Heating Cycle

Similar fan systems are used for heating, as well as for ventilating occupied spaces, by increasing the number of coils to four or five. Where they are all installed together the control remains the same as shown in Fig. 2, and the additional coils are controlled directly from a room thermostat which also causes T_2 to turn on full heat while the room is cool, but to function as described previously while the room is warm. This facilitates rapid heating of the room, after a vacant period.

An alternate plan is the use of a fan discharge thermostat whose control point can be automatically varied, and a room thermostat to reset it. Thus when the room is cold, air is delivered at a maximum temperature designed for rapid heating, and when the room is too warm, the air is kept as cool as can be safely introduced, or as the weather permits. The discharge temperature varies between these two extremes at the command of the room thermostat, until it finds the proper point for the existing conditions. This makes it unnecessary to vary the fan discharge thermostat manually to prevent overheating in moderate weather, or chilling in cold weather.

The heating coils are often separated into two groups, one at the suction side of the fan, controlled as shown in Fig. 2, and the other on the down stream side of T_2, controlled from the room. Control T_2 is then called the *tempered air* thermostat.

In all types of fan heating systems it is desirable to have the tempered air thermostat in the fan discharge where stratification has been broken up by the fan.

Where a fan system supplies heat to several rooms or zones that require separate treatment, the tempered air control can remain as in Fig. 2, and the variation can be supplied in any of the following ways:

1. By installing a separate duct to each zone, and using individual heating coils, each under control of its respective room thermostat.

2. By installing double chambers at the fan discharge, only one of which is supplied with additional heating coils. Individual room or zone ducts have mixing dampers which allow air to be taken from the warm air chamber, the tempered air chamber, or both, as demanded by their respective room thermostats. With this arrangement, precautions must be taken to prevent the warm air from being churned back and into the tempered air while a number of the mixing dampers are calling for the latter. If the warm air is controlled at a constant temperature under all conditions, the coils should be placed not less than 8 ft from the fan discharge and the dividing plate extended back several feet toward the fan. A good solution for the problem is to use an automatically adjusted thermostat in the warm air chamber, controlled by an outdoor thermostat so as to carry maximum warm air temperatures in the coldest weather and minimum in moderate weather.

3. By using a trunk duct, and varying the amounts of air delivered, by dampers at individual outlets or for the various zones. If a minimum amount of air is required for ventilation, the dampers must not close entirely. Thus to prevent over-heating, the trunk duct temperature must be varied according to the weather, as previously described. Also static pressure control may be needed. See a subsequent sub-head for a more detailed discussion of this subject.

Case 1 is illustrated in Fig. 3. Thermostat T in the fan discharge controls outside and return air through damper motors D_1 and D_2, face and by-pass dampers through damper motor D_3 and the steam supply to a heating coil through valve V_1. By having the face damper closed, and

the by-pass open, before steam is throttled, there can be no danger of freezing the coil. Thus the D_3 operation is completed before V_1 starts. However, the relationship between D_1 and D_2 controlling the amount of recirculation, and D_3 regulating the amount of steam heat added, depends on the design of the ventilation system. If the maximum amount of outside air is desired for ventilation, and return air is used only when insufficient steam is available, D_1 and D_2 operate to bring in all outside air before D_3 starts. On the other hand if greatest heating economy is desired and full outside air is to be used only to prevent overheating, D_3 completes its motion to close the face damper, before D_1 and D_2 start. Any relationship can be attained between these two extremes. Relay R prevents T from closing the outside damper completely, when a minimum of outdoor air is required during operation. Valves V_2 and V_3 control the steam supplied to booster coils for two zones, in accordance with the

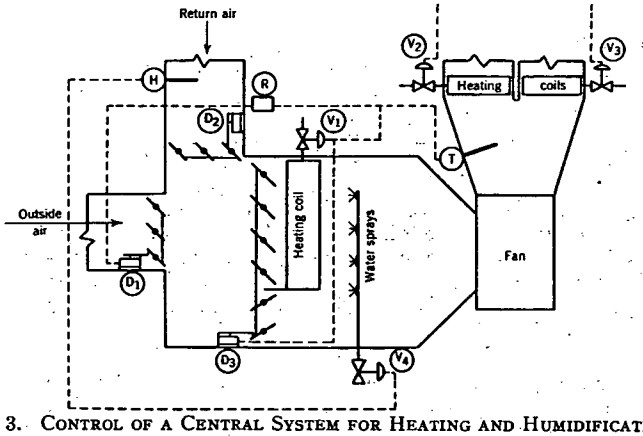

FIG. 3. CONTROL OF A CENTRAL SYSTEM FOR HEATING AND HUMIDIFICATION

requirements of room type zone thermostats, not shown in the diagram. Humidistat H, in the return air, regulates the amount of water supplied through V_4 to the spray heads.

Humidification

Humidification with air washers has been mentioned in connection with control of ventilating systems. Where ample room air change is provided, it is generally assumed that the dew-point of the conditioned space will soon equal that of the delivered air. This is due to exterior walls, especially glass, being less pervious to vapor flow than to heat transmission. With partial recirculation, dew-point control prevents over- as well as under-humidification, for ordinary installations.

Where air washers are not used, humidification may be accomplished by water sprays, preferably with heated water; by steam heated water in pans; or by steam jets, if their odors are not objectionable. Sub-atmospheric steam cannot be used, of course, for jets, and is not of much more value in coil heated pans. In all these cases the control is obtained by