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A Laboratory Wiener Curing Cabinet

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A Laboratory Wiener Cabinet

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1.0 Introduction

One aspect of the work undertaken at the Food Research Institute is the fundamental study of the influence of formulation changes and the use of various protein sources on the production of wiener products. For the results of this work to be extrapolated to the industrial situation it is necessary to process the material under conditions which can be related to commercial practice. One facility which has not been available to F.R.I. was a suitable cook house in which to process the small lots of wieners under conditions which replicate commercial batch or continuous processes.

During the processing of the wiener type products, the product is thermally processed following either a stepwise heating process or a programmed temperature increase. As well as temperature, the relative humidity of the cook house is controlled and changed during the processing cycle.

Engineering Research Service has designed, constructed and tested a small laboratory cooking facility which will simulate commercial batch or continuous processing. Programmed control of both temperature and humidity is provided.

2.0 Review of Literature

While several manufacturers of smokehouse equipment offer "small" commercial units, these cabinets are designed to handle product loads in excess of about 50 Kg (1-4). For research purposes these cabinets are too large, and uneconomical for use in individual processing runs on 1-5 Kg of product.

A very simple cabinet for handling fermented sausage products was described by Johnson (1975). Temperature is controlled for this cabinet via an external water bath and circulating pump. No direct control of humidity is provided although high humidity (≑ 95% RH) is maintained by an open water surface in the bottom of the chamber.

Monagle (1974) has pointed out the importance of the effects of temperature, humidity and air flow on the production of wieners. It seems evident from industrial practice that control of both temperature and humidity is essential if any data from small laboratory curing cabinets is to be extrapolated to commercial practice.

3.0 Equipment

3.1 Cabinet Design

The small wiener curing cabinet (Fig. 1, 2) was designed and constructed to handle product batches of 1-5 Kg. External dimensions of the cabinet are 41 cm wide x 69 cm deep x 138 cm high. The cabinet is insulated with 2.5 cm of styrofoam and the structural strength provided by a shell of 1.9 cm plywood. Exterior and interior sheathing is of type 316 stainless as is all the duct work. Door and rear panel construction is the same as the cabinet, i.e. 1.9 cm plywood and 2.5 cm styrofoam clad in stainless.

Air is circulated through the cabinet by a "squirrel cage" fan[a] powered by a 1/20 hp motor. The electric drive motor is mounted externally and coupled to the fan by a phenolic shaft. This was necessary to isolate

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[a] Delhi blower Model D530

the motor from the cabinet heat. From the fan, the air passes over 1500 watts of electric heater mounted in the vertical rear duct. Air is distributed into the cabinet through the perforated upper duct and passes down through the product load (Fig. 3). In the lower portion of the cabinet the air is drawn through a humidifier cloth and re-enters the circulating fan. Air flow of 2.7 m^3/min provides for 12 air changes per min in the cabinet.

Two sloped stainless steel drip trays are provided below the product, both to catch any drained liquid and isolate the humidifier from the product.

3.2 Control System

Programmed control of both wet and dry bulb temperatures are provided by a Honeywell cam programmer-controller-recorder[b]. The wet and dry bulb sensors are located in the rear duct, above the heaters. The dry bulb portion of the controller activates a secondary relay capable of handling 2.7 kilo watts at 110 volts. Control of humidification is provided by the wet bulb temperature controller. The controller activates a pulse timer which controls a solenoid valve in the humidifier water supply line. The system then pulses (15 sec on, 15 sec off) water onto the humidifier cloth. This pulsation was necessary to avoid the extreme overshoot which could occur due to the slow response of the mercury filled wet bulb sensor.

Program cams can be cut for each desired temperature and humidity cycle noting that because it is dry bulb/wet bulb control the humidity program must be converted back to wet bulb readings in order to cut the cams.

Test Procedure

To determine product temperature distribution, batches of 16 wieners were processed with a thermocouple in the center of each wiener (Fig. 4).

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[b]Honeywell Model 602C43-WW-24-111-893

To hold the thermocouples correctly in the centers of the wieners, each thermocouple was mounted in a spring coil of the same diameter as the wiener casing. The wiener casings were filled with emulsion with the thermocouples enclosed in the casing.

Triplicate trials were conducted to determine temperature distribution while using a typical processing program (Fig. 6). Fourteen air temperature thermocouples were used and distributed throughout the cabinet (Fig. 4).

4.0 Test Results

4.1 Air Temperature Distribution

While precise air temperature distribution has not been attained, the distribution achieved is quite adequate. Under normal operation in a program cycle, the maximum deviation in air temperature distribution between 60 and 80^{o}C is ± 3^{o}C. Air and wiener temperature distribution at four periods during a temperature program are given in Fig. 4.

4.2 Wiener Temperature

As with the air temperature distribution, some variation occurred in the wiener, although this variation was less than in the air. Maximum product temperature deviation at cabinet temperatures between 60 and 80^{o}C was ± 2^{o}C. Product temperature distribution improved with increased temperature with a deviation of ± 1^{o}C at 80^{o}C air temperature.

4.3 Humidity

Humidity was monitored during the trials using wet and dry bulb thermocouples mounted in the air duct beside the control sensors. For the sample program used (Fig. 6), humidification control was achieved within ± 5% RH at 75°C dry bulb temperature. This RH cycle is reduced to ± 4% at 85°C dry bulb. It should be noted that there is control only of humidification and that additional equipment would be required for any dehumidification.

5.0 Summary

The small curing cabinet developed has proven satisfactory for the production of research sized samples of wieners. Programmed control of both wet and dry bulb provides the ability to simulate both batch and continuous industrial processing conditions. Maximum temperature differences by location in the cabinet were less at the higher temperatures. Wiener center temperature spread at 80°C was 2°C.

6.0 References

1. Manufacturers' literature, Koch Supplies Inc., 1411 West 29th St., Kansas City, Mo. 64108.

2. Manufacturers' literature, Griffiths Laboratories Ltd., 757 Pharmacy Ave., Scarborough, Ont. M1L 3J8.

3. Manufacturers' literature, McGruer, Fortier Meyers Ltd., 300 Canal Bank Rd., Ville St-Pierre, Que. H8R 1H3.

4. Manufacturers' literature, Vortron & Assoc., P.O. Box 1017, Beloit, Wis. 53511.

5. Johnson, M.G. and Acton, J.C. 1975. Laboratory method for fermentation of meat and poultry sausages in fibrous casings. Applied Microbiol. 29 (6), 855.

6. Monagle, C.W., Toledo, R.T. and Saffle, R.L. 1974. Effect of smokehouse temperature, humidity and air velocity on rate of heating and quality of frankfurters. J. Food Sci. 39, 602.

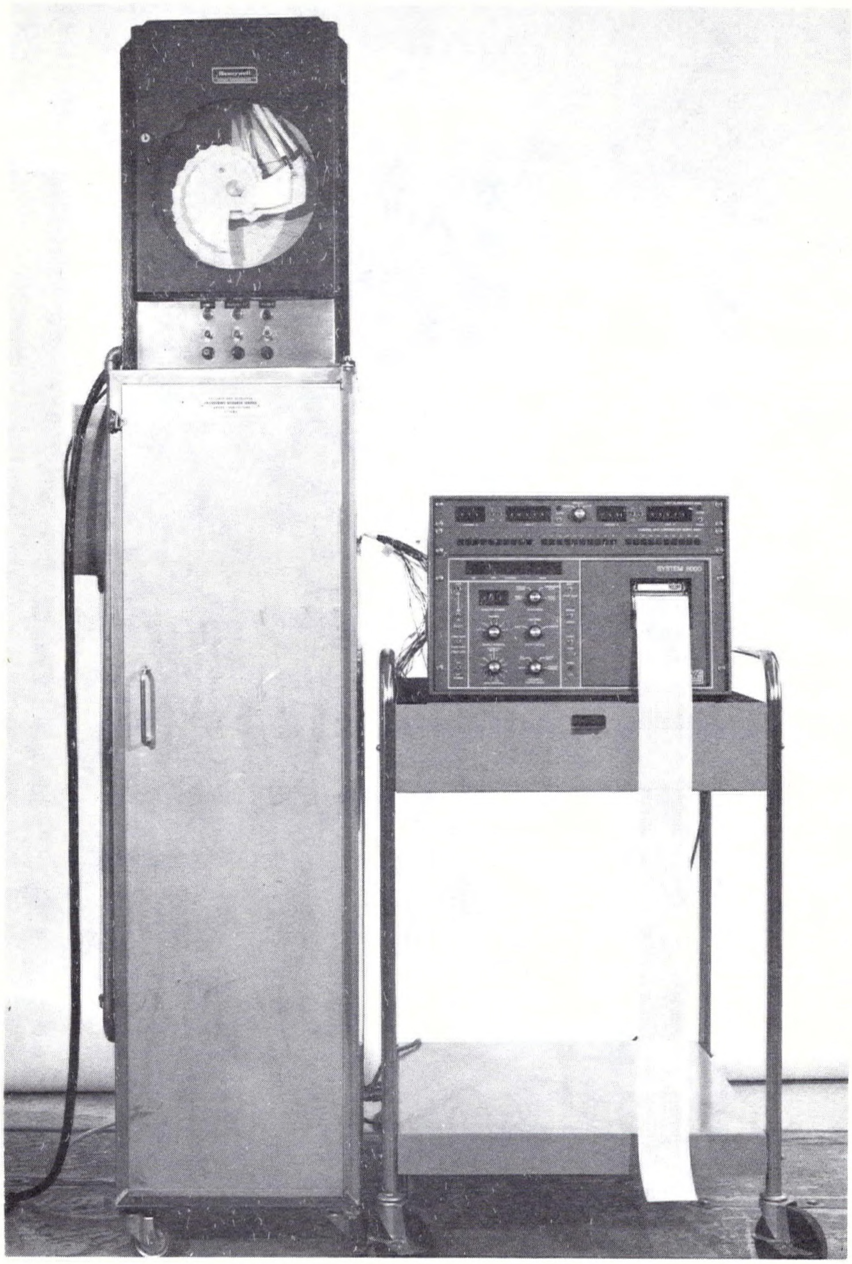

Figure 1. Over-all view of programmed curing cabinet.

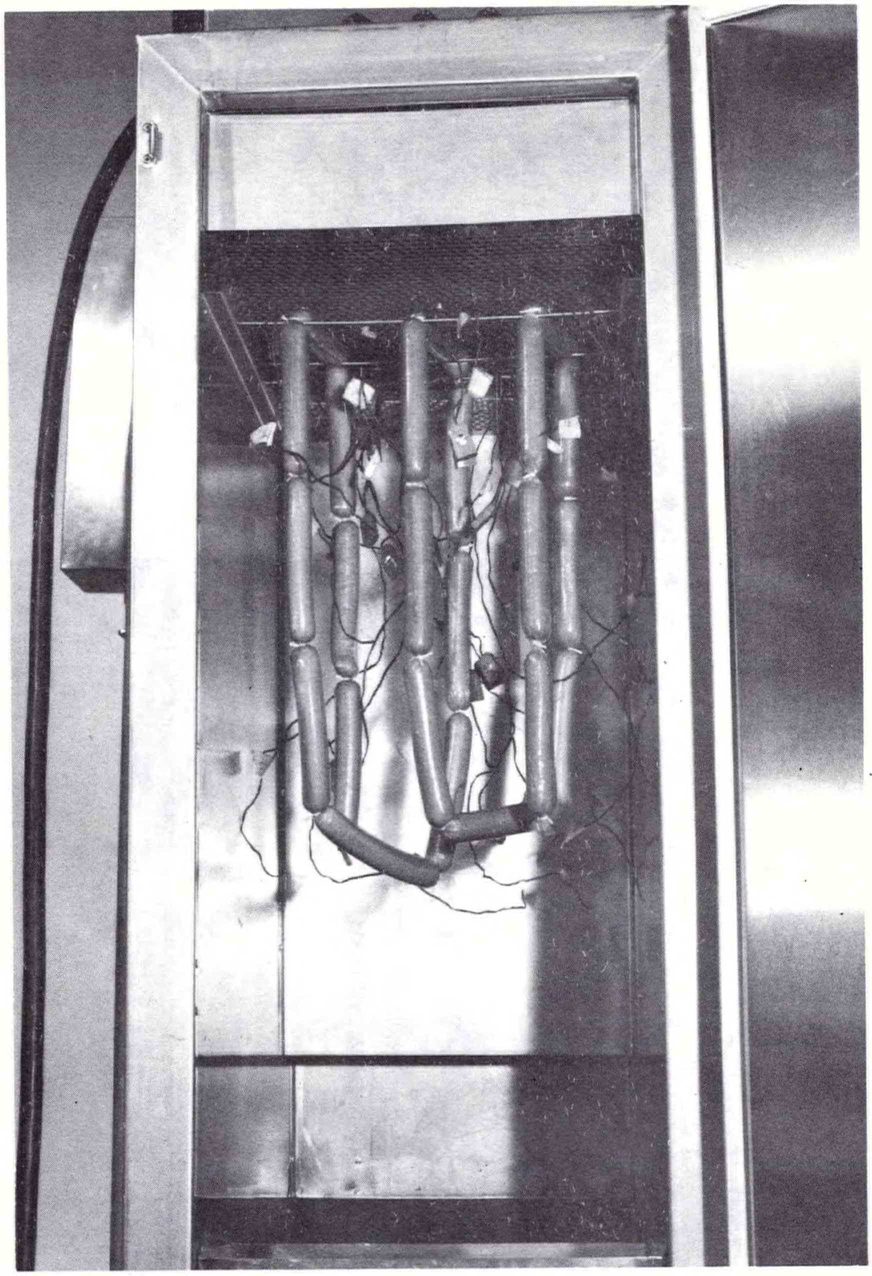

Figure 2. Interior view of loaded cabinet.

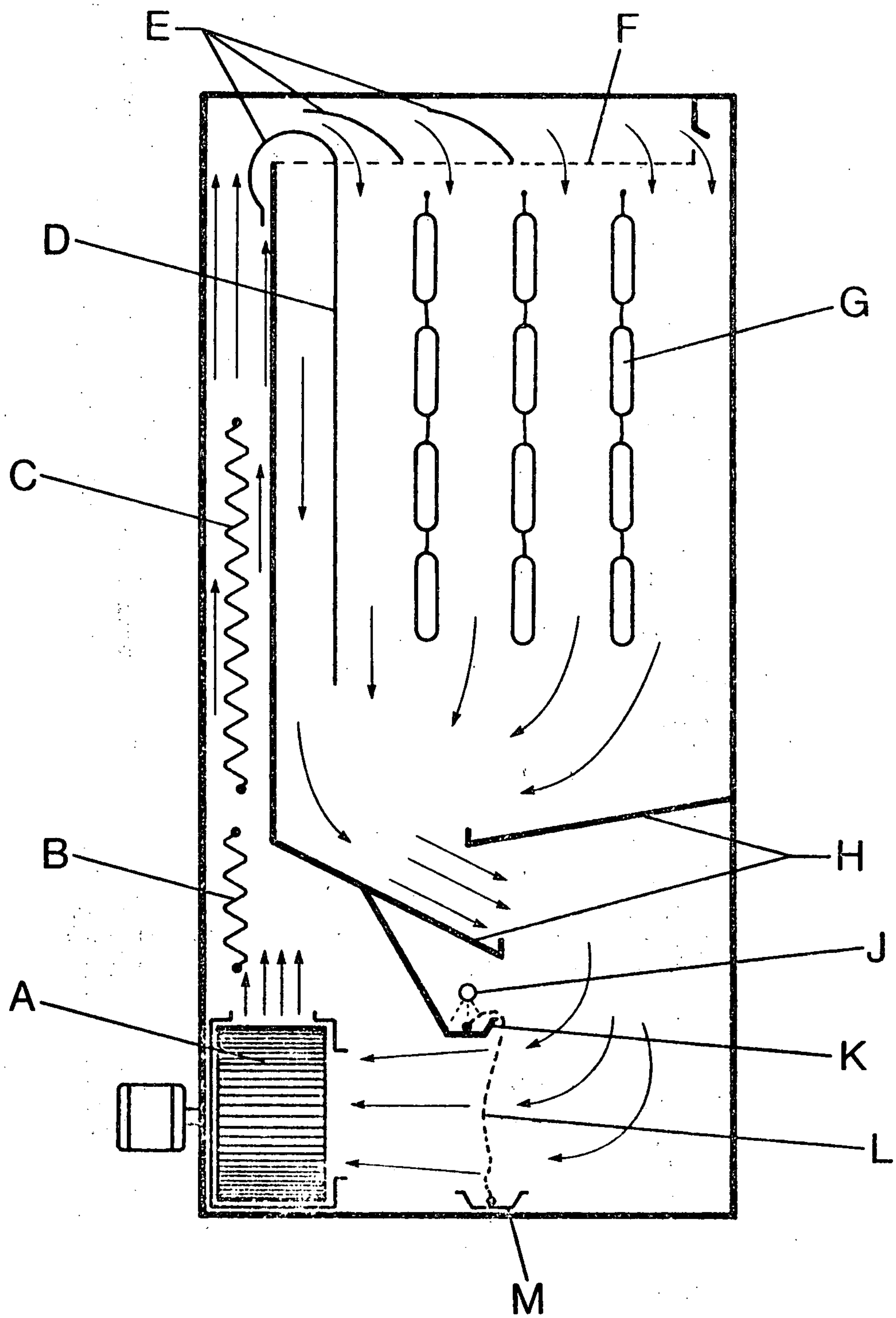

Figure 3. Schematic view of duct and equipment. A. Air blower; B. 500 watts heater; C. 1,000 watts heater; D. Heat radiation shield; E. Air distribution vanes; F. Perforated diffuser; G. Product; H. Drip trays; J. Water supply line; K. Feed water trough; L. Humidifier cloth; M. Water over flow.

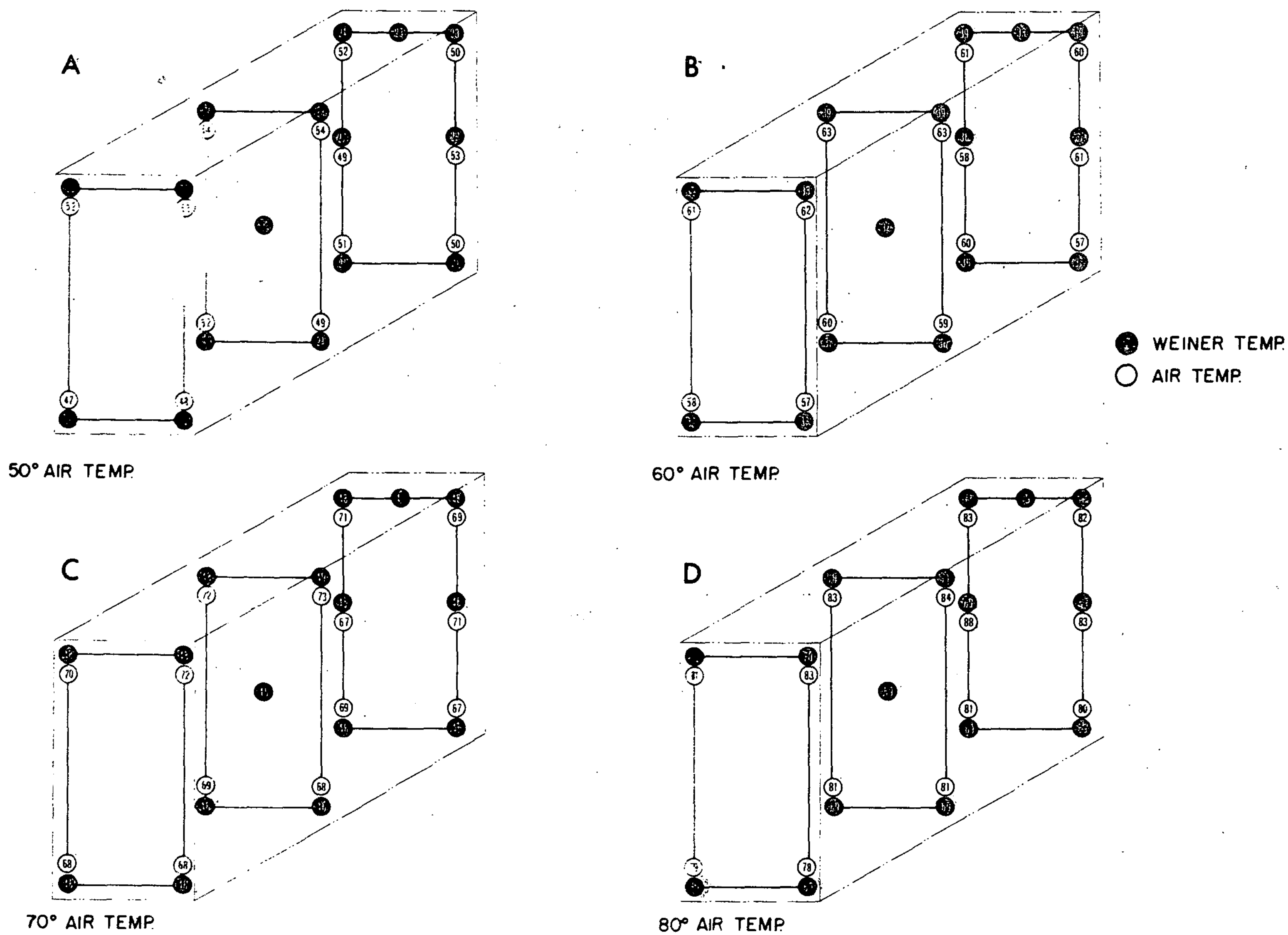

Figure 4: Air and wiener temperature distribution.

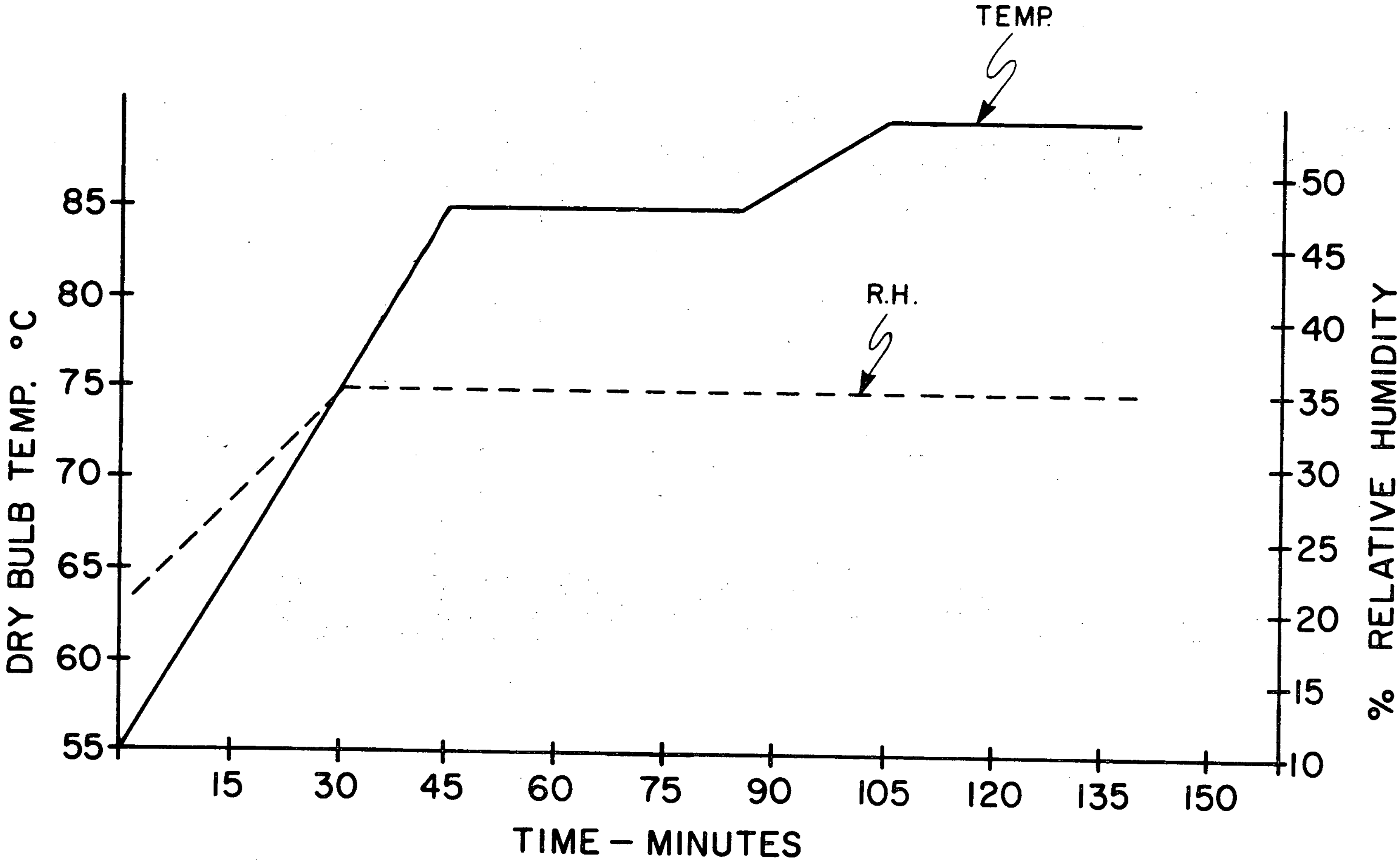

Figure 5. Sample program - temperature/humidity.