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Recirculating Purging System for Hemispherical Net Radiometers[1]

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ABSTRACT

A recirculating purging system for soft dome net radiometers was developed to prevent internal fogging and reduce maintenance during cool and wet weather. An airflow of 3–5 $mm^3\ s^{-1}$ was sufficient to keep the domes inflated and clear of condensate without introducing signal errors. The desiccant needs to be changed only two to three times a year.

1. Introduction

A purging system was developed to prevent internal condensation in hemispherical net radiometers without frequent changing of desiccant. Continuous recirculation of dry air through the radiometer and a desiccant tube prevented condensate formation during cool and wet periods.

We observed, like others (Peterson *et al.*, 1973; Mukammel, 1972), that condensate formation or fogging causes serious errors in radiation measurements. Mukammel found that dew deposition over the dome of a Funk-type pyradiometer reduced the output as much as 50% of that of a pyradiometer without dew. While his study concerned external deposition, we found that without an adequate internal purging system, water droplets from dew or rainfall on the outside of the thin plastic dome usually produced condensate on the inside surface from localized cooling as the external water evaporates, and from diffusion of water through the plastic dome. The condensate persists even after droplets disappear. Previously recommended procedures to eliminate this problem required using large amounts of dried air and frequent changes of desiccant.

To eliminate these problems, we developed a system which recirculates the purging air stream through a desiccant column and the radiometer and back through the desiccant, thus assuring adequate removal of any water which may enter through the domes or small leaks.

We previously used a system for pressurizing and drying miniature net radiometers, as recommended by Fritschen (1965), which consisted of sealing one of the two pressurization tubes of the radiometer and connecting the other tube to a source of dry air, usually produced with a desiccant column. A vibrator aquarium pump equipped with a check valve set at 23 mb ($\frac{1}{3}$ psi) maintained proper inflation of the radiometer domes. This procedure was satisfactory in warm weather, but during rainy or cool periods water frequently condensed on the inside of the domes. The system required complete purging every 2 or 3 days under extremely wet conditions. When a continuous stream of dry air was passed through the domes at a low rate to prevent fogging, as recommended for such conditions, the desiccant soon became hydrated.

The system we developed to correct these problems improves the quality of the data, costs less than $30 for parts, and can be assembled by most technicians with some shop experience. The time spent in maintaining the radiometer system is reduced to routine inspections and to periodic changes of desiccant.

2. Description

The purging system recirculates air through a desiccant and provides pressurization for the radiometer domes. Recirculating air through the radiometer interior assures dry air and increases desiccant life since redrying requires less water extraction than drying ambient air. Development of the system began in 1970, and the design has been modified to improve its performance and reliability (Fig. 1). Air flows from the pump outlet through the desiccant to the radiometer. A tee on the outlet of the desiccant container connects with a 23 mb ($\frac{1}{3}$ psi) check valve, to assure that pressure will not exceed that value in the radiometer. The air line from one of the radiometer pressurization tubes is connected to the desiccator via a metering valve to permit adjusting the rate of airflow through the radiometer. The check valve outlet is connected to the pump

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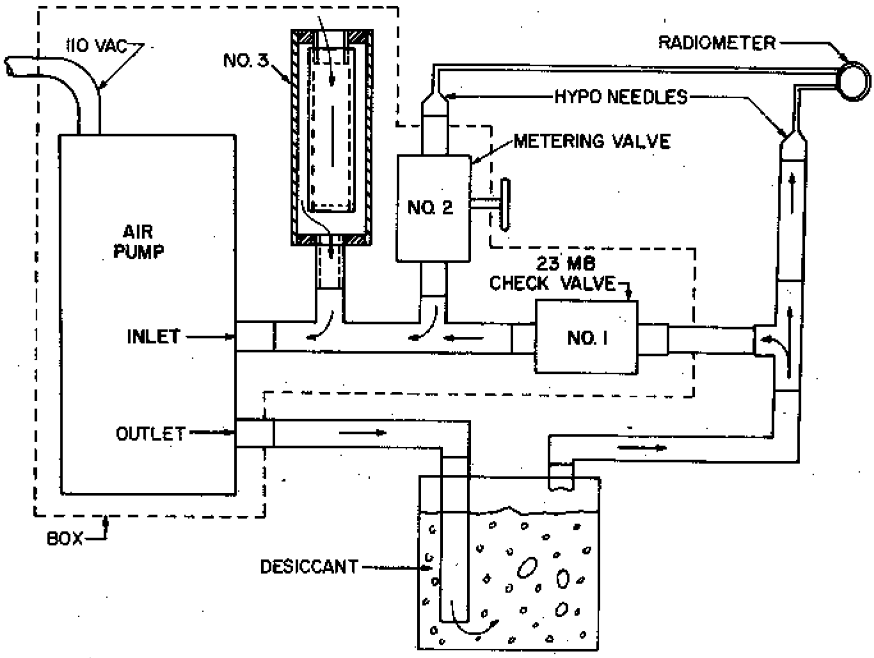

FIG. 1. Schematic diagram of recirculating purging system for pressurizing and drying hemispherical net radiometers with lists of parts as follows: single unit vibrator-type aquarium pump, 23 mb (⅓ psi) valve (No. 1) with 6.35 mm fittings; needle valve (No. 2), micrometering, 6.35 mm fittings; check valve (No. 3); hypo needles; box and hardware; tees and tubing.

inlet so that no surplus air is lost. A one-way valve (No. 3) on the inlet of the pump allows ambient air to be added to the system to compensate for any leakage and assure adequate dome inflation. This valve may be obtained commercially or built in the laboratory with surgical rubber tubing and plastic. The laboratory version (Fig. 1) is constructed of a 5 cm long by 1 cm i.d. thin-wall surgical rubber tube. A 1–1.5 cm long slit is cut neatly in the tubing side to allow passage of air. The rubber tube is plugged at one end and the other end is connected to the inside of a 2 cm i.d. rigid plastic tube, as indicated in Fig. 1. The aquarium pump must be disassembled, drilled to convert the inlet to receive a connection similar to its outlet, and checked for air leaks after reassembly. The unit compactly fits into a 10 cm×13 cm×15 cm minibox with desiccant holder mounted close to the unit to minimize tubing lengths.

3. Results and discussion

The rate of airflow through the radiometer can cause errors by convective cooling of the sensing surfaces. The instruction manual (Fritschen and Mullins, 1965) furnished with FRINET net radiometers[2] indicates that at a 0.95 ly min^{-1} radiation level, an 8 mm^3 s^{-1} airflow, passing through the top dome first, decreases the radiometer output 0.7%. However, when it passes through the bottom dome first, it increases the output 0.4%. With our system, an airflow of 3–5 mm^3 s^{-1} was sufficient to prevent fogging, and thorough testing showed that recirculating air at this flow rate changed the output less than 0.2%.

[2] Mention of company or product names is not to be considered as endorsement or recommendation by the Department of Agriculture, but is included for information and for the convenience of the reader.

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