

[54] **SAMPLE TAKING APPARATUS**

[76] Inventor: **Ernst Singer**, 3491 Puget Dr.,
 Vancouver, British Columbia,
 Canada

Primary Examiner—S. Clement Swisher
Attorney, Agent, or Firm—Fetherstonhaugh & Co.

[22] Filed: **Aug. 6, 1973**

[21] Appl. No.: **385,903**

[52] U.S. Cl. **73/422 R, 73/423 R**

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

[58] Field of Search **73/421 R, 421 B, 422 R,
 73/422 TC, 423 R**

[56]

References Cited

UNITED STATES PATENTS

2,811,041	10/1957	Beatty	73/423 R
3,096,653	7/1963	Martin et al.	73/422
3,747,411	7/1973	McDermott	73/423 R

FOREIGN PATENTS OR APPLICATIONS

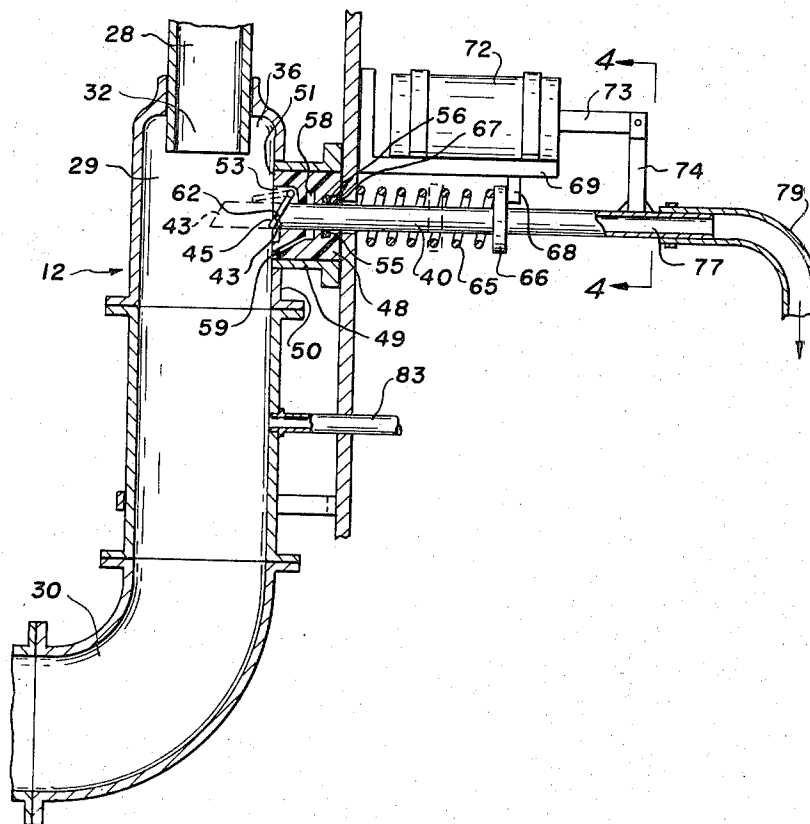
134,910	1960	U.S.S.R.	73/422 TC
---------	------	---------------	-----------

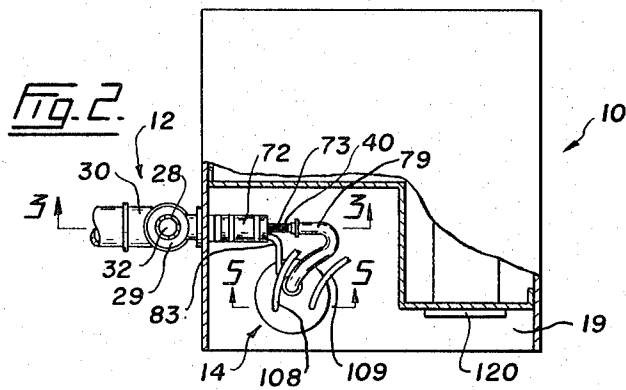
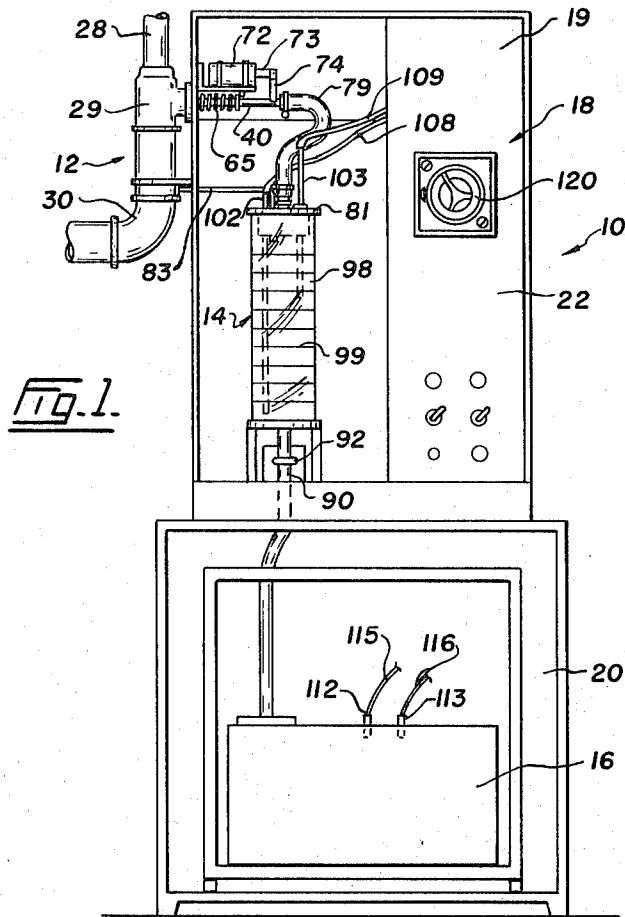
[57]

ABSTRACT

Apparatus including a sampling tube with means for moving an open end thereof into and out of a liquid flowing through a conduit, said tube being connected to a sample chamber having therein control means for causing retraction of the tube from the liquid when the sample in the chamber reaches a predetermined volume. At the same time as the sampling tube is retracted from the liquid, a valve is opened to allow the sample to flow from the chamber into a container therefor.

24 Claims, 6 Drawing Figures





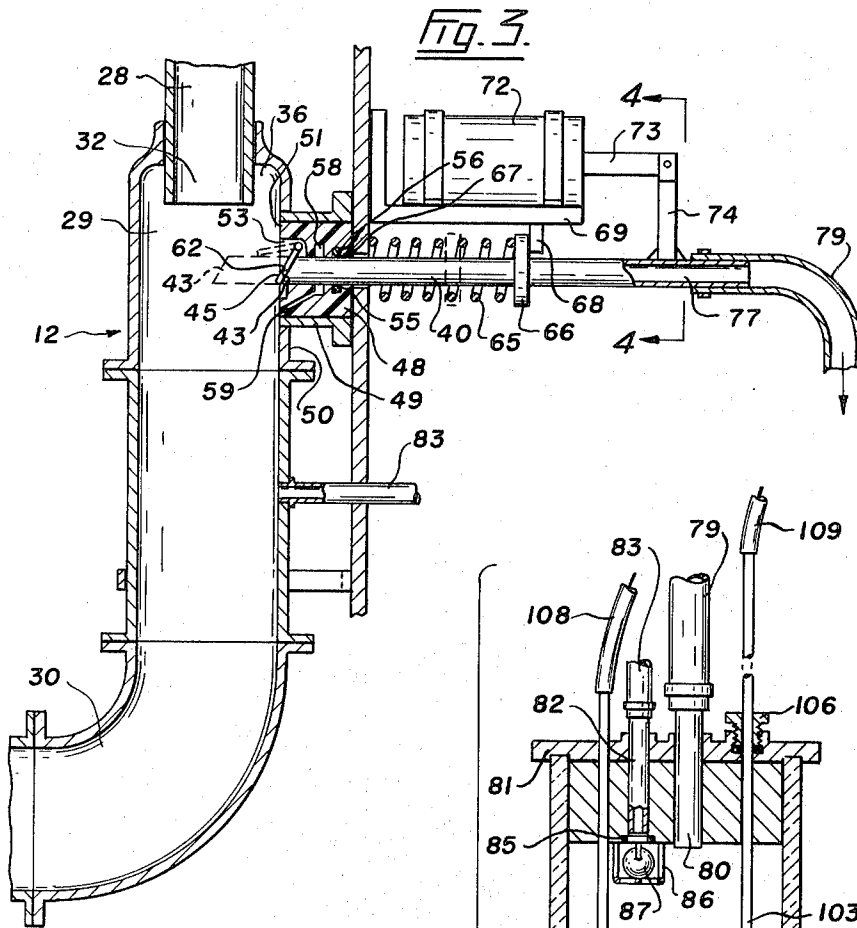


Fig. 4.

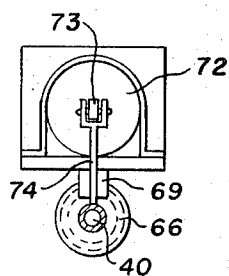


Fig. 5.

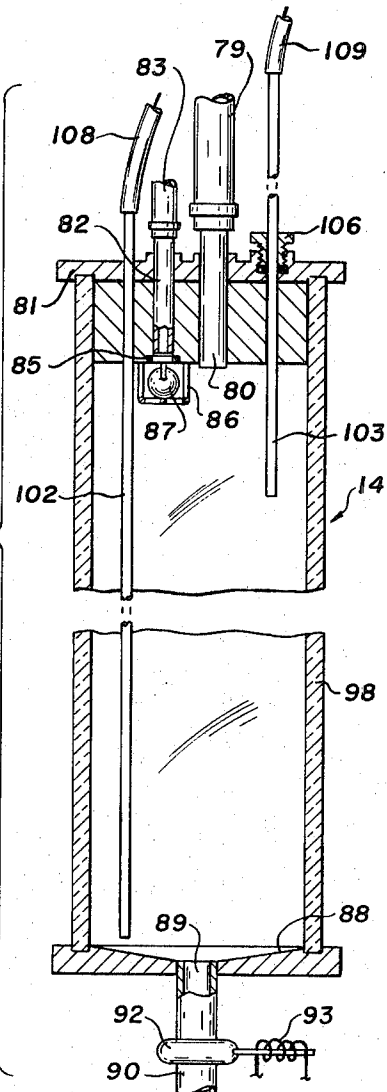
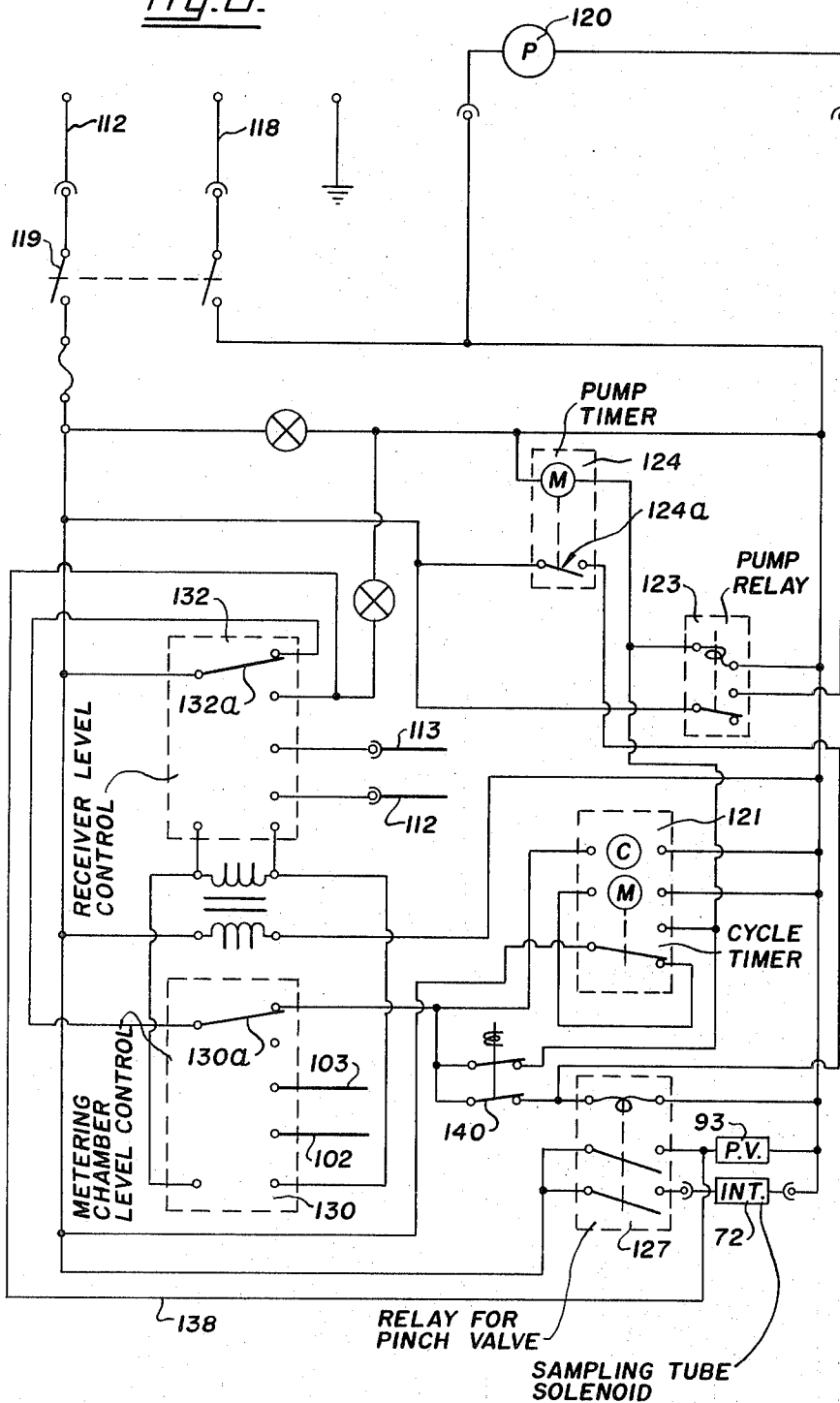


Fig. 6.



SAMPLE TAKING APPARATUS

This invention relates to apparatus for periodically taking samples from liquids with or without solids therein.

Although this apparatus can be used for taking samples from liquids without solids therein, it is primarily designed for sampling liquids containing solids such as, for example, sewage, with practically no chance of being clogged or put out of operation by the solids.

The prior art includes devices for taking samples from liquids. Some of these, however, can take samples only from slow-flowing liquids with the result that it is difficult to obtain representative samples with the solids therein because of the tendency of the solids to settle out of this liquid. Some of the prior art samplers are open, and are subject to frequent spills, and in some situations allow corrosive and poisonous fumes to escape, thus damaging the instrumentation associated with the sampler. This is highly undesirable.

The present sample taking apparatus has numerous advantages over the prior art for the same purpose. This apparatus is such that samples can be taken from relatively high velocity liquids so that they are truly representative since the solids do not settle out. The samples can be taken from the flow core of the liquid and not just from the surface thereof. Furthermore, the apparatus is such that it constitutes a closed system so that there is no open vessel where liquid can spill as a result of malfunctioning of the apparatus, and the sample liquid is removed rapidly so that the solids do not have time to settle out.

The liquid from which samples are to be taken flows through a conduit. This may be a conduit through which the liquid normally flows, or it may be in the form of a by-pass through which the liquid flows. In addition, the liquid may flow continuously through the conduit, or it may be pumped therethrough only during the time a sample is being taken. On the other hand, the conduit at the point where the sample is taken may form part of the present apparatus.

The term "conduit" as used herein is intended to include a pipe, tube, duct, or any other device through which liquid can flow.

Apparatus in accordance with the present invention for taking samples from liquids with or without solids therein and flowing through a conduit, comprises a sampling tube mounted for longitudinal movement and extending towards a conduit for a liquid from which samples are to be taken. This sampling tube has an open inner end that is to be moved into and out of liquid flowing through the conduit when a sample is required. The apparatus also includes means for moving said tube to shift the inner end thereof into the flowing liquid to permit some of the liquid to flow through the tube, and to shift said inner end out of the liquid to stop said flow.

In a more specific sense, this sample taking apparatus comprises a conduit formed by a substantially tubular wall and through which liquid from which samples are to be taken can flow, this conduit having an inlet at one end and an outlet at an opposite end. The conduit includes a recess formed to one side of the inlet thereof so that liquid flowing through said inlet passes by the recess. A sampling tube having an open inner end normally in this recess out of the liquid flow extends out of the conduit. This tube is longitudinally movable to

shift the inner end thereof into and out of the liquid flowing through the conduit. The apparatus includes means for moving the tube to shift the inner end into the flowing liquid to permit some of the liquid to flow through the tube and to shift said inner end out of the liquid to stop this flow.

The apparatus of the preferred form of this invention also includes a metering chamber into which the sample liquid is directed, and means for causing withdrawal of the sampling tube when the sample reaches a predetermined volume in the chamber and subsequently allowing the sample to flow out of the chamber into a suitable collector.

An example of this invention is illustrated in the accompanying drawings, in which

FIG. 1 is a front view of the sample taking apparatus,

FIG. 2 is a plan view of the apparatus with part of the top of the cabinet thereof broken away,

FIG. 3 is an enlarged sectional view taken on the line 3—3 of FIG. 2,

FIG. 4 is a vertical section taken on the line 4—4 of FIG. 3,

FIG. 5 is an enlarged sectional view taken on the line 5—5 of FIG. 2, and

FIG. 6 is a diagram of the wiring and electrical components of one form of this apparatus.

Referring to the drawings, 10 is one form of a sample taking apparatus in accordance with this invention and preferably including generally a conduit 12, a sample or metering chamber 14, and a receiver 16. In this example, the apparatus includes a cabinet 18 having an upper section 19 and a lower section 20. The sample chamber 14 is located in upper section 19, while receiver 16 is located in lower section 20. A control panel 22 may be provided in upper section 19 of the cabinet. Although conduit 12 has been shown mounted on the side of cabinet 18, it can be remote from the cabinet and connected to the mechanism therein by a tube.

As stated above, the conduit from which the samples are to be taken by this apparatus may be a pipe through which the liquid normally travels, a by-pass from said pipe, or a special conduit 12 as shown. In this case, conduit 12 is connected to a pipe extending from the pipe through which the liquid normally travels, or to a pump which, in turn, is connected to the liquid pipe. The discharge end of conduit 12 is connected to a pipe extending back to the liquid pipe or to a suitable discharge point.

FIG. 3 illustrates a preferred form of conduit 12 for the apparatus. This conduit comprises a pipe 28 which extends a short way into an enlarged tubular section 29 having an outlet 30 at its lower end. Pipe 28 forms an inlet 32 for conduit section 29. Actually, pipe 28 may terminate at the top of tubular section 29, but it is preferable to have it extend a short way into said section, as shown. In either case, a recess or space 36 is formed to one side of inlet 32. With this arrangement, liquid flowing into section 29 from pipe 28 flows past recess 36 to outlet 30.

A sampling tube 40 is mounted for longitudinal movement relative to conduit or pipe 29, and has an open inner end 43 which is normally positioned at or in recess 36 clear of the main flow of liquid through conduit 12. Sampling tube 40 is mounted for longitudinal movement relative to the conduit in any desired manner so that its inner end 43 can be moved into the flow of liquid entering through inlet 32, as shown in

dotted lines in FIG. 3, and back out of said flow into recess 36, as shown in full lines. The inner end 43 of the tube is preferably formed with a bevel 45 which faces inlet 32.

In this example, tube 40 is slidably mounted in and extends through a suitable sleeve or bearing 48, such as a teflon bearing, which is mounted in a retainer 49 secured to the tubular wall 50 of conduit section 29 and over an opening 51 formed in said wall. Bearing sleeve 48 is formed with a cavity 53 which communicates with recess 36 and acts as a sub-recess for or an indentation in said recess. In this example, the inner end 43 of tube 40 normally rests in said sub-recess 53. A sealing ring 55 in the form of an O-ring fits in a groove 56 and slidably grips tube 40. In addition to this, an annular groove 58 is formed in bearing 48 and communicates with the minute clearance space between tube 40 and said bearing, and a passage 59 communicates at one end with the lower portion of groove 58 and extends through bearing 48 and opens out of the inner end thereof into conduit 12. The purpose of this groove is to trap any liquid that might move between tube 40 and the surrounding bearing and to return this liquid to conduit 12 through passage 59. If desired, a flap valve 62 may be hinged mounted in sub-recess 53, normally covering the inner end 43 of the sampling tube. This valve is so mounted that when the tube is moved inwardly, the tube engages the valve to swing it upwardly out of line with the tube end. This uncovers the tube end and swings the flap valve out of the way.

Sampling tube 40 is moved back and forth longitudinally in any desired manner. In this example, a spring 65 surrounds the tube and lies between a stop 66 fixedly secured to said tube and the outer end 67 of bearing 48. Outward movement of the sampling tube is limited by a stop 68 depending from a bracket 69, said stop 68 being engaged by spring stop 66 when the inner end 43 of the sampling tube is in recess 36 or sub-recess 53, if the latter is provided. Inward movement of tube 40 is accomplished by a solenoid 72, the core 73 of which is connected to a lug 74 secured to and projecting upwardly from tube 40. Energization of solenoid 72 moves the sampling tube inwardly relative to conduit 12 until the inner end 43 of said tube is positioned centrally of the flow of liquid from inlet 32.

The outer end 77 of sampling tube 40 is connected in any desired manner to sample chamber 14, and in this example, a flexible hose or tube 79 is connected at one end to the outer end of the sampling tube, and its opposite end either extends into chamber 14, or is connected to a tube 80 which extends through cover 81 to and into said chamber. As previously stated, conduit 12 and the sampling tube may be located at a point remote from cabinet 18, in which case tube 79 is made long enough to extend from the sampling tube to chamber 14 within cabinet 18, or the sampling tube itself may be made long enough to extend from the remote conduit into the cabinet.

A vent pipe 82 extending through cover 81 either opens to atmosphere outside chamber 14 or is connected by a hose 83 to the interior of conduit 12, see FIGS. 1, 3 and 5. Pipe 82 opens into the sample chamber through a seat 85, and a cage 86 retains a floatable check ball 87 in line with but normally spaced below said seat. This ball acts as a check valve to prevent liquid from flowing from chamber 14 out through pipe 82, but air and gas can pass out of the chamber through

pipe 82. Hose 83, if present, directs this air and gas into conduit 12 and thereby keeps them out of the atmosphere around the apparatus. Check ball 87 is essential if hose 83 is not used, otherwise the ball can be dispensed with since any overflow liquid would be directed by the hose into conduit 12.

Chamber 14 is preferably provided with a concave bottom 88 having a central outlet 89 therein from which a tube 90 extends into the top of receiver 14. This tube is controlled by a suitable valve, and in this example, a pinch valve 92 is provided for this purpose. This pinch valve is operated by solenoid 93 and in this example the valve is normally open and is closed when solenoid 93 is energized.

It is preferable to make chamber 14 in the form of a transparent tube 98 having graduation marks 99 on its surface. These graduation marks may be separated in increments of 50cc or 100cc, or any other desired measurement.

Apparatus 10 is designed to take samples of uniform volume from a flowing liquid, and the size of these samples may within limits be varied or adjusted as desired. For this purpose, suitable means is provided for stopping the flow into chamber 14 when a sample of a predetermined volume is therein. A pair of electrodes 102 and 103 are provided for this purpose. Electrode 102 extends to near the bottom of the chamber and may be fixedly mounted in said chamber. The lower end of electrode 103 is positioned above the lower end of electrode 102, and electrode 103 is preferably adjustably mounted in the chamber, in which case it extends through a hand tightened gland nut 106. Electrodes 102 and 103 are connected by wires 108 and 109 to a circuit connectable to a source of electrical power and including solenoid 72 of sampling tube 40 and solenoid 93 of pinch valve 92, see FIG. 6. When the liquid in chamber 14 contacts both of the electrodes 102 and 103, the sample in the chamber is of the desired volume, and solenoid 72 is de-energized to allow spring 65 to withdraw sampling tube 40 from conduit 12, and solenoid 93 is de-energized to allow pinch valve 92 to open and thereby permit the sample to flow through pipe 90 into receiver or container 16.

It is desirable to provide means for stopping the operation of this apparatus in the event of receiver 16 becoming filled as a result of either neglect to empty the receiver in good time, or malfunctioning of the normal shut-off system when the required sample has been obtained in the sample chamber. Electrodes 112 and 113 are provided inside receiver 16 near the top thereof, and these electrodes are connected by wires 115 and 116 to the main circuit so as to de-energize solenoid 72 to cause sample tube 40 to be withdrawn and at the same time to energize solenoid 93 to close pinch valve 92, if the liquid in the receiver reaches the top thereof.

FIG. 6 illustrates by way of example one electrical system to be used with apparatus 10. The apparatus is connected to an electrical power source by leads 117 and 118, and the apparatus is set up for use or rendered inoperative by a switch 119. This system includes a pump 120 which will be set into operation when a sample is required to pump the liquid through pipe 28 and conduit 12. The system can be set into operation by an external signal from a cycle timer, flow meter, or the like. In this example, a cycle timer 121 is provided for this purpose. Timer 121 commences a sampling cycle by closing relay 123 which starts pump 120 to pump

liquid through conduit 12, and also actuates pump timer 124 which closes timer switch 124a after a predetermined delay. The closing of switch 124a causes relay 127 to close and thereby energize solenoid 93 to close pinch valve 92, and energize solenoid 72 to move sampling tube 40 into the sample-taking position in conduit 12. Tube 40 directs some of the liquid flowing through conduit 12 into metering chamber 14. When this liquid contacts both of the volume control electrodes 102 and 103, switch 130a of relay 130 is opened to cut off power to timer 121 thereby causing switch 124a of pump timer 124 to open and cut off power to relay 127. This de-energizes solenoids 93 and 72 to allow pinch valve 92 to open and to allow spring 65 to withdraw the sampling tube from the flowing liquid. The apparatus is no longer taking a sample, and the liquid has been transferred from the metering chamber to the collector. This is the end of the sampling cycle.

If the liquid in collector 16 reaches electrodes 112 and 113, switch 132a of relay 132 is operated to cut power off from timer 121 and to energize solenoid 93 through circuit 138 to close the pinch valve. This prevents any more liquid from being directed towards the collector, and the apparatus will remain in this condition until the collector is emptied or, if the apparatus has malfunctioned, until the error is corrected.

A switch 140 is provided in the circuitry to enable the apparatus to be started manually to take a sample.

I claim:

1. Apparatus for periodically taking samples from liquids with or without solids therein and flowing through a conduit, comprising a sampling tube mounted for longitudinal movement and extending towards a conduit for liquid from which samples are to be taken, said sampling tube having an open inner end to be moved into and out of liquid flowing through the conduit, means for moving said tube to shift the inner end thereof into the flowing liquid to permit some of said liquid to flow through the tube and to shift said inner end out of the liquid to stop said flow, a closed sample chamber for receiving the sample liquid, a flexible tube connected to an outer end of the sampling tube and extending to the chamber to direct liquid from said tube into the chamber, and control means in the chamber and operatively connected to said tube moving means to cause the inner end of the sampling tube to be moved out of the liquid when the liquid sample in the chamber reaches a predetermined volume.

2. Sample taking apparatus as claimed in claim 1 including means for allowing the liquid sample to flow out of the sample chamber after said sample reaches said predetermined volume.

3. Sample taking apparatus as claimed in claim 2 including a receptacle connected to the chamber by a tube to receive the samples from said chamber, and a shut-off valve in said tube.

4. Sample taking apparatus as claimed in claim 3 including control means in the receptacle for causing said valve to be operated to shut-off the tube when the liquid in the receptacle reaches a predetermined level.

5. Sample taking apparatus as claimed in claim 3 including control means in the receptacle for causing the inner end of the sampling tube to be shifted out of the liquid in the conduit when the liquid in the receptacle reaches a predetermined level.

6. Sample taking apparatus as claimed in claim 1 including a vent opening in the chamber at the top

thereof, and a float valve positioned to close the opening if the liquid in the chamber reaches said opening.

7. Sample taking apparatus as claimed in claim 1 including a vent opening in the chamber at the top thereof, a tube extending from said vent opening into the conduit to conduct liquid into the latter if the liquid in the chamber reaches said opening.

8. Apparatus for periodically taking samples from liquids with or without solids therein; comprising a conduit formed by a substantially tubular wall and through which liquid from which samples are to be taken can flow, said conduit having an inlet at one end and an outlet at an opposite end, a recess formed in the conduit to one side of the entrance thereof so that liquid flowing through said entrance passes the recess, a sampling tube extending out of the conduit and having an open inner end normally in said recess, said tube being longitudinally movable to shift said inner end into and out of the liquid flowing through the conduit, means for moving said tube to shift the inner end thereof into the flowing liquid to permit some of said liquid to flow through the tube and to shift said inner end out of the liquid to stop said flow, a sample chamber for receiving the sample liquid, a flexible tube connected to an outer end of the sampling tube and extending to the chamber to direct liquid from said tube into the chamber, and control means in the chamber and operatively connected to said tube moving means to cause the inner end of the sampling tube to be moved out of the liquid when the liquid sample in the chamber reaches a predetermined volume.

9. Sample taking apparatus as claimed in claim 1 including sealing means around the sampling tube to prevent liquid from leaking out of the conduit around the tube.

10. Sample taking apparatus as claimed in claim 1 in which said tube moving means comprises resilient means connected to the sampling tube normally retaining the inner end thereof out of the liquid, and a solenoid operatively connected to the tube, said solenoid when energized moving the tube inner end into the liquid.

11. Sample taking apparatus as claimed in claim 1 in which said tube moving means comprises resilient means connected to the sampling tube normally retaining the inner end thereof out of the liquid, and a solenoid operatively connected to the tube, said solenoid when energized moving the tube inner end into the liquid; and including two electrodes in the chamber positioned to be contacted by the sample liquid when the latter reaches a predetermined volume, and an electrical circuit including said electrodes and said solenoid to cause the solenoid to be de-energized when both electrodes are contacted by the liquid.

12. Sample taking apparatus as claimed in claim 11 in which one of said electrodes is positioned above the other of said electrodes in the sample chamber.

13. Sample taking apparatus as claimed in claim 12 in which said one electrode is adjustable vertically of the chamber relative to said other electrode.

14. Sample taking apparatus as claimed in claim 8 including a flap valve positioned normally to close the inner end of the sampling tube when said inner end is positioned in the recess, said valve being swung out of the way by the tube when said tube is moved to shift the inner end thereof into the flowing liquid.

15. Sample taking apparatus as claimed in claim 8 including means for allowing the liquid sample to flow out of the sample chamber after said sample reaches said predetermined volume.

16. Sample taking apparatus as claimed in claim 15 including a receptacle connected to the chamber by a valve-controlled tube to receive the samples from said chamber.

17. Sample taking apparatus as claimed in claim 8 including sealing means around the sampling tube at said recess to prevent liquid from leaking out of the conduit around the tube.

18. Sample taking apparatus as claimed in claim 8 in which the sampling tube extends substantially normal to the flow of liquid through the conduit, and said inner end of the tube is bevelled with the bevel facing the flow of liquid.

19. Sample taking apparatus as claimed in claim 8 in which said recess is formed by an enlargement of the conduit around the entrance thereof.

20. Sample taking apparatus as claimed in claim 19 in which the conduit entrance comprises a tube extending into said enlargement of the conduit, said sampling tube being located downstream of said tube.

21. Sample taking apparatus as claimed in claim 8 in

which said tube moving means comprises resilient means connected to the sampling tube normally retaining the inner end thereof out of the liquid, and a solenoid operatively connected to the tube, said solenoid when energized moving the tube inner end into the liquid.

22. Sample taking apparatus as claimed in claim 21 in which said tube moving means comprises resilient means connected to the sampling tube normally retaining the inner end thereof out of the liquid, and a solenoid operatively connected to the tube, said solenoid when energized moving the tube inner end into the liquid; and including two electrodes in the chamber positioned to be contacted by the sample liquid when the latter reaches a predetermined volume, and an electrical circuit including said electrodes and said solenoid to cause the solenoid to be de-energized when both electrodes are contacted by the liquid.

23. Sample taking apparatus as claimed in claim 22 in which one of said electrodes is positioned above the other of said electrodes in the sample chamber.

24. Sample taking apparatus as claimed in claim 23 in which said one electrode is adjustable vertically of the chamber relative to said other electrode.

* * * * *

30

35

40

45

50

55

60

65