ELECTRONICALLY OPERATED TIPPING-BUCKET RAIN GAUGE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to rain gauges and more particularly to a gauge for measuring low-to-moderate rainfall rates wherein incremental volumes of rain water are removed from the bottom of a column of the collected rain water, whereby the rainfall rate is calculated by determining the number of increments of rain water removed from the column during a period of time.

2. Description of the Prior Art

Various techniques have been employed for measuring rainfall rates, such as, measuring the flow of water between capacitor plates; measuring the momentum of drops formed from the collected rain and allowed to fall a fixed distance; or measuring the water accumulation with a commercially available tipping-bucket rain gauge. While these gauges have been satisfactory for their intended purposes, they have not been found satisfactory for the measurement of low-to-moderate rainfall rates; for instance, in the order of 0.3 to 30 mm/h. In the case of the commercially available tipping-bucket rain gauge, a two-compartment tipping-bucket arrangement is utilized which tips when a certain quantity of water, usually 8.1 ml, has accumulated in one compartment, thereby emptying that compartment and exposing the other compartment for filling. Because of the relatively large quantity of water required to tip such a bucket arrangement, the best resolution obtainable is in increments of 0.25 mm of rainfall.

SUMMARY

To overcome the disadvantages of hitherto employed rain gauges for the measurement of low-to-moderate rainfall rates, the rain gauge of the present invention has been advised which comprises, essentially, a rotary bucket wheel positioned beneath and communicating with a water column of collected rain. When the water column exceeds a certain height, as determined by an electronic probe circuit, the bucket wheel is actuated whereby a predetermined volume of water, for instance 0.1 ml, is removed from the bottom of the water column. By the construction and arrangement of the rain gauge, rainfall can be measured in increments of 0.005 mm.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an end elevational view of the rain gauge of the present invention;

FIG. 2 is an enlarged, side elevational view, partly in section, of the rain gauge of the present invention; and

FIG. 3 is a block diagram of the electronic probe circuit employed in the rain gauge of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and more particularly to FIG. 1 thereof, the rain gauge of the present invention comprises a rotary stepping motor **1** connected to a wheel **2** having buckets **3** provided in the peripheral surface thereof, the wheel being positioned beneath a water-channeling block **4** through which collected rain water is conducted from a funnel **5** to the buckets. The collected water is sequentially discharged from each bucket to a trough **6** positioned beneath the wheel during rotation of the bucket wheel, to be described more fully hereinafter.

A fixed cam shaft **7** is connected to a suitable support block **8** which, together with the trough **6** and stepping motor **1**, are mounted on a suitable base **9.**

The details of the construction of the bucket wheel **2** and water-channeling block **4** are shown in FIG. **2** wherein it will be seen that the buckets **3** consist of a plurality of radially extending cylinders, each having a piston **10** slidably mounted therein and biased radially inwardly by a spring **11** mounted between the inner peripheral surface **2a** of the ring and a collar **12** secured to the piston rod **13.** The springs **11** bias the inner end of each piston rod against the peripheral edge of a cam **14** fixedly secured to the shaft **7.** The development of the cam **14** is such that as the bucket wheel is rotated counter-clockwise each piston is progressively urged radially outwardly to the outer end of its respective cylinder until the spring is fully compressed. After one revolution of the wheel, the respective piston rod arrives at the stepped portion **14a** of the cam whereupon the biasing force of the spring moves the piston rod radially inwardly until the piston once again is positioned at the bottom or inner end of the cylinder. The volume of each cylinder is only 0.1 ml; thus, by the construction and arrangement of the cam-actuated, spring-biased pistons, surface tension, which causes a problem when filling a small volume with water, is eliminated.

The pistons are provided with O-rings **15** to prevent leakage of water along the piston rods and a thin layer of oil is applied to the peripheral surface of the bucket wheel, as at **16,** for lubrication and to prevent water leakage between the wheel and the water-channeling block **4.** The side wall at the lower end of each cylinder is provided with a vent opening **17** to facilitate the sliding movement of the piston within its respective cylinder.

The water-channeling block **4** is provided with a main bore **18** communicating at the upper end thereof with the discharge end **5a** of the funnel, the lower end of the main bore communicating with the upper end of each cylinder or bucket in the wheel **2.** A laterally extending bore **19** is formed in the block **4** and communicates between the main bore and a recess or pocket **20** formed in the block providing a well for the receiving of an electrical probe **21.**

The water-channeling block **4** and funnel **5** are stabilized on the base support **9** by a hold-down spring **22,** and a hold-down bracket **23** secured to a rigid arm **24** fixedly secured to the base support **9.**

The electronic probe circuit for actuating the rotary stepping motor **1** is illustrated in FIG. **3,** and includes a probe amplifier and trigger **22,** a monostable multivibrator **23,** and a power amplifier **24** connected in the circuit between the probe **21** and the rotary stepping motor **1.**

In the operation of the rain gauge of the present invention, when the water column in the well **20** reaches the level of the electric probe **21,** the probe amplifier and trigger circuits **22** detect a current flow between the probe elements to thereby generate a trig-