13. The capability of recording the sample collection date and time should exist.
14. The provision for operation using DC battery power or 110-volt AC power should exist.
15. The weight of the entire sampler or any one of its principal components should not exceed 100 pounds.
16. The maximum dimensions of the entire sampler or any one of its components should not exceed 35 inches in width or 79 inches in height.
17. The required floor area for the fully assembled sampler should not exceed 9 square feet (3 ft by 3 ft).

It is essential that the an automated sampler be able to meet the majority of the outline criteria. Automated samplers generally consist of: (1) a pump to draw a suspended-sediment from the stream flow, and, in some cases, back flush to prevent cross-contamination between samples, as well as to prevent freezing during winter months; (2) a sample container unit to hold sample bottles in position for filling; (3) a sample distribution system to divert a pumped sample to the correct bottle; (4) an activation system that starts and stops the sampling cycle, typically either at a regular time interval or in response to a rise in fall of the stream (gage height); and (5) an intake system through which samples are drawn from a point in the sampled cross section.

An advantage of automated samplers over grab sampling is that automated samplers can collect suspended-sediment samples during periods of rapid stage changes caused by storm-runoff events. Automated samplers also reduce the manpower necessary to carry out intensive sediment-collection programs. However, because of their mechanical complexity, power requirements, and limited sample capacity, automated samplers often require more frequent site visits than a conventional observer station. All the automated samplers use pumps powered by batteries or an AC power supply. This presents a significant problem in remote settings, where changing or recharging batteries is difficult. Batteries also add substantial weight to a sampler unit. Moreover, these units can be prone to freezing during cold weather.

Most automated samplers need a separate flow meter to correlate sampling to the test site's flow, in order to provide flow proportional sampling. These systems are complicated and often require on-site calibration to ensure accuracy.

Sampling frequency for automatic sampling systems should be much greater at peak flows than during gradual base flows. High flows, such as those caused by a storm or spring runoff, typically contain high sediment concentrations. The peak sediment concentrations however do not usually coincide with the water-discharge peak. Therefore, a need for intermittent flow-proportional sampling is necessary to accurately depict the conditions within the steam environment.

Some of the automatic pump-type samplers are the U.S. PS-69, U.S. CS-fl, U.S. PS-82, Manning S-4050, and ISCO 1680. The U.S. PS-82 is the most recent design available from F.I.S.P. The Manning and ISCO samplers, frequently used by federal and state agencies, were developed by private companies. None of the current samplers meet all 17 of the optimum criteria set out above. The most critical of the shortcomings is that none of the samplers provide direct, proportional flow, or isokinetic, collection of samples. Examples of some sampler designs may be seen in U.S. Pat. No. 5,693,894, invented by Jobson (1997), and a technology intensive and costly sampler developed by Hungerford and Dickinson (1994), U.S. Pat. No. 5,299,141.

SUMMARY OF THE INVENTION

Therefore, one of the objects of this invention is to provide a sample collection device that takes flow proportional samples. Another object is to provide a sample pump that does not require battery or AC power. Another object is provide a flow velocity meter. Another object is provide constant pumping, in order to avoid freezing during cold weather. Another object is provide a light-weight, stand-alone sampler that is easy to manufacture. Another object is to provide a sampler that meets a majority of the USGS criteria.

The present invention meets these objects by providing a flow driven pump that uses the flow of the test site, such as a stream, to drive a pump, thereby eliminating the need for outside power for the pump. Because the pump is flow driven, it can run constantly, thereby inhibiting freezing and providing all weather suitability. The constant action of the pump also flushes the system, thereby preventing cross-contamination of samples taken at different times. The invention also incorporates a simple pulse counter that monitor's the revolutions of the turbine propeller and can be used to measure velocity. The invention also provides a collection and distribution unit that can collect and store numerous samples in a small, light-weight container. Because the pump does not require battery power, the present invention can be left in the field for extended periods of time without maintenance.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a general, overall view of the components of the present invention, and a cross-section side view of the propeller turbine and pump unit.

FIG. **2** is a cross-section end view of the propeller turbine and pump unit.

FIG. **3** is a cross-section side view of the funnel and float switches.

FIG. **4** is a cross-section side view of the distributor rotor.

FIG. **5** is a bottom view of the distributor rotor, showing the water channel outlet.

FIG. **6** is a top view of the distributor housing.

FIG. **7** is a cross-section side view of the distributor housing.

FIG. **8** is a cross-section side view of the collection and distribution unit.

FIG. **9**A is a schematic of half of the data and control circuitry.

FIG. **9**B is a schematic of the other half of the data and control circuitry.

FIG. **10** is a cross-section of the turbine and pump unit inserted between sections of pipe.

DESCRIPTION OF THE INVENTION

FIG. **1** shows an overview of one embodiment of the present invention used to take samples from a stream **29**. The turbine is shown generally at **10**, secured above a streambed **28** by a support bracket **31**. The flow of the stream is indicated by arrows **12**. The flow **12** enters a cylindrical turbine housing **11**. The axis of the turbine housing **11** is indicated at **13**. A vertical cross member **16** in the housing **11** supports a shaft **15** which is aligned with and rotates on the axis **13**. A turbine propeller **14** is mounted to one end of the shaft **15**. At the other end of the shaft is an eccentric or wobble-cam **17**. As seen most clearly in FIG. **2**, a connecting rod or push rod **18** has a big end **39** that rides about the wobble cam **17**. The push rod **18** extends up through the housing **11** and attaches to a diaphragm **21** which is part of a conventional diaphragm pump **19**. The suction of the pump