MODIFICATION OF BRIDGE CONTROLS

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Paper No. 6

CSU. Atmospheric Science Technical Paper No. 6

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BIBLIOGRAPHIC DATA SHEET	1. Report No. CER60-25	2.	3. Recipient's Accession No.

4. Title and Subtitle

MODIFICATION OF BRIDGE CONTROLS TO SIMULATE DIURNAL CYCLIC VARIATION OF TEMPERATURE, HUMIDITY AND RADIATION

5. Report Date: July 1960

6.

7. Author(s): Richard A. Schleusener and Larry G. King

8. Performing Organization Rept. No. CER60-25

9. Performing Organization Name and Address

Civil Engineering Section
Colorado State University
Fort Collins, Colorado 80521

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

13. Type of Report & Period Covered

14.

15. Supplementary Notes: CSU, Atmospheric Science Technical Paper No. 6.

Reprinted from Agricultural Engineering, Vol. 41, No. 7, pp. 450-451, July 1960.

16. Abstracts

17. Key Words and Document Analysis. 17a. Descriptors

Environmental control chamber
Temperature
Humidity
Radiation
Evaporation
Soils

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

18. Availability Statement	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 3
	20. Security Class (This Page) UNCLASSIFIED	22. Price

Colorado State University.
Atmospheric Science Technical Paper No. 6

Modification of Bridge Controls to Simulate Diurnal Cyclic Variation of Temperature, Humidity, and Radiation

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AN environmental control chamber in which temperature, humidity, and radiation can be controlled has been constructed in connection with a study of evaporation from soils*. The experiments established a need for cyclic variation of temperature, humidity, and radiation to simulate the diurnal variation of these meteorological parameters.

The details of the system devised to accomplish this objective are described in this paper. Similar arrangements may be used in a variety of applications employing a bridge circuit.

For maintaining steady temperature in the chamber, the controls consisted of a temperature sensitive element located in the return duct and connected into a resistance bridge circuit. A change in temperature at the element produced a change in its resistance, unbalancing the bridge circuit and creating a voltage signal. This voltage signal was amplified to operate a relay which in turn operated the proper corrective mechanism to adjust the temperature within the chamber so as to bring the bridge back into balance. The controls for maintaining a steady condition of relative humidity operated in a similar manner.

In order to produce cyclic variations, an unbalance was introduced on one leg of each bridge at appropriately timed intervals. Timing and control for the system was provided by a timer giving an impulse every 72 min (1/20 of a 24-hr day) to an eight-bank, twenty-position stepping relay. The desired diurnal cycles of ambient conditions are shown in Fig. 1, the dashed lines of which show the stepwise variations that approximated the desired curves.

Fig. 2 shows the arrangement used to accomplish the desired stepwise variation in temperature and humidity, also the details for turning on and off various combinations of heat lamps *(g)* for simulating radiant energy from the sun.

On the stepping relay, banks m_1 to m_4 control the timed sequence of heat lamps to simulate radiant energy. Bank m_5 is not used. Banks m_6 and m_7 are used to program the variation in temperature. Fig. 2 shows, for example, that when the stepping relay is in position 1-3, and 19 and 20, the potentiometers *(b)* are bypassed, and the bridge operates the same as under steady-state conditions. For other positions of the stepping relay, additional resistances *(b)* are added to one leg of the bridge, thereby producing an unbalance which results in a temperature change within the chamber until the temperature bridge is brought into balance with the added resistance of the potentiometers *(b)*.

Bank m_8 is used in a manner comparable to banks m_6 and m_7 to add varying amounts of resistance to one leg of the relative humidity control bridge for positions other than 1 to 6 and 20 of the stepping relay.

Fig. 3 shows the timer, rectifier, stepping relay, and resistance units used to accomplish the modification to produce cyclic conditions within the environmental control chamber.

Fig. 4 shows a typical weekly record from a recording hygrothermograph located inside the chamber. The degree to which the equipment is successful in producing the desired cyclic variation in temperature and humidity can be seen by comparing Fig. 4 with Fig. 1.

The amplitude of the variations of temperature or humidity can be changed by adjustment of the potentiometers *(b)* or the adjustable resistor *(i)*. The range within which the equipment operates for a fixed amplitude can be set using the control point adjustment on each bridge.

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*Colorado contributing project to Western Regional Project W-32 concerning basic hydrologic factors relating to water conservation.

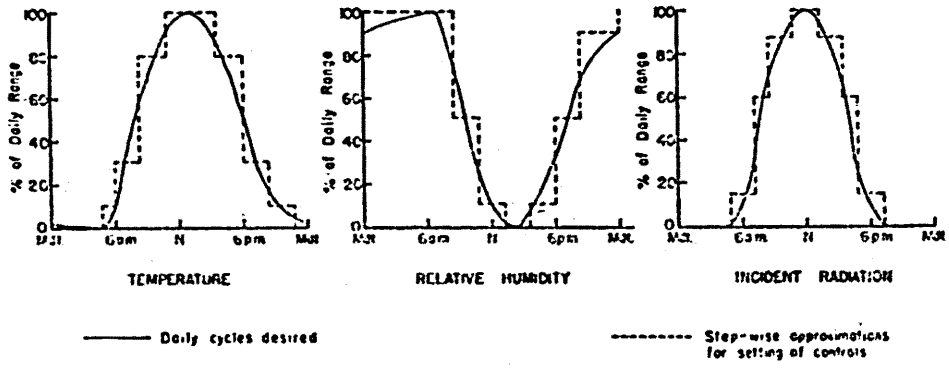

Fig. 1 Diurnal cycles of ambient conditions in environmental control chamber

This article is reprinted from AGRICULTURAL ENGINEERING (vol. 41, no. 7, pp. 450-451, July 1960), the Journal of the American Society of Agricultural Engineers, St. Joseph, Michigan

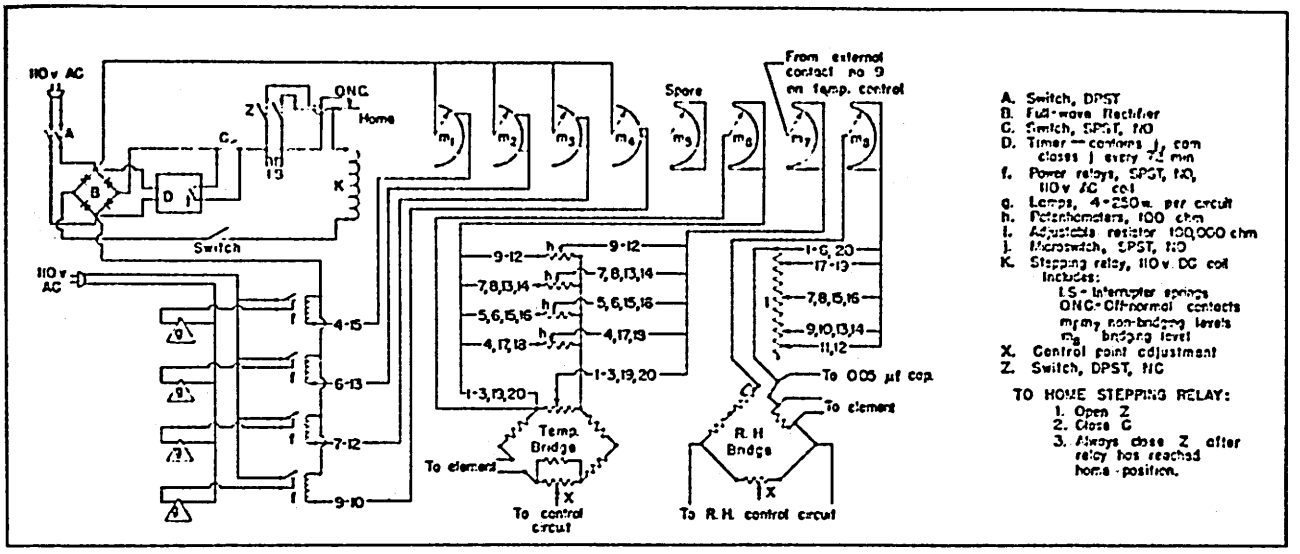

Fig. 2 Circuit for cyclic control of ambient conditions of temperature, humidity, and radiation

The stepwise variations which appear in Fig. 4 could be smoothed by the addition of a greater number of control points within the 24-hour period. This would require a stepping relay having more than twenty positions and a greater number of resistance units.

The performance of the equipment is considered adequate to accomplish acceptable diurnal cyclic variation of temperature, humidity, and radiation. The equipment has been operating in a satisfactory manner for about eighteen months.

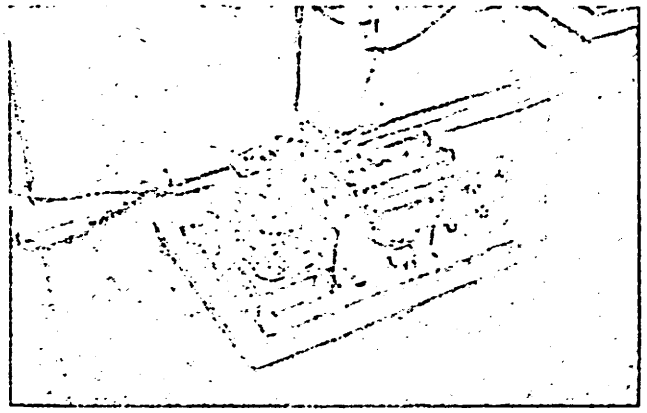

Fig. 3 View of timer, stepping relay and associated equipment used to produce cyclic variation of ambient conditions

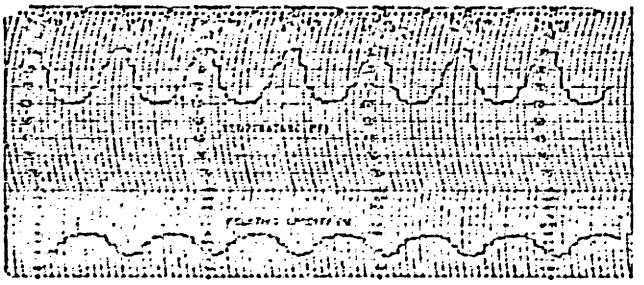

Fig. 4 Hygro-thermograph record showing diurnal cycles of temperature and humidity produced in environmental control chamber