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AN ADAPTABLE TEMPERATURE CONTROLLED CABINET

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Control of soil temperature is required in many biological studies involving growing plants or organisms associated with them. Controlled environment cabinets can be used but are expensive and therefore simpler, inexpensive alternatives have been designed. The Cornell Temperature Tanks (Ferris *et al.*, 1955) use converted milk coolers to cool water in which glazed pots, containing soil and plants, are immersed. Several other variations of water baths have been described (Kijne and Jacob, 1963; Harrison *et al.*, 1965; Steele, 1967). Although a water medium allows control of temperature within well defined limits, the use of circulating air is generally simpler and provides more flexible usage. Earley and Cartter (1945) designed a box structure incorporating a thermostatically controlled air-heating and cooling system in which were placed solution bottles and gravel culture jars containing the soybean plants they were studying. Fassuliotis (1962) used a converted soft drink dispensing machine to provide the cooling unit in a simple box in which air circulated around suspended plant pots. Lownsbery and Mitchell (1965) used a similar system but with a domestic air conditioner to provide cooled air.

Controlled temperature cabinets designed and constructed at the Scottish Horticultural Research Institute recirculate cooled or heated air within the body of the cabinet; a flexible arrangement of top covers allows a variety of different size soil containers to be used. The following description refers to stock commercial items

from which the cabinet were constructed; the size can be varied but must be related to the capacity of the refrigeration compressor.

Components and Construction

The cabinet consists essentially of a wooden box in which cooled or heated air is circulated around plant pots or other containers suspended from the removable lid (Figs. 1 and 2). A box structure attached to the end of the cabinet houses cooling coils and heating elements, and air is circulated by means of four electric fans. The refrigeration compressor is located outside where the ambient temperature is lower than in the glasshouse in which the cabinets are situated.

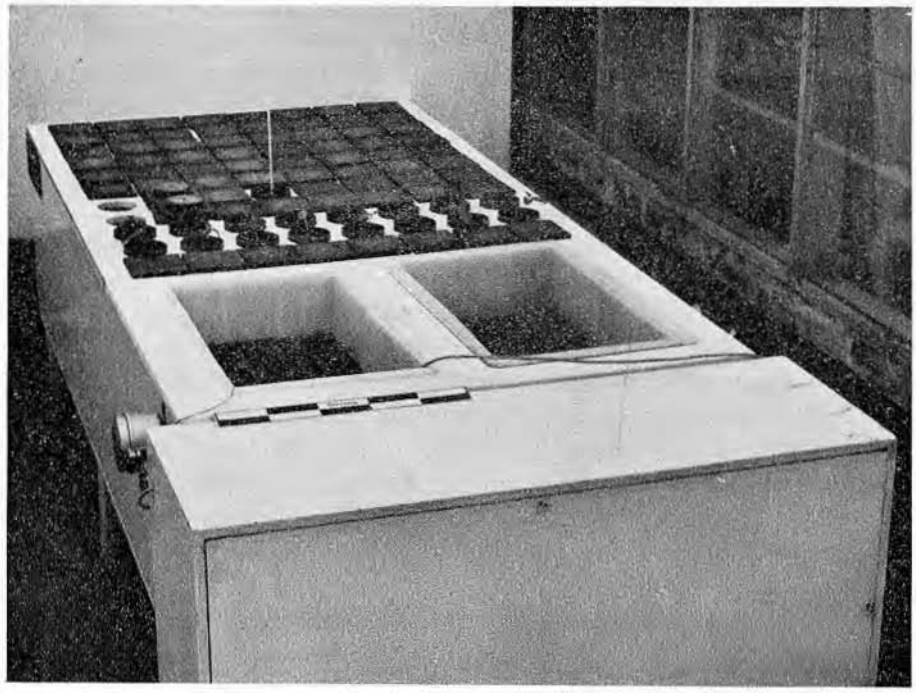

Fig. 1 - View of the controlled temperature cabinet installed in a glasshouse showing the removable top holding two glass-covered, plastic boxes; 10 cm plastic plant pots, and wooden blanking-off pieces.

The cabinet is constructed of 18 mm thick plywood, preferably of the 'marine' type, and is lined on all inner surfaces with an insulation lagging of 25 mm thick polystyrene. The plant chamber is 244 cm long, 122 cm wide and 71 cm high, and rests on six supports, 20 cm high, to raise the unit to a convenient working height. The efficiency of air circulation is increased by a horizontal partition which is also inclined to drain off any excess water from the pots. The box attached to the end of the plant chamber to house heating and cooling elements measures 135 cm wide, 46 cm deep and 71 cm high. Four tungsten filament electric light bulbs are fitted in the bottom of the box as heating elements; the size and

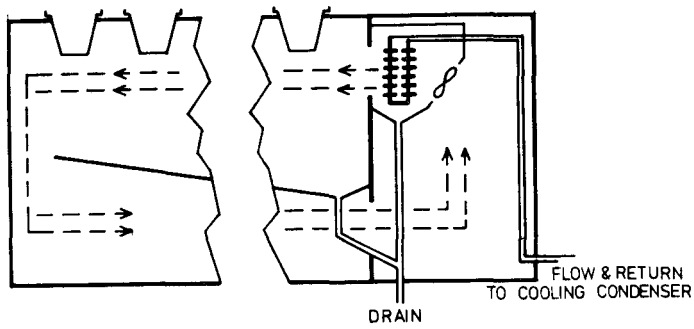

Fig. 2 - Diagram shohing the general layout of the cabinet in vertical section.

number of bulbs can be varied to meet particular temperature requirements. Cooling is by four 7 watt electric fans (14 cm diameter) running continuously at 3,380 rpm and blowing the recirculated air through a Searle Bush blow down coil (model SU 28, Searle Manufacturing Co. Ltd., Farnham, England) and which has an extraction rate of 832 or 1,249 watts (2,840 or 4,260 BTU's) per hour at evaporation temperature differences of 5.5° and 8° C respectively. Refrigeration is supplied by a Prestcold Sterne compressor (model TH 90, Prestcold Ltd., Reading, England), the ¾ horsepower motor having an extraction rate per hour of 1,319 watts (4,500 BTU's) when operating at a maximum ambient temperature of 32° C.

A Ronald Trist-Sauter capillary tube thermostat (model TVB 1, Ronald Trist Controls Ltd., Slough, England), with an operating range of 0-50° C and a switching differential of 1.5-10° C is used to regulate the required temperature. This thermostat is supplied with

a changeover mercury-tube switch with a mid-off setting which will allow temperature control of the heating phase across one set of contacts, the mid-off position where neither cooling nor heating systems are operating, and temperature control of the cooling phase across another set of contacts. The sensor of the thermostat is placed in one of the pots containing saturated sand or soil; the same pot can be used to house the sensor of a recording thermograph.

The removable plywood top of the plant chamber has the required number and size holes cut in it to accommodate the soil receptacles; it is reinforced with wooden strips across the width to support the weight of the receptacles. Plastic pots of 20, 12.5, or 10 cm diameter can be used; the raised edge of the pots ensures a tight fit in the holes and holds each at a standard height above the surface. Wooden blanking off pieces are used to prevent circulating air from escaping through holes not in use. Plastic stacking boxes (70 x 40 x 20 cm) with a sheet of plate glass to seal the top can be used as an enclosed, temperature controlled growth chamber; a 10 cm deep layer of sterile sand is placed in each box and in it are embedded plastic pots (25 ml capacity) containing soil and plants.

Because of their simplicity and easy adaptability the temperature controlled cabinets can be constructed to suit most requirements. In glasshouses in which the air temperature varied during the year between 15° and 35° C, it was possible to maintain soil temperatures in the temperature controlled cabinets at 10°±1°C. Automatic or capillary type watering systems can readily be adapted for use with them and various lighting systems can be installed above the cabinet top to provide supplementary or extended day lighting.

We thank Mr J. Couttie and his staff for technical suggestions and for skilfully constructing the cabinets.

SUMMARY

The construction of a simple, wooden cabinet is described with a removable top in which plant pots or other soil containers can be suspended into heated or cooled air circulating within the body of the cabinet. Cooling is effected by standard refrigeration equipment and heating by tungsten electric light bulbs.

RIASSUNTO

Un cassone condizionato a temperatura regolabile.

È descritto un cassone di legno con coperchio removibile in cui è possibile sospendere vasi o altri contenitori di terreno in aria condizionata. Il freddo è prodotto da un sistema refrigerante e il caldo da lampade elettriche al tungsteno.

RÉSUMÉ

Une chambre climatisée à température réglable.

Un simple coffre en bois au toit amovible et perforé, dans lequel on peut suspendre des pots ou autres récipients contenants de la terre, en air climatisé, est décrit. Le refroidissement utilise un système de réfrigération et le chauffage se fait grâce à des ampoules électriques au tungstène.

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