and humidity. Except in very warm climates, heating or tempering coils are required to warm the entering outdoor air to a temperature above freezing, the heat being supplied by means of hot water or steam. Cooling coils provide the necessary sensible cooling and dehumidification. The coils may be chilled by direct expansion of an approved refrigerant within the tubes, or by a pump-circulated liquid such as water or brine. A water-tight drainage tank must be installed under the cooling coil and should extend for a distance toward the fan.

Reheater coils utilizing steam or hot water reheat the air in warm weather for control purposes or bring the air to its final temperature in cold weather. For humidification in dry weather, water sprays are used either separately

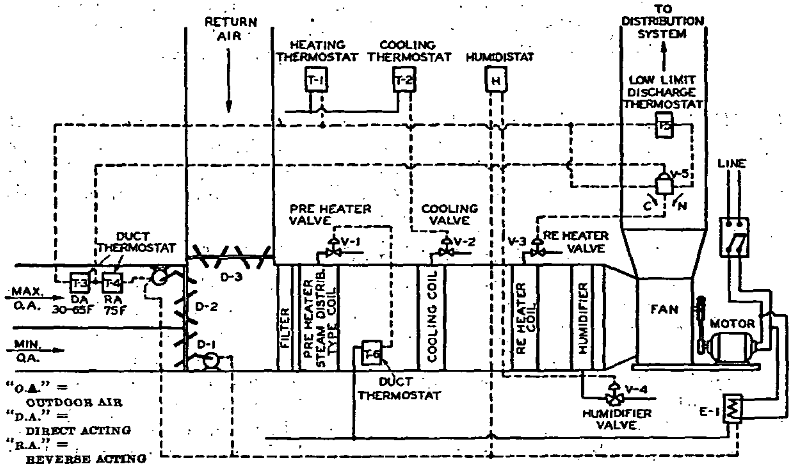

Fig. 1. Typical Year-Round Central System

as shown or combined with the cooling coils having the spray nozzles directed against the coil surfaces. The spray water may be circulated by a small pump from the water tank under the spray chamber.

The general requirements for the control of the various components of the central station apparatus are covered in Chapter 39. The functioning of a typical set of controls as illustrated in Fig. 1 is as follows:

Whenever the fan is started, solenoid air valve or relay E-1, actuated by the fan motor starter, opens minimum outdoor-air damper D-1, places humidistat H in service, and allows duct thermostats T-3 and T-4 to control the maximum outdoor-air damper D-2 and the return-air damper D-3.

When the fans stop, E-1 is de-energized to close the outdoor-air dampers and also to close humidifier valve V-4.

Thermostat T-1 positions steam valve V-3, on the reheater coil, to maintain a constant space temperature. As the space temperature rises, T-1 positions reheater valve V-3 to a closed or to a minimum open position, as determined by low limit discharge thermostat T-5. Duct thermostat T-6, in the preheater discharge, positions preheater coil valve V-1 to maintain a constant preheater discharge temperature.

On rising outdoor temperature, between 30 F and 65 F, duct thermostat T-3 located in the outdoor-air intake, moves maximum outdoor-air damper D-2 toward the open position provided that T-1 is satisfied. At 65 F outdoor, D-2 will be fully open and return-air damper D-3 will be fully closed.

As the outdoor-air temperature rises above 65 F, duct thermostat T-3 positions V-5 in such a way as to by-pass low limit thermostat T-5, so that reheater coil valve

V-3 is operated directly from thermostat T-1. As outdoor-air temperature rises from 65 F to 75 F, duct thermostat T-4 gradually closes maximum outdoor-air damper D-2 and opens return-air damper D-3.

Cooling thermostat T-2 positions cooling coil valve V-2 to admit more chilled water as the space temperature rises.

Humidistat H positions humidifier valve V-4 to maintain the desired humidity in the conditioned space.

ZONING AND ZONE CONTROL

It is apparent that while an apparatus like that of Fig. 1 would be very desirable for any single room, since in that case the air could be delivered at optimum conditions, the cost of a complete individual system for each room and the space required for the equipment generally would be prohibitive. Economy is favored if the varying requirements of numerous rooms or zones can be simultaneously satisfied by air from a single central supply system.

Various methods are practicable for controlling the temperature, humidity and air movement in various rooms or zones. A measure of control is attainable merely by proportioning the flow of air to each room, though usually such control by throttling dampers is difficult to maintain and should be avoided when possible.

Another scheme is to install a properly proportioned coil in the branch air supply duct serving each room or zone to warm the air to suit the occupants. For example, the air leaving the fan that serves several zones may be cooled, before entering the fan, to the condition favorable for one zone, and the air for each other zone may be reheated by the branch duct coil to the required temperature. It is also possible to circulate a heat absorbing medium in the branch duct coils to reduce the temperature of the air passing to rooms that would be overheated if they received air at the condition leaving the central air supply system. When heat transfer devices are placed in branch ducts for improved temperature control, mechanically circulated water gives excellent results as a heat carrier. The water usually is warmer than the air but it is possible to use water colder than the air.

It is practicable also to use single central air conditioning equipment similar to that shown in Fig. 1, in conjunction with several fans, one for each room or zone. In such cases there may be a separate reheater on the suction side of each relatively small supply fan.

The designer must remember that the various supply fans will compete with each other for air, against the resistance interposed by the filters, coils, etc., that are used in common under such circumstances, and consequently, unless the fans are of backward-curved blade, non-overloading type, they may alternate in carrying more than their share of the air, and thereby cause the air distribution to be chaotic and unsatisfactory.

Another method of controlling temperature in various rooms served by a central air supply system is shown in the sectional elevation, Fig. 2. The supply fan is placed immediately after the humidifier. When cooling the air in hot weather, the humidifier is not operated. The fan will deliver the air through the heating coil and through the cooling coil to the two air pressure chambers A and B at the right of these coils. From these chambers many separate ducts, one of which is shown, each with a double-blade mixing damper, may convey the air to the various rooms. The mixing dampers, one of which is shown, are interlocked so that as the upper one closes, the lower one opens; selecting between them, air in the required quantity from either the warmer chamber A or the cooler one B.