

2. Turning steam on and off on time intervals proportioned to the needs for heating.
3. Varying the absolute pressure of steam in the system.

The usual zone controlling device is arranged to sense the effect of sun, wind, or rain, as well as the outdoor local zone temperature, and in some instances, is fitted with additional elements sensing the indoor zone or zone radiator temperatures. It functions to regulate the rate of flow or the flow impulse as required to maintain the desired indoor zone temperature condition. A switch panel containing manual switches arranged to raise or lower the operating point of each zone controller is frequently mounted at a selected location. These panels may contain time switches for automatic cycling of day-night or other predetermined control programs. In buildings where some zones or all zones have no night occupancy, provisions may be made to index the control system to maintain predetermined low economy temperatures during the unoccupied periods, a short morning warm-up period, and normal operation throughout the occupied period, by either manual operation or automatic cycling by time switch. For hot water heating systems, the zone controller functions to regulate the water temperature in accordance with the prevailing outdoor temperature.

For discussion of zoning in air conditioned buildings see section on Zoning in Chapter 21.

CONTROL OF UNIT SYSTEMS

Because of the usual segregated location of unit equipment throughout a building and its consequent lack of competent supervision, complete automatic control is essential to its satisfactory operation.

Unit Heaters

In its simplest form, unit heater control consists of a room thermostat to start the unit heater motor when heat is required and shut it off when the demand is satisfied. With this limited control, it is possible in some instances that, with no steam available at the heater, the operation of the fan would cause objectionable drafts. To avoid this, limit controls are available which will prevent the operation of the fan at the command of the room thermostat except when steam is available, as determined by the temperature of the steam or return pipe or the pressure of the steam supply.

Where several unit heaters serve a limited area, they may be grouped for purposes of automatic control, and several heaters placed in operation at the command of one thermostat. By properly grouping the units which will operate together, the benefit of zone control can often be obtained with a minimum of control equipment. Where such group operation is utilized, the thermostat and limit control usually function through a relay, as the combined load of the several motors may exceed the current capacity of the thermostatic control device.

In some cases where cold drafts will not result, it is desirable to operate the unit heaters continuously for circulation of air. In such instances the room thermostat regulates the supply of steam to the unit through a control valve in the steam supply line and the unit heater motor operation is manually controlled.

Unit heaters equipped with dampers arranged for by-passing air around the heating coils are controlled by room thermostats operating modulating damper motors attached to these dampers so that as the temperatures rise, a decreasing amount of air is heated. When the by-pass is wide open the heating effect is so much reduced that control of the steam supplied to the coil is not generally important. If valve control is added, the throttling of the steam may be concurrent with, or subsequent to, the opening of the by-pass.

Cooling Units

The recommended form of temperature control for a cooling unit contemplates the continuous operation of the fan, with automatic regulation of the compressor or cooling coil, or both, as determined by a thermostat in the room, or in the return air to the cooling unit. Such operation insures continuous circulation of air in the room, and in addition to providing the cooling effect of moving air, overcomes the tendency of the air to stratify. As the temperature begins to rise, the controller opens the valve to a cold water cooling coil, or for direct expansion coils, opens a valve in the refrigerant line, closes a by-pass around the coil or starts a compressor.

Cooling units may also be controlled by arranging the room thermostats to start and stop the fan motors or by a combination of motor and refrigerant control.

Unit Ventilators

There are various types of unit ventilators available but in general all types are designed to draw air from the outside or to mix outside and recirculated air, heat it and introduce it into the room under control of a thermostat.

The design of unit ventilators has to an extent been based on the requirements for automatic temperature control and the cycles of control have been developed to include other heating devices in the rooms with unit ventilators. Unit ventilators are frequently used in schools and other types of buildings where states have laws or regulations governing the minimum amount of ventilation to be provided. The control of the amount of outdoor air is designed to conform to the various laws. Usually the device circulates a constant amount of air and the amount automatically taken in from outdoors is controlled in one of these ways:

1. Full recirculation until the room temperature reaches a certain point, generally two degrees, below the desired room temperature; then a minimum amount of outdoor air for ventilation while the temperature is maintained by throttling steam; and if the room temperature rises with all steam shut off, the gradual increase in amount of outdoor air up to 100 per cent.
2. Full recirculation until the room reaches a set point below room temperature, after which all air is taken from outside.
3. Gravity recirculation while the fan motor is not running, with full outside air as soon as the fan starts, obtained by a relay in the motor circuit.
4. Full recirculation or all outdoor air as determined by a manual switch which can be operated at any time whether or not the fan is running. All the unit ventilators in a single building may be operated by one or many switches.

With arrangements 1 or 2, it is desirable to include a relay to prevent the intake dampers from opening while the fan is not running, regardless of room temperatures. With a dual system of control this is essential to