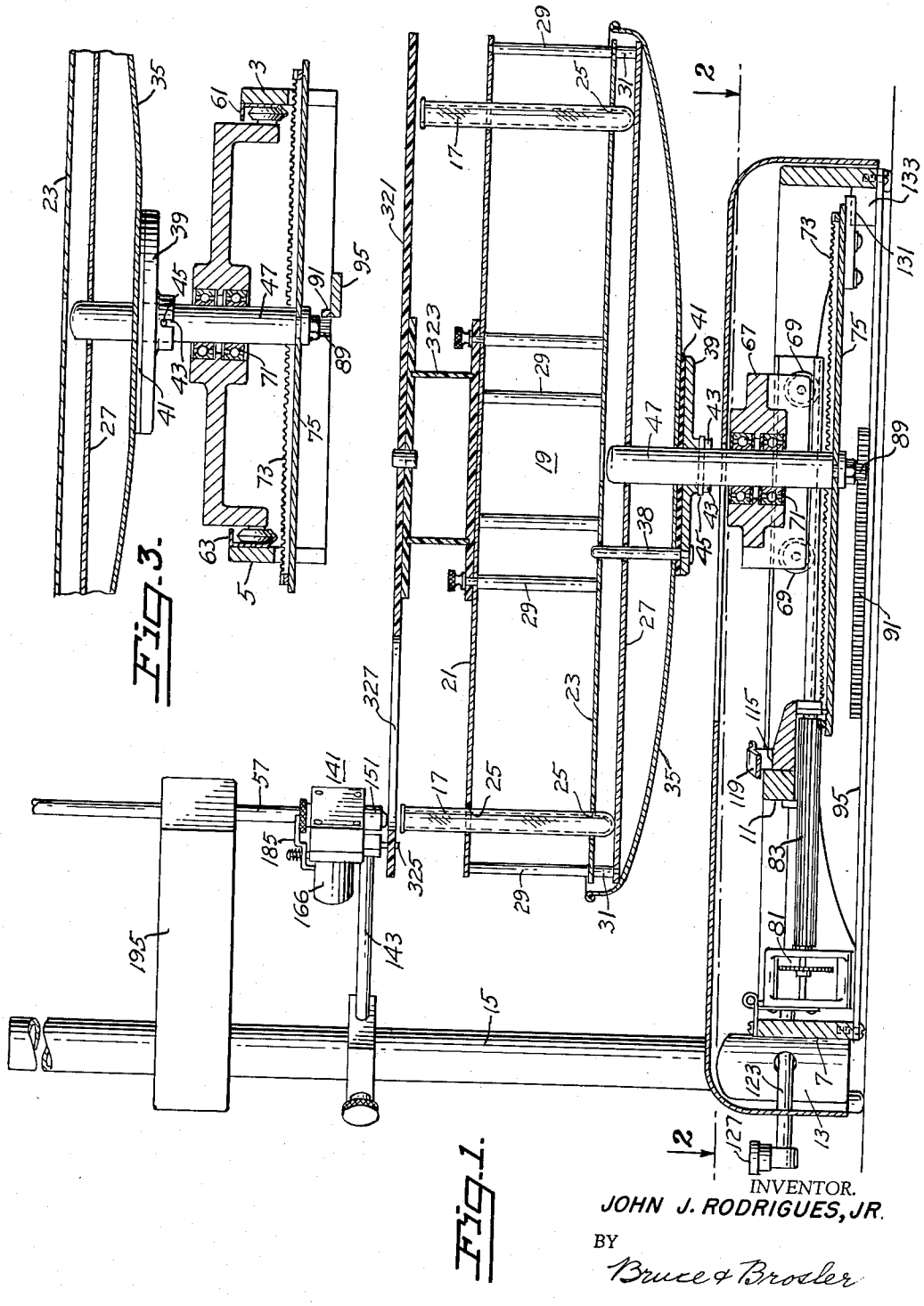


Fig. 1.

Fig. 3.

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4 Sheets-Sheet 2

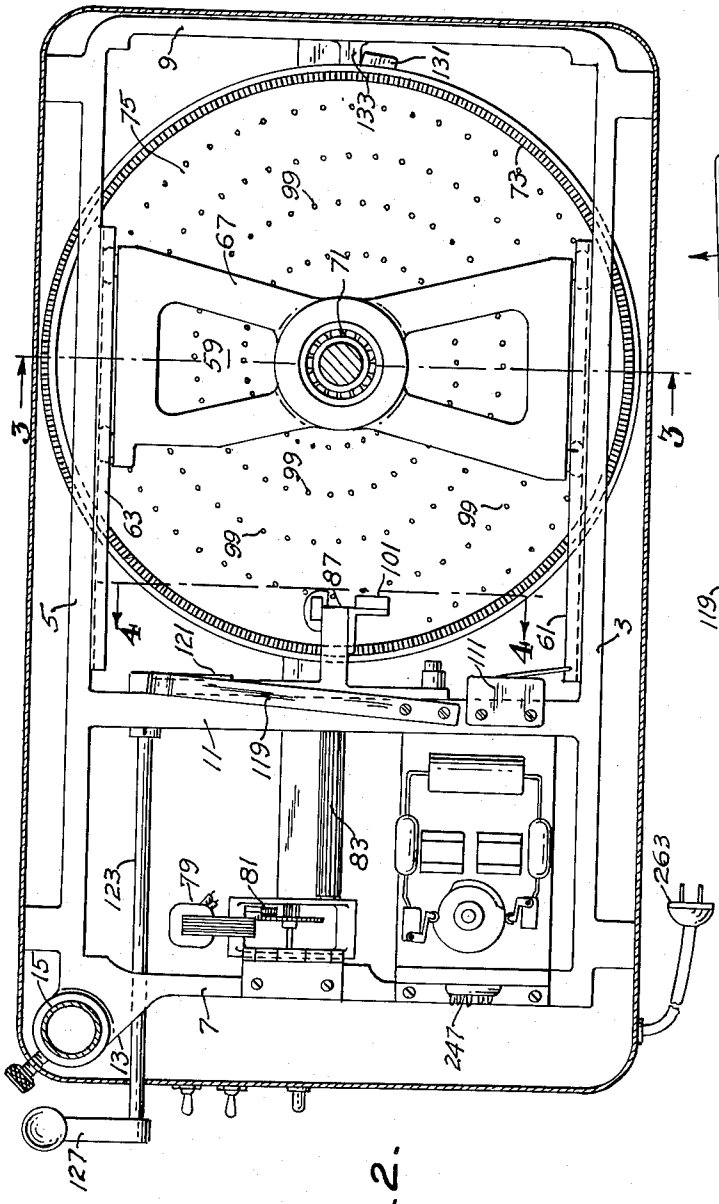


Fig. 2.

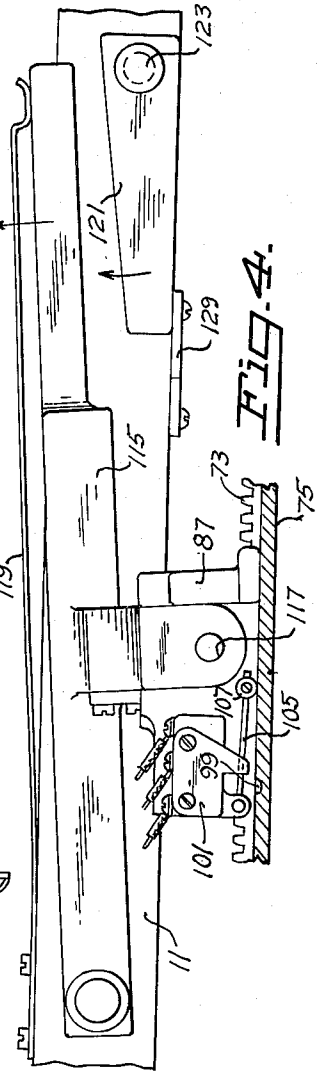


Fig. 4.

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Fig. 6.

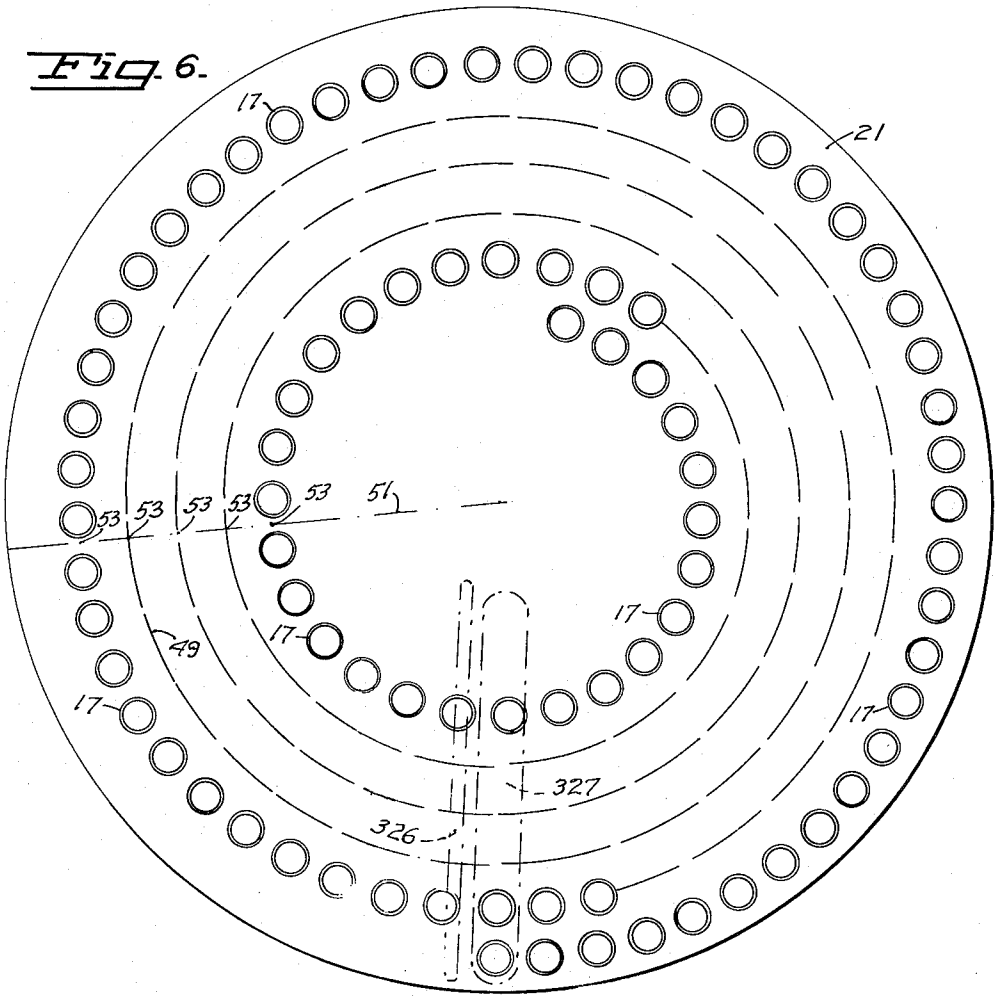
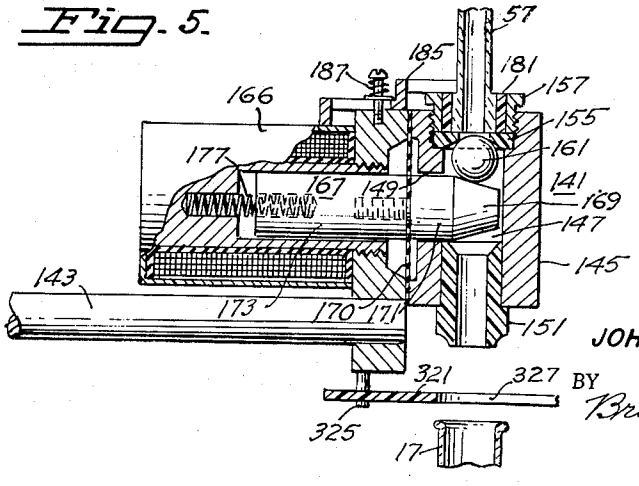


Fig. 5.



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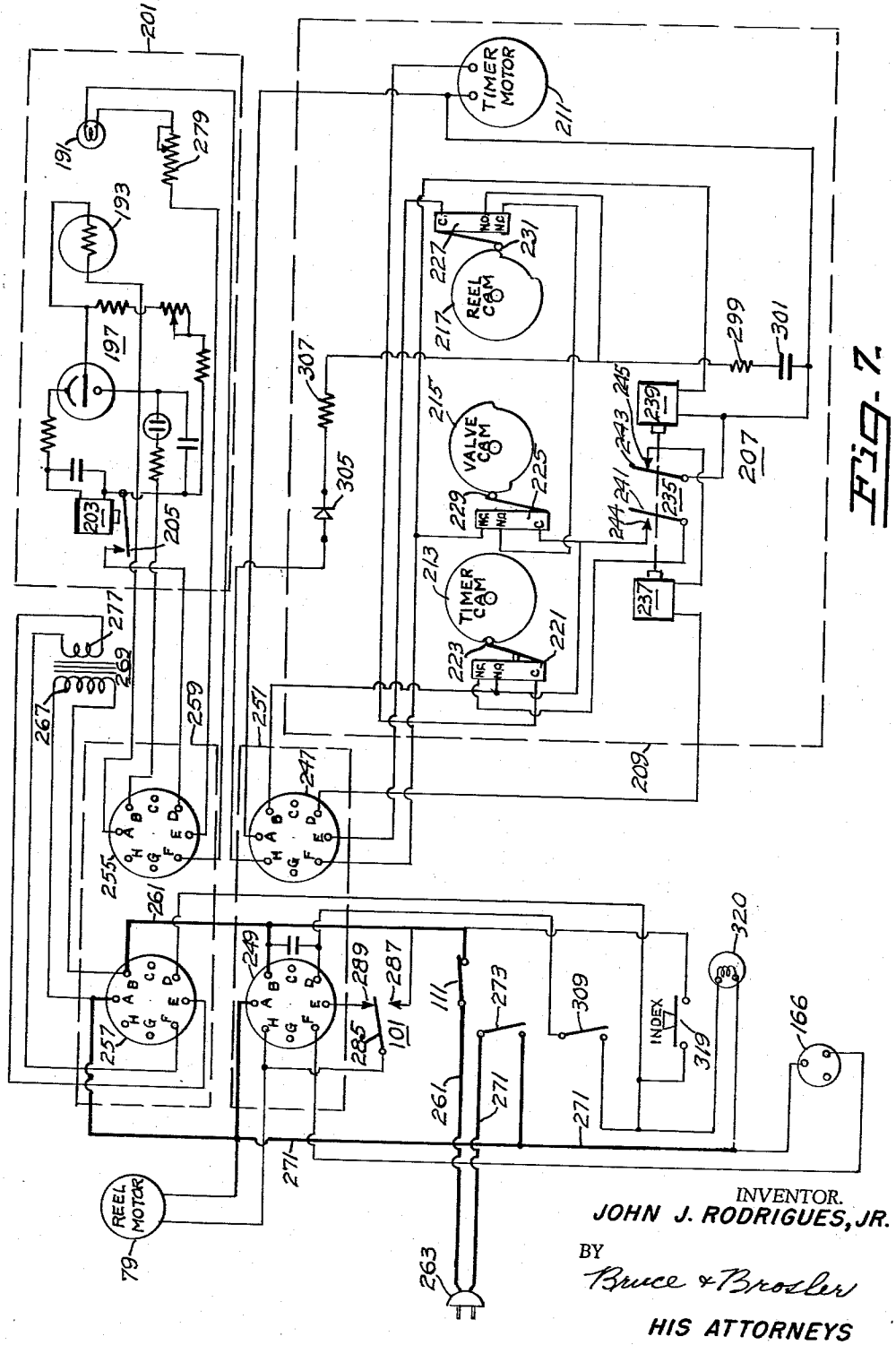


Fig. 7

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United States Patent Office 2,997,077 Patented Aug. 22, 1961

2,997,077

FRACTION COLLECTOR

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Filed Apr. 6, 1959, Ser. No. 804,311
6 Claims. (Cl. 141—130)

My invention relates to laboratory equipment and more particularly to fraction collectors.

Among the objects of my invention are:

(1) To provide a novel and improved fraction collector;

(2) To provide a novel and improved fraction collector of the spiral type;

(3) To provide a novel and improved fraction collector of the spiral type, having greater capacity than corresponding collectors of the prior art;

(4) To provide a novel and improved fraction collector of the spiral type which permits of the interchangeability of reels for different tube diameters and without the necessity of additional changes or adjustments;

(5) To provide novel and improved means for indexing a fraction collector;

(6) To provide a novel and improved fraction collector in which splashing or spilling of liquid between tubes is eliminated;

(7) To provide a novel and improved valve assembly;

(8) To provide a novel and improved valve assembly for use in a fraction collector;

(9) To provide a novel and improved valve assembly for control of liquid flow; and

(10) To provide a novel and improved liquid control valve assembly in which no metal is contacted by liquid flowing therethrough.

Additional objects of my invention will be brought out in the following description of a preferred embodiment of the same, taken in conjunction with the accompanying drawings, wherein

FIG. 1 is an elevational view in section through the fraction collector of the present invention;

FIG. 2 is a plan view in section taken in the plane 2—2 of FIG. 1;

FIG. 3 is a fragmentary view in section taken in the plane 3—3 of FIG. 2;

FIG. 4 is a view in section taken in the plane 4—4 of FIG. 2;

FIG. 5 is a view in section taken through a valve assembly depicted as a component in the fraction collector of FIG. 1;

FIG. 6 is a plan view of a reel assembly plate in the foregoing apparatus; and

FIG. 7 is a circuit diagram depicting the control system involved in the operation of the fraction collector of FIG. 1.

Referring to the drawings for details of my invention in its preferred form, the same comprises a base frame substantially rectangular in form and including side frame members 3, 5, end frame members 7, 9, with an intermediate transverse member 11, and a corner extension 13 provided with a vertical passage to receive a post 15 for the mounting of various components employable in the dispensing of liquid in measured amounts to test tubes 17 supported in a reel assembly 19, the reel assembly of the present invention including vertically spaced circular reel plates 21, 23 having a plurality of aligned tube receiving holes 25 and a floor plate 27 beneath the lower of the reel plates for supporting such tubes on a common plane. The reel plates and base plate may be maintained in proper spaced relationship by spacer sleeves 29, 31 about the bolts or machine screws

which maintain the reel plates and base plate in an assembly.

The assembled reel plates and base plate are removably disposed in a drip pan 35 by setting the same down over a drive pin 38 extending upwardly through the pan from a flanged drive collar 39 affixed thereto with an intervening layer 41 of sealing material, the drive collar having diametrically located notches 43 in the lower edge thereof to straddle a pin 45 through a drive shaft or spindle 47 on which the reel assembly may be assembled for coupling the spindle to the pan and driving the reel assembly.

Of considerable importance to the present invention is the layout and distribution of the tube receiving holes of this reel assembly. In this connection, the holes 25 in each reel plate 21 and 23 are uniformly spaced along a spiral 49 characterized by the fact that its radii of curvature decrease linearly per degree of circumference of the plate, or expressed in the terms of the plate rotating at a constant angular velocity, the radii of curvature of the spiral decrease linearly per unit of time. This results in the spiral 49 intersecting any radius 51 of the plate at equally spaced points of intersection 53.

A marked advantage will be realized by selecting that spiral which will produce points of intersection spaced in accordance with the spacing between successive hole centers. Under these conditions, one can enlarge the holes to the point where adjacent holes would overlap. The significance of this lies in the fact that a plurality of reel assemblies can be made available for tubes of different diameters, and these may be interchanged without making any adjustments to the equipment, the number of tubes being the same in each case. The basic requirement for this feature is that the pattern of hole centers be the same in every reel assembly.

To bring the successive test tubes in a reel assembly into registry with a collecting cylinder 57 or the like from which to receive a charge, the reel assembly must be subjected to rotational movement, simultaneously with a linear movement of the reel assembly in the general direction of the collecting cylinder from a remote starting position of the reel assembly. Toward this end, mounting means for the reel assembly is provided, including a carriage assembly 59 carried on a pair of tracks 61, 63 affixed to and facing each other from opposing sides 3, 5 respectively of the base frame.

Such carriage assembly includes a carriage frame 67 extending transversely of the base frame and having wheels 69 adapted to ride in the aforementioned tracks 61, 63. Centrally of the carriage frame is a bearing 71 through which passes the drive spindle 47. Adjacent the lower end of the spindle, is a ring gear 73 of substantial diameter, in the present instance exceeding the width of the base frame, the side members 3 and 5 of which are arched along the lower edges thereof to permit of this gear to extend therebeyond.

Structurally, the gear 73 is carried by a disc 75 affixed centrally thereof on and adjacent the end of the spindle.

Rotation of the reel assembly is accomplished by a pinion drive to the ring gear from a motor 79 and associated gear reduction train 81 mounted at the end member 7 of the base frame, the pinion drive connection involving a pinion 83 of sufficient length to engage the ring gear 73 with the carrier assembly in its most remote position on the tracks 61, 63.

The free end of this pinion is supported in a bearing 87 slidably resting on the disc 75 which carries the ring gear 73. The elongated pinion referred to, permits linear movement of the carriage assembly on the tracks, in the direction toward the drive motor 79 while the drive motor is functioning to produce rotation of the reel assembly.

Such linear movement of the carriage is derived from

the rotational movement imparted through the ring gear to the spindle 47 on which the reel assembly is mounted. This is accomplished by adding a small pinion 89 at the lowermost end of the spindle below the disc 75 and meshing said pinion with a rack 91 supported alongside the path of travel which the spindle must negotiate during travel of the carriage assembly along the tracks. Such rack is accordingly affixed to a bar 95 extending between the end members of the base frame and affixed thereto. Thus, by reason of the fact that this rack 91 is fixed and stationary, rotation of the pinion in mesh therewith will necessarily cause the carriage assembly to travel linearly along the tracks and carry the reel assembly along with it.

The size of this pinion will determine the rate of linear movement and, accordingly, its size will be such as to bring successive test tubes into registry with the collecting cylinder as the reel assembly is rotated.

As thus far described, energization of the drive motor 79 will bring about a continuous rotation of the reel assembly along with simultaneous and continuous linear movement. However, to permit charging in turn, each test tube carried by the reel assembly, with its proper amount of liquid from the collecting cylinder, necessitates bringing the reel assembly to rest as each test tube arrives in registry with the collecting cylinder, and for a sufficient period of time to permit of the collecting of such charge in the test tube.

Stopping of the reel assembly to initiate a rest period for the aforementioned purpose is, in accordance with the present invention, accomplished by means of indexing means which, in the preferred form illustrated in the drawings, involves the disc 75 or equivalent having a plurality of indexing recesses 99 in the surface thereof, which in conjunction with the surface of the disc, determine functioning periods of a sensing switch 101, which in turn has a bearing on the operating periods of the drive motor. This sensing switch is mounted on the pinion end support 87.

The location of the recesses in the surface thereof may be conveniently determined in a routine manner by manually rotating the reel assembly 19 and when successive tube receiving holes arrive in filling position, an index mark may be noted on the indexing disc at the location of the sensing switch.

The resulting pattern of indexing recesses will follow a spiral, which will not necessarily conform to the spiral pattern of the test tube receiving holes of the reel assembly. It is sufficient to know that whatever pattern results from this routine manner of determining the same, that each of the recesses resulting will determine the filling position of the corresponding test tube in one of the holes in the reel assembly above.

The switch to be associated with the indexing means, is preferably a single pole double throw type of micro switch, actuable by a sensing lever 105 pivoted to the switch housing, with the free end of the lever carrying a ball 107 adapted to ride the surface of the indexing disc. With the switch normally closed when the ball is riding the surface of the disc, dropping of the ball end of the lever into a recess will accordingly open such switch.

While the supporting means 87 has been referred to initially as a means for supporting the free end of the long pinion 83, the fact that such supporting means rides the surface of the indexing disc, imparts to it an additional and perhaps more important function of causing the micro switch 101 and its sensing lever 105 to ride any unevenness or irregularities in the surface of the indexing disc, thereby maintaining a constant and proper relationship between the sensing lever and the indexing disc, so that the sensing switch will not change its status should any unevenness or irregularities appear.

As the carriage assembly approaches the end of its linear travel along the tracks, the last tube hole in the reel assembly will reach its position beneath the collecting cylinder. Automatic shutdown of the equipment at this stage of operation, is desirable following the dispensing of liquid to said tube. This can be accomplished by interposing a limit switch 111 in the path of movement of some part of the carriage assembly, and causing such limit switch, when engaged by said carriage assembly, to disconnect all power from the equipment. In the preferred embodiment illustrated, the limit switch is mounted on the intermediate transverse member 11 of the base frame, with its actuable member in the path of travel of the carriage frame 67.

Depending on the length of run to be made, an operator may wish to reset the carriage and reel assemblies to start with the first hole of the spiral or he might wish to begin a run at some intermediate hole, the hole selected being such that the run will terminate with the innermost or last hole of the reel assembly. Under these conditions, the equipment will automatically shut itself off at the completion of the run, regardless of where the run is started.

To enable one to manually and quickly reset the equipment to thus initiate a run at any desired position on the spiral, manually operable means is provided for mechanically disconnecting or uncoupling the drive motor pinion 83 from its engagement with the ring gear 73, and for removing the sensing switch 101 from its contact with the indexing disc. This is accomplished in a very simple manner by lifting the supporting means 87 for the free end of the pinion, which in turn also lifts the sensing switch.

The means whereby this can be accomplished involves a lever 115 pivotally secured at one end to the proximate side surface of the transverse member 11 of the base frame, said lever including at an intermediate point, a suspended bearing 117 adapted to receive the remote end of the pinion 83. Such lever is normally maintained under downward pressure by a leaf spring 119 anchored at one end to the upper surface of the transverse member 11, with its free end bearing down on the free end of the aforementioned lever.

Lifting of this lever against the action of such spring, will accomplish the object in mind and this is done by a lifting arm 121 fixed to the exposed end of a shaft 123 rotatably journalled in both the transverse member 11 and the end member 7 of the base frame, and carrying at its opposite end a manually engageable lever 127 extending in the reverse direction to the lift arm 121, whereby depressing of the manually engageable lever will rotate the lift arm in the direction of elevating the free end of the drive pinion and the sensing switch.

In conjunction with this, the drive motor and gear train assembly is hingedly affixed to the base frame member 7 to permit the necessary tilting thereof resulting from the lifting of the pinion in the manner aforementioned. With the pinion and sensing switch thus raised from their operating positions, the reel assembly and carriage assembly are free to move both rotatably and linearly, thus enabling the reel assembly to be manually set at any starting position desired.

When not in use, the lift arm may be caused to assume a position of rest with its free end engaging a lip 129 extending out from the lower edge of the transverse frame member 11.

When it is desired that the reel assembly be reset to start a run at the first test tube position, such starting position can be automatically determined in advance by providing a bumper 131 at such location on the edge of the indexing disc, that it will abut a stop 133 extending inwardly from the proximate end member 9 of the base frame, just after the first index recess has overrun its indexing position.

Since the sensing switch 101 under these conditions will be closed, it can be made to close a circuit to the drive motor 79 which will then bring the first index recess back to its proper starting place, at which moment the sensing lever will drop into the recess and disconnect

the drive motor, thus stopping the equipment and leaving it in condition for a run.

In employing a fraction collector, liquid is dispensed into the test tubes from a collecting cylinder **57**, either by volume, time actuation, or drop counting. The apparatus as illustrated in FIG. 1 is set up for dispensing by volume and will be described from this viewpoint, though the apparatus is adapted for dispensing the liquid by time actuation or by drop counting.

The collecting cylinder rests with its lower end extending into the upper end of a novel valve assembly **141** depicted in FIG. 5, and supported from the post by a clamping bracket **143**.

Such valve assembly comprises a valve housing **145** having a direct flow passage **147** therethrough, and a plunger passage **149** intersecting the flow passage.

In the lower end of the flow passage is a dispensing spout **151** while at the upper end of the housing, the passage is counter-bored and threaded to provide for the insertion of a valve seat **155** and threaded to receive a hollow nut **157** to clamp the valve seat to the shoulder formed by the counter-bore and provide an entrance to the valve assembly for the lower end of the collecting cylinder **57**.

The flow passage **147** is adapted to be closed by the seating of a ball valve **161** against the valve seat **155** from below where it is controlled by an associated solenoid **166** affixed to the valve housing and having a plunger **167** slidably extending therefrom into said plunger passage and terminating in a tapered end **169** in the flow passage below the ball valve and slidably supporting the valve on its tapered end.

The plunger is sealed against leakage of liquid from the valve assembly by way of the plunger passage, by intersecting the plunger with a diaphragm **170** and sealing the peripheral edge of the diaphragm to the valve housing between the housing and the solenoid.

To accomplish this result and at the same time permit solenoid operation of the plunger, the wall portion of the housing surrounding the plunger passage is recessed to permit spanning thereof by the diaphragm, while the plunger itself is made up of two sections, one **171** to one side of the diaphragm within the plunger passage and formed with a threaded recess facing the other section, while the other section **173** lies to the other side of the diaphragm outside of the valve housing and includes a threaded extension passing through the diaphragm and threaded into the first section, thereby to clamp the diaphragm between the two sections.

The outer section extends into the solenoid winding, axially thereof where it engages a compression spring **177** normally tending to force the plunger to its outer or valve closing position, in the absence of energization of the solenoid. Upon energization of the solenoid, the electrical force produced is sufficient to pull in on the plunger against the compressive action of the spring, and release the ball valve from engagement with its valve seat. The valve in this condition is open, thus permitting direct flow of liquid therethrough.

By making the valve assembly housing, the valve seat and holding and dispensing spout along with the included tapered section of the plunger, all of plastic such as "Teflon" and by making the ball valve of glass or like material, all component parts of the valve assembly which are apt to come in contact with the liquid flowing therethrough, are inert and the probability of contamination of such liquid is thereby greatly minimized if not completely eliminated.

To the lower end of the collecting cylinder, is affixed a collar **181** of a diameter to comfortably fit the entrance to the valve assembly. A pressure clip **185** affixed to the upper end of the valve assembly and engaging the exposed end of the collar under pressure of a light screw retained spring **187**, serves to anchor the lower end of the cylinder in the valve assembly in a positive manner.

Above the valve is a light source **191** and photocell **193** assembled in a housing **159** adapted to mount on the post. The collecting tube passes through the light-source-photocell housing between the light source and photocell therein. The photocell will thus respond differently in the presence or absence of liquid in the collecting cylinder at the point where the rays from the light source pass through the tube to the photocell. Circuits associated with the photocell may therefore be utilized to control the various functions essential to proper operation of the fraction collector. What those functions are may best be developed by an analysis of the control circuits involved and for this purpose, reference will be made to the circuits of FIG. 6 in conjunction with the apparatus depicted in the preceding figures of the drawings.

Referring to the circuit diagram, the light source **191** and photocell **193** and associated photocell circuits **197** which are assembled in the housing **195**, are depicted within the broken line rectangle **201** in the upper right hand corner of the circuit diagram. The photocell circuit involved is of a conventional character and need not be analyzed except to the extent of identifying the photocell **193** which when exposed to lower light intensity by the presence of liquid intercepting the light rays from the lamp **191**, results in energization of a relay **203** in the output circuit to close a normally open contact **205** associated with said relay.

Also involved in the control system is a sequence timer **207** enclosed within the broken line rectangle **209**, and including a timer motor **211** carrying on its shaft, three cams, one cam **213** for determining the operating cycle of the timer motor **207**, the second cam **215** for determining the open period of the valve **161** within the aforementioned operating cycle of the timer motor, and a third cam **217** which controls the start of each cycle of operation of the reel assembly, but not the duration thereof.

Associated with the timer cam **213** is a micro-switch **221** having a normally open (NO) contact, a normally closed (NC) contact, and a terminal contact (C) common to both, such switch being provided with a cam follower **223** adapted to change the status of the switch in response to changes in cam contour.

Similar micro-switches **225** and **227** are associated with the valve cam and reel assembly cam respectively, the switch **225** having a cam follower **229** and the switch **227** having a cam follower **231**.

The high section of each of these cams determines a change in status of the associated switch from its normal status while the low section restores the associated switch to its normal status.

In conjunction with the functioning of the timer motor and its cams, as component parts of the sequence timer, is a double acting latching relay **235** involving two relay coils **237**, **239** and a pair of mechanically interlocked armatures **241**, **243** each having an associated contact **244**, **245** respectively, one contact being engaged while the other is disengaged.

The sequence timer, as an assembly, is mounted within the base frame between the transverse member **11** and the end wall **7**, with a connecting plug **247** facing outwardly for effecting electrical circuit connections to the components of the sequence timer. This plug is depicted in association with a corresponding coupling socket **249** both being included within a broken line rectangle **251** to depict the association of one to the other with the corresponding points on each being similarly labelled A through H.

In like manner, a similar arrangement of a plug **255** and socket **257**, also included within a broken line rectangle **259**, is depicted in the circuit digram in association with the light source **191** and photocell circuits **197**.

One side **261** of a power supply line, represented by a

supply plug 263 passes through the limit switch 111 and connects to point B of each of the sockets 249 and 257, as well as to one side of the primary winding 267 of a filament transformer 269.

The other side 271 of the supply line connects to a manually operable line switch 273 to point A on each of the sockets 249 and 257, as well as to the other side of the primary winding 267 of the filament transformer. The secondary winding 277 of this filament transformer connects through coupling contacts E and F of the coupling 257—255, through a variable voltage dropping resistor 279 to the filament of the light source 191 so that the light source is on so long as power is applied to the equipment.

The drive motor 79 for the reel assembly is connected at one side directly to the one side 271 of the line while the other terminal of the motor is connected to point H on the socket 249 and to the armature 285 of the sensing switch 101 and through such armature to either of two contacts, one of which 287 is connected directly to the other side 261 of the line, while the other contact 289 is connected through point E of the socket and plug coupling 249—247 to the common terminal of the micro-switch 227 associated with the reel assembly cam 217. In the quiescent state of the equipment, the cam follower 231 associated with this reel assembly cam is resting on the high portion of the cam, which changes the status of the associated micro-switch from its normal condition. Accordingly under the circumstances, the normally open contact will be closed and this contact connected through the resistor 299 and capacitor 301 of a dynamic braking circuit, then through point A of the plug and socket coupling 247—249 to the one side 271 of the power supply line.

With the armature 285 of the sensing switch 101 in engagement with the first contact 287 which occurs when the ball on the sensing lever is riding the surface of the indexing disc, the drive motor for the reel assembly will be connected across the supply line and accordingly will be energized. The reel assembly will accordingly be driven until one of the recesses of the indexing disc arrives beneath the ball, causing the ball to drop therein and shift the armature 285 of the sensing switch to the opposite contact 289 to disconnect power from the motor.

In the absence of other factors, the inertia of the rotating armature of the driving motor could conceivably drive the indexing disc beyond a point of intended rest, and force the ball out of the recess back onto the surface of the disc to again apply power to the motor and continue its operation.

Accordingly, a dynamic braking feature is provided which includes the aforementioned resistor 299 and capacitor 301, and may be traced from point H on the socket-plug coupling 249—247 through a rectifier 305 and resistor 307 and then completed through the aforementioned resistor 299 and capacitor 301, whereby during running periods of the drive motor 79, the capacitor 301 will be charged. Upon opening the circuit to the motor at the sensing switch 101, which as previously indicated, occurs when the sensing lever ball drops into a recess of the indexing disc, the charged condenser 301 and resistor 299 will be shunted across the motor in a direction to brake the same and bring it to an abrupt halt.

In this quiescent state, nothing further happens in the equipment until a change occurs at the photocell 193, as when the liquid in the collecting cylinder rises to a level where the light rays to the photocell are interrupted thereby. Upon such occurrence, the thyratron will be triggered and the relay 203 in the output circuit thereof will become energized to close its normally open contact 205. A connection from this contact through point D of the coupling 255—257 will result in extending the one side 261 of the power supply line through a manually closable switch 309, through point D of the coupling 249—247 to one side of the coil 237 of the latching relay 235, which at its other side is connected through the closed contact of the other coil 239 and point A of the coupling 247—249 to the other side 271 of the power supply line.

When thus energized, the interlocked contacts will shift and become latched, thereby changing the status of the contacts from that depicted in the drawings. The contact associated with the then energized coil 237, being now closed, will extend one side 261 of the supply line through point B of coupling 249—247 to the normally closed contact of the switch 221 associated with the timer cam 213. This cam having but a single notch determines start and stop of the timer motor 211, and the cam follower 223 at this time being in such notch, a connection will exist from the normally closed contact to the common terminal of the switch 221, and from there to one side of the timer motor 211 which at its other side, is connected directly to the other side 271 of the supply line through point A of the coupling 247—249.

When thus energized, the timer motor will begin simultaneous rotation of all the cams.

The cam follower associated with the timer cam 213, immediately upon riding onto the high portion of this cam, will open the associated normally closed contact and simultaneously therewith close the normally open contact, to establish a holding circuit which will last for a complete revolution of the timer cam, when the follower associated therewith will again drop into the notch and open the circuit to the timer motor.

In the meantime, the follower 229 associated with the valve cam 215 will drop to the low surface of this cam thereby establishing normal conditions in the micro-switch 225 associated therewith.

Two things happen when this occurs. One side 261 of the supply line extends through the point B on the coupling 249—247 to the common terminal of the micro-switch 225, through the micro-switch to the normally closed contact where the circuit branches.

One branch extends to one side of the other coil 239 of the latching relay, the other side of which is directly connected through point A of the same coupling, to the other side of the supply line, thus energizing this relay coil to re-establish the initial condition of this latching relay as depicted in the drawings.

The other branch line extends through the point F on the same coupling, and from there to one side of the solenoid 166 of the valve assembly 141, the other side being connected directly to the other side of the power supply line. Thus, the solenoid will become energized to retract the plunger in the valve assembly and open the passage therethrough, whereby liquid then in the collecting cylinder may be discharged through the valve assembly passage directly into a test tube below, without spill or splash.

This open condition of the valve will prevail for that portion of the sequence cycle represented by the low portion of the valve cam 215. Upon return of the follower to the high portion of the valve cam, the solenoid on becoming de-energized, the valve will return to its closed condition, but the status of the latching relay will remain unaffected due to the mechanical latching built into such relay.

With respect to the reel assembly cam 217, nothing happens until its low portion arrives beneath its associated cam follower 231 at which time, normal conditions of the micro-switch associated therewith will prevail. When this happens, a circuit will be completed from the side 261 of the supply line through the point B on the coupling 249—247 to the common terminal on the micro-switch 225 associated with the valve cam, through the normally open contact of this switch (now closed) to the normally closed contact of the micro-switch 227 associated with the reel assembly cam, through this switch to its common terminal, then through point E of the

same coupling to the braking contact 289 of the sensing switch, then through the armature 285 of the sensing switch to the reel assembly motor 79 whose other terminal is connected to the other side of the supply line. The assembly motor thus becomes energized causing the sensing lever ball to ride out of the recess in which it was resting, and force the armature of the sensing switch to swing over to the other contact and place the reel assembly motor directly across the supply line. The indexing disc thereafter functions in the manner of a holding circuit, but does it mechanically, until the following recess therein arrives at the ball on the sensing lever, when again the power to the drive motor will be removed and the motor stopped.

The above-described sequence of operations repeats itself automatically until the test tube in the last hole of the reel assembly receives its quota of liquid, following which the limit switch 111 will be actuated to remove power from the apparatus.

A push button type index switch 319 is adapted to short across the solenoid contact 205 and enable the apparatus to function independently of the photocell circuit when desired. A signal light 320 indicates such operation.

The entrance of dust into the test tubes is minimized by provision of a dust cover assembly including a circular plate 321 pivotally carried on a support 323 mounted on the reel plate 21, thus permitting the reel assembly to rotate while the cover plate is maintained stationary by a pin 325 depending from the valve assembly into a holding slot 326 in the dust cover plate. An enlarged slot 327 in the dust cover plate starting beneath the valve assembly and extending parallel to the path of travel of the spindle 47, exposes each test tube as it arrives in filling position.

From the foregoing description of my invention in its preferred form, it will be apparent that the same fulfills all the objects of the invention as previously set forth.

The disposition of the test tube holes with hole centers equally spaced along a linear spiral, results in an increase in capacity of the fraction collector in terms of the number of test tubes carried by the reel assembly, over prior art spiral fraction collectors of comparable size. At the same time, the present invention permits of a substitution of reel assemblies, each of different hole size without the necessity of making any change or adjustment in the apparatus itself.

While the indexing of the reel assembly is accomplished in the preferred embodiment of the invention by the provision of an indexing disc having a plurality of indexing recesses in the surface thereof to actuate a sensing switch, an equivalent result may be realized through the utilization of printed circuits which respond to rotation of the reel assembly to make and break a circuit comparable to that under control of the sensing switch of the preferred embodiment as described.

Accordingly, while I have disclosed my invention in its preferred form, I do not desire to be limited in my protection to the specific details illustrated and described except as may be necessitated by the appended claims.

I claim:

1. A fraction collector comprising a base frame; a collecting cylinder supporting means on said frame; a reel assembly for holding a plurality of test tubes or the like for sequential disposal below such collecting cylinder, said reel assembly including a reel plate having a plurality of tube receiving holes located on a spiral of linearly varying radii of curvature with the centers of said holes equally spaced, means rotatably mounting said reel assembly for simultaneously linear movement toward such collecting cylinder supporting means from a remote starting position to sequentially bring successive holes into alignment with such collecting cylinder when supported by said supporting means; a drive motor in drive connection with said rotatable mounting means for said reel assembly; and means for indexing said reel assembly to effect disconnection of said drive motor as successive tube receiving holes arrive beneath such collecting cylinder.

2. A fraction collectotr comprising a base frame; a collecting cylinder supporting means on said frame; a reel assembly for holding a plurality of test tubes or the like for sequential disposal below such collecting cylinders, said reel assembly including a reel plate having a plurality of tube receiving holes located on a spiral of linearly varying radii of curvature with the centers of said holes equally spaced; means rotatably mounting said reel assembly for simultaneously linear movement toward such collecting cylinder supporting means from a remote starting position to sequentially bring successive holes into alignment with such collecting cylinder when supported by said supporting means; a drive motor in drive connection with said rotatable mounting means for said reel assembly; and means for indexing said reel assembly to effect stopping thereof as successive tube receiving holes arrive beneath such collecting cylinder, said means including an indexing plate rotatable with said reel assembly and including a plurality of motor circuit opening means each disposed to arrive at a predetermined point with the arrival of a corresponding test tube opening beneath such collecting cylinder to disconnect said drive motor and halt rotation thereof.

3. A fraction collector comprising a base frame; a collecting cylinder supporting means on said frame; a reel assembly for holding a plurality of test tubes or the like for sequential disposal below such collecting cylinder, said reel assembly including a reel plate having a plurality of tube receiving holes located on a spiral of linearly varying radii of curvature with the hole centers equally spaced; means rotatably mounting said reel assembly for simultaneously linear movement toward such collecting cylinder supporting means from a remote starting position to sequentially bring successive holes in alignment with such collecting cylinder when supported by said supporting means, said reel assembly mounting means including a pair of tracks supported by said frame, a reel assembly supporting carriage carried by said tracks for movement therealong, said reel assembly supporting carriage including a carriage frame, a ring gear rotatably supported by said frame and movable therewith along said track, drive means for rotating said gear, said drive means including a fixed position motor connectible in an electrical circuit, a pinion coupled to said motor and in drive connection with said gear, said pinion being of a length to permit contemplated linear travel of said carriage without disengagement of said pinion from said gear, a rack carried by said base frame, and a pinion supported by said carriage in mesh with said rack and rotatable with said gear to effect the linear movement of said carriage with the rotational movement of said gear; and means for indexing said reel assembly to effect stopping thereof as successive tube receiving holes arrive beneath such collecting cylinder.

4. A fraction collector comprising a base frame; a collecting cylinder supporting means on said frame; a reel assembly for holding a plurality of test tubes or the like for sequential disposal below such collecting cylinder, said reel assembly including vertically spaced reel plates, each having a like plurality of tube receiving holes located on a spiral of linearly varying radii of curvature, with the hole centers equally spaced, a pan below the lower of said reel plates, and means holding said reel plates and pan in assembled relationship, means rotatably mounting said reel assembly for simultaneously linear movement toward such collecting cylinder supporting means from a remote starting position to sequentially bring successive holes into alignment with such collecting cylinder when supported by said supporting means, said reel assembly mounting means including a pair of tracks supported by said frame, a reel assembly supporting carriage carried by said tracks for movement therealong, said reel assembly supporting carriage including a carriage

frame, a ring gear rotatably supported by said frame and movable therewith along with track, drive means for rotating said gear, said drive means including a fixed position motor connectible in an electrical circuit, a pinion coupled to said motor and in drive connection with said gear, said pinion being of a length to permit contemplated linear travel of said carriage without disengagement of said pinion from said gear, a rack carried by said base frame, and a pinion supported by said carriage in mesh with said rack and rotatable with said gear to effect the linear movement of said carriage with the rotational movement of said gear; and means for indexing said reel assembly to effect stopping thereof as successive tube receiving holes arrive beneath such collecting cylinder, said means including an indexing plate rotatable with said reel assembly and including a plurality of motor circuit opening means each disposed to arrive at a predetermined point with the arrival of a corresponding test tube opening beneath such collecting cylinder to disconnect said drive motor and halt rotation thereof.

5. A fraction collector comprising a base frame; a collecting cylinder supporting means on said frame; a reel assembly for holding a plurality of test tubes or the like for sequential disposal below such collecting cylinder, said reel assembly including vertically spaced reel plates, each having a like plurality of tube receiving holes located on a spiral of linearly varying radii of curvature, with the hole centers equally spaced, a floor plate below the lower of said reel plates, means uniting said reel plates and floor plate into an assembly, a pan supporting said assembled reel plates and floor plate and a drive pin coupling said pan and reel and floor plate assembly in a drive connection; means rotatably mounting said reel assembly for simultaneously linear movement toward such collecting cylinder supporting means from a remote starting position to sequentially bring successive holes into alignment with such collecting cylinder when supported by said supporting means, said reel assembly mounting means including a pair of tracks supported by said frame, a reel assembly supporting carriage carried by said tracks for movement therealong, said reel assembly supporting carriage including a carriage frame, a ring gear rotatably supported by said frame and movable therewith along said track, drive means for rotating said gear, said drive means including a fixed position motor connectible in an electrical circuit, a pinion coupled to said motor and in drive connection with said gear, said pinion being of a length to permit contemplated linear travel of said carriage without disengagement of said pinion from said gear, a rack carried by said base frame, and a pinion supported by said carriage in mesh with said rack and rotatable with said gear to effect the linear movement of said carriage with the rotational movement of said gear; and means for indexing said reel assembly to effect stopping thereof as successive tube receiving holes arrive beneath such collecting cylinder, said means comprising an indexing plate rotatable with said reel assembly and including a plurality of motor circuit opening means, each disposed to arrive at a predetermined point with the arrival of a corresponding test tube opening beneath such collecting cylinder to disconnect said drive motor and halt rotation thereof; and means for timing the discharge of liquid from such collecting cylinder with respect to the arrival of a test tube below such collecting cylinder.

6. A fraction collector comprising a base frame; a collecting cylinder supporting means on said frame; a collecting cylinder supported on said supporting means; a reel assembly for holding a plurality of test tubes or the like for sequential disposal below such collecting cylinders, said reel assembly including a reel plate having a plurality of tube receiving holes located on a spiral of linearly varying radii of curvature with the centers of said holes equally spaced, means rotatably mounting said reel assembly for simultaneously linear movement toward such collecting cylinder supporting means from a remote starting position to sequentially bring successive holes into alignment with such collecting cylinder when supported by said supporting means; a drive motor in drive connection with said rotatable mounting means for said reel assembly; and means for indexing said reel assembly to effect disconnection of said drive motor as successive tube receiving holes arrive beneath said collecting cylinder; and means for emptying said collecting cylinder when said drive motor is thus disconnected.

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