LIQUID SAMPLING

This invention relates to discrete sampling of liquids, as is desirable in stream monitoring, industrial waste control, sewage treatment, and related anti-pollution efforts.

It is customary in sampling of liquids over a protracted period of time to take samples at intervals within the period and to group them into a single or composite sample so as to compensate for variations therebetween. However, sometimes deviations in characteristics of a liquid being sampled are of greater interest than are composite or average values, as in instances of floods, spills from sewage or industrial plants, or investigations of diurnal, seasonal, or annual ranges. In such instances, collection of successive individual or discrete samples is desirable.

A primary object of the present inventon is improved discrete sampling of liquids.

Another object is sequencing of diversion and distribution of liquid samples.

A further object is provision of sampling apparatus, including electrical controls, for accomplishing the foregoing objects.

Other objects of this invention, together with means and methods for attaining the various objects, will be apparent from the following description and the accompanying diagrams of an embodiment of the invention by way of example rather than limitation.

FIG. 1 is a block diagram of process aspects or steps of this invention;

FIG. 2 is a schematic diagram, largely in block form, of apparatus components of the invention;

FIG. 3 is a simplified front elevation, partly cut away, of a unit of equipment embodying such apparatus;

FIG. 4 is a sectional elevation of part of the apparatus of FIG. 3, taken at IV—IV thereon;

FIG. 5 is an enlarged sectional elevation of another portion of the apparatus of FIG. 3, taken at V—V thereon;

FIG. 6 is a plan view, partly in section, taken at VI—VI on FIG. 3; and

FIG. 7 is a schematic circuit diagram of electrical components of the apparatus.

In general, the objects of this invention are accomplished, in discrete sampling of liquids, by the steps of flowing liquid to be sampled past a diversion locus, intermittently diverting liquid therefrom into a distribution path, and terminating the distribution path at a succession of collection locations upon successive diversions of liquid into the path.

FIG. 1 indicates TIMING of the DIVERSION of liquid to be sampled at intervals and subsequent DISTRIBUTION of the samples for COLLECTION separately in a region subject to TEMPerature CONTROL. INDEXING of the distribution to allocate successive samples to individual collection locations within the region is timed similarly frequently but after a delay sufficient to ensure completion of individual sample flow, as is explained more fully hereinafter.

FIG. 2 shows schematically that liquid from body **10** thereof to be sampled may be forced by a submerged PUMP through intake line **11** to a DIVERTER, which from time to time diverts samples into line **12** to a DISTRIBUTOR. The distributor allocates successive samples to individual collection vessels or COLLECTORS via lines 13a to 13f, etc. (only six lines being illustrated). The collection locations are in the cooled region of a REFRIGERATOR (outlined in broken lines). During the intervals between diversion of samples the pumped liquid runs from the distributor back to the body of liquid through return line **15**.

FIG. 3 shows, in front elevation, a unit of equipment embodying the apparatus components of FIG. **2**. Cabinet **21** is shown with door **22**, which is hinged at the left and provided with handle **23** at the right, partly cut away to reveal the interior. Liquid intake line **11** and return line **15** are visible above and below cylindrical diverter chamber **25** to which they connect. The lower part of the cabinet is occupied by refrigerator **27**, which as handle **28** at the left on door **29**. Bracket **30** mounted on top of the refrigerator carries a number (e.g., two dozen) of receiving chambers **31***a*, **31***b*, etc., many of which are hidden behind the door or behind visible chambers. (The receiving chamber to the right of 31a is superimposed in phantom upon other components to avoid obscuring them.) As shown more clearly in a later view (FIG. **6**) the receiving chambers are arranged in a ring equidistant from rotatable distributor head **33** supported centrally above the bracket on the shaft of indexing motor **35** mounted underneath. The distributor head receives the end of sample line **12** in its open top and carries spigot arm **37** at its side. At the under side of the spigot arm and near its outer end is discharge opening **38**, shown positioned over the open top end of receiving chamber **13***b*. Collection lines **13***a*, **13***b*, etc., (only a few of which are shown, in the interest of clarity) run from the bottoms of the respective receiving chambers into the top left corner of the refrigerator, where individual collection vessels (not visible here) are located, as shown in a later view (FIG. **5**). Behind the illustrated components is a control panel, which supports electrical components, but this view is insufficiently detailed to show them; they appear schematically in a later view (FIG. **7**).

FIG. **4** shows in axial vertical section, taken in the front-to-rear direction, cylindrical diverter chamber **25** and attached elements. Flexible diverter tube **42** depends from interconnection to intake line **11** at the top to terminate midway of the vertical extent of the chamber, normally to the left (nearer the front) of upstanding baffle **45**, which divides the lower portion of the chamber into two parts. Return line **15** draws from the left (front) part, while sample line **12** drawns from the right (rear) part. Collar **47** about the lower end of the diverter tube is pivoted to rod **48**, which connects it to the armature of solenoid **49** mounted outside the diviter. Shown in borken lines is the diverted position of the tube over the sample drain when the solenoid is actuated to divert it and the liquid flowing therethrough.

FIG. **5** shows a fragmentary vertical section taken parallel to that of the preceding view but at a lower level and facing to the left in FIG. **3**, including part of the upper left corner of refrigerator **27** and representative receiving chamber **31***b* and adjacent elements. The receiving chamber has funnel-shaped cap **51***b* with depending shoulder fitting into hollow cylindrical body **52***b*, which has funnel-shaped bored plug **53***b* at the bottom with a shoulder fitting upward into the body. Sample collection tube **13***b* fits at its top into the bore of the plug, and extends through the top of the refrigerator, which is bored to receive it, and then terminates at its lower end above the open top end of test-tube-like collection vessel **56***b*, which is one of a plurality of like vessels retained in tray **57**. The tray is supported re-