WHAT IS AUTOMATIC ENVIRONMENTAL CONTROL?

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The automatic temperature control system started with an idea by "a typical grower" that the same device that maintains correct temperatures in his living room should be just the answer for controlling the environment of his greenhouse.

After discovering that automatic controls can save labor and fuel while improving the quality of crops, growers soon began demanding thermostats more suitable to greenhouse use. Honeywell designed them -- improving switching action, providing more suitable temperature ranges, introducing corrosion-resistant parts and providing proper sensitivity for this specialized application. Meanwhile, research and field tests were launched to help further improve the temperature, humidity and ventilation conditions in the typical greenhouse.

From these studies a fully automatic, basic design has "grown". It is designed so portions of it may be installed now and additional features added later. It will pay for itself in two to five years.

The complete greenhouse system includes:

1. Automatic temperature control through (a) modulating control of heating valves in sequence and (b) automatic ventilation.
2. Automatic dehumdification with (a) a humidity controller that can take over control of ventilators on a humidity increase and (b) maintenance of proper space temperature by simultaneous thermostatic control of valves as needed.
3. Automatic operation of humidifying equipment as needed.
4. Automatic resetting of thermostat settings according to light intensity as detected by a photo tube.

A conventional parallel steam pipe system can be successfully operated with two-position control equipment. However, the greater simplicity and flexibility of modulating controls appealed to growers and they soon began connecting the ends of the parallel pipes into a "trombone system." Modulating valves were added to permit continuous all-weather stem flow.

This was usually cheaper than installing the two-position equipment needed to give equal results. Moreover, it permitted the later addition of other devices needed to give a completely controlled greenhouse environment.

In a typical modulating system the automatic valves permit all pipes to be filled when the valve is wide open. For milder weather the number of steam-carrying pipes is automatically reduced as required. (Fig. 1). The use of multi-stage valves permits greater flexibility -- such as independent control of wall or bench coils -- giving even more precise temperature regulation. (Figs. 2 and 3).

Further improvements followed, including a four-zone arrangement in which each zone within the greenhouse is equipped with its own thermostat. To this system was next added a remote-setting switch so temperatures in each zone could be changed from one location.

This provided a basic heating control system.

Automatic Ventilation

Then growers began asking for automatic regulation of ventilators. Four years ago Honeywell launched a project in which the ventilation control system was connected to the

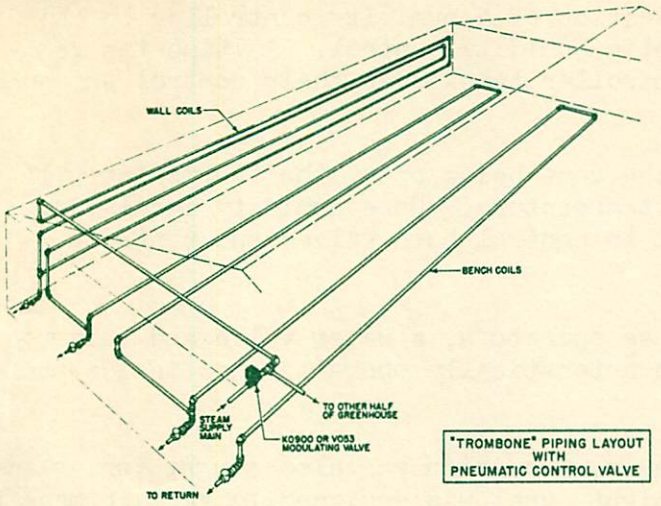

Figure I

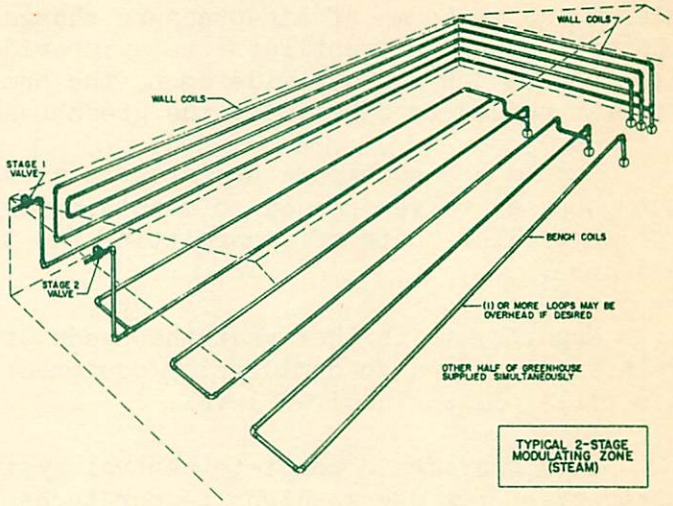

Figure II

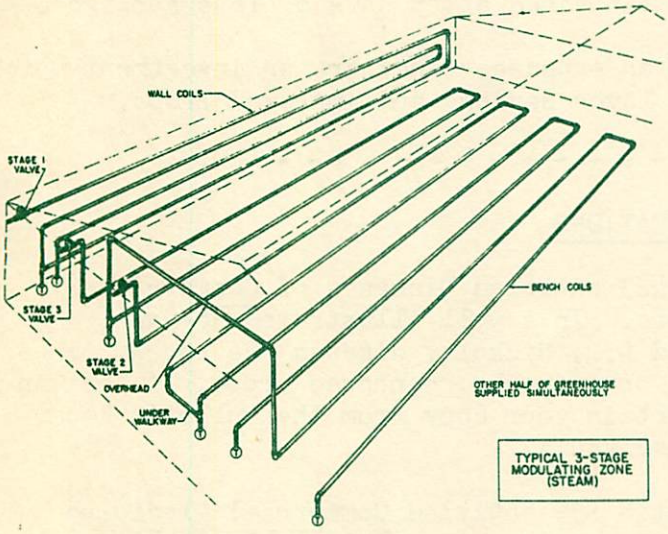

Figure III

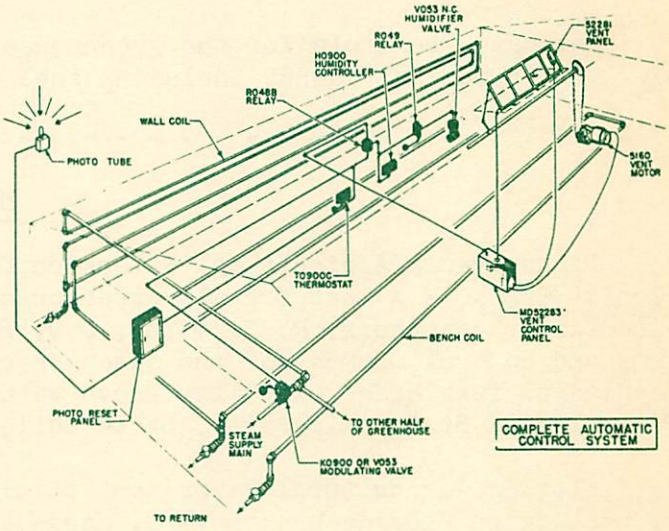

Figure IV

same thermostat control line that operates the heating valves. Adjustment of the ventilators was then made automatically, according to changes in temperature which are detected by the thermostat in terms of air-pressure change. The addition of a humidity controller to the master temperature-ventilator relay provided automatic humidity control. Anytime the ventilators are not already wide open, the humidity controller takes over their control and opens them as needed to dehumidify the greenhouse.

Should space temperature drop as a result of the vent being open, the thermostat will then turn on valves needed to maintain the desired temperature. Once humidity levels drop, the controller shuts off, permitting the thermostat to control both valves and vents in sequence.

However, to further meet the needs of greenhouse operators, a water valve and valve relays were added so humidifying equipment could be automatically operated when inside humidity falls below a desired level.

This provides a complete control system. However, provision was also sought for gradual changeover from day to night temperatures. A day-night panel was designed to replace manual switching.

At a predetermined time in the morning the thermostat temperature setting starts to climb, and at a predetermined time in the evening begins to drop. A five-hour range of adjustment for either day or night operation is provided and manual controls permit changes in the operation when cloudy days make lower temperatures necessary.

To this was finally added a photo panel on which a tiny light change -- too slight to be noticed by the human eye -- is measured and converted by a standard photo tube into an electronic signal.

It is amplified by an electronic tube to operate a relay which positions a reset motor to give a change in air pressure proportional to the small light change. (Fig. 4). A reset dial is also provided so higher night-time temperatures may be had following days of high light intensity and lower night-time temperatures maintained after days of less sunlight.

Automatic controls for the greenhouse are not an expense. They are an investment which pays off in many dividends including fuel savings, lavor savings and improved crops.