used it is good practice to have a valve on the coil which closes after the face damper is closed to prevent overheating due to radiation from the coil or to damper leakage. When used for space heating, reheat coils are controlled by valves or face and bypass dampers actuated by a thermostat in the space or the return air. Usually a low-limit discharge thermostat is used in conjunction with the space or return-air thermostat to maintain the delivered air temperature above the design minimum. To avoid the lag associated with room or return-air control of the reheat coil, it often is preferable to use a controller in the fan discharge which is compensated by space temperature.

Humidity Controls

Steam-pan or grid type humidifiers usually are controlled by a valve actuated by a proportional room or return air humidistat or wet-bulb thermostat. The valve should close when the fan stops.

Single-bank sprays, when used primarily for humidification, are usually controlled by a two-position room or return-air humidistat or a wet-bulb thermostat operating a valve in the water line or starting and stopping the pump. Air washers should be run continuously and are usually controlled by varying the temperature of the washer water or the air entering the spray chamber. An apparatus dew-point thermostat with its measuring element located in the air washer water, or in the outlet of the washer beyond the eliminator plates, may be used to (1) operate a mixing valve, or a steam valve on the water heater, to control the washer water temperature; (2) control a valve on the tempering coil ahead of the washer; (3) operate outdoor-air and return-air dampers to control the mixed air temperature entering the washer; or (4) operate a combination of these arrangements.

Cooling and Dehumidification Controls

Dehumidification by condensation is so closely related to sensible cooling that it is convenient to discuss them together. Three typical applications of controls are discussed.

Direct Expansion Systems. A thermostat measuring the space temperature may be used to open and close a solenoid refrigerant valve on the coil inlet; control the starting and stopping of one or more refrigerating compressors, or otherwise control the compressor capacity; position face and bypass dampers, or a return-air bypass damper, in combination with the opening and closing of the refrigerant coil valve or the starting and stopping of the compressor; control a back pressure regulating valve with proportional action; or control a liquid-refrigerant valve on the inlet to the coil with proportional action. The positive opening and closing of the refrigerant valve or the starting and stopping of the refrigeration compressor will result in wide variations in discharge temperature and dehumidification. When such variations are objectionable, it is desirable to employ proportional damper controls or proportional control of refrigerant flow in conjunction with refrigeration equipment capacity controls as discussed in Chapter 36.

Chilled Water and Brine Coils. A thermostat measuring the space temperature may be used to control a valve on the inlet or outlet of the cooling coil; control a three-way mixing valve; position face and bypass dampers at the coil; or position a return-air bypass damper. An apparatus dew-point thermostat may also be used to control the cooling coil valve.

Air Washers. Since the air leaving an efficient washer is practically saturated, the temperature of the spray water will determine the dew-point temperature of the air leaving the washer. With this condition it is possible to maintain very accurate dew-point temperatures and consequently accurate relative humidities under a given ratio of sensible-to-latent heat gain in the conditioned space, provided the space dry-bulb temperature is accurately controlled. In general, the water pump operates continuously and a thermostat measuring the dew-point temperature is used to position a three-way valve to mix refrigerated water with bypassed washer water. To compensate for variations in latent load, a humidistat measuring the space relative humidity may be employed as a master controller to readjust the set point of a dew-point submaster controller.

Static Pressure Control

Since fans are selected to produce the desired results for a certain system characteristic, any change in the system characteristic will change the output of the fan. Such changes occur, for example, on single-duct systems in which the volume of air delivered is varied and in double-duct systems where quantities of air are shifted from one duct to the other to obtain final space control. System characteristics may also change when the relative quantities of outdoor air and recirculated air are varied, when exhaust fans are run intermittently, and for other reasons. Such changes result in a changing static pressure in the system, a changing noise level, and changing velocities at air outlets which upset the air flow patterns.

Static pressure control of some form is usually required on such systems, and it is accomplished by a static pressure controller measuring the pressure at a selected point in the system with respect to an atmospheric reference point or some other point inside the building. It can be used to actuate a damper operator on fan inlet vanes, on a multi-blade damper on the suction or discharge side of the fan, or on a damper in a bypass connection between the fan discharge and the fan suction.

Control of Final Space Conditions

It is sometimes satisfactory to control the entire area or zone served by a central fan system from a single point as described in previous sections relating to reheat coils, humidifiers and to cooling and dehumidification. The factors to be considered in properly zoning the building are discussed in the section on zone control. Where the entire area does not meet the requirements of a single zone, it may be subdivided so that the air distribution system can be arranged for individual control of each smaller area. This may be accomplished by a thermostat in each space operating warm- and cold-air mixing dampers in the duct serving the space, or operating valves on individual reheat or cooling coils for each space. By providing a sufficient number of subdivisions of the area served by a central fan system, individual room control can be achieved.

Control of a Typical System

Fig. 9 shows a complete control arrangement for a typical central-fan air conditioning system in which individual room control is not provided. The controls can be pneumatic, electric, or electronic.

When the fan is started relay E-1, actuated by the fan-motor starter, opens outdoor-air damper D-1, places humidistat H in service, and allows insertion thermostat T-1 to operate preheat coil valve V-1, maximum-outdoor-air damper D-2, return-air damper D-3 and exhaust damper D-4. When the fan stops, E-1 is de-energized and closes the outdoor-air dampers and humidifier valve V-4.

The sequence of operation described will in general also apply to high-pressure fan systems except that it is considered desirable to open the outdoor-air damper before starting the fan. With this arrangement, a manual switch operates damper D-1. An auxiliary switch mounted on the damper starts the fan when the damper is *fully* open. It also stops the fan when the damper *starts* to close.

Insertion thermostat T-1 maintains a temperature of 55 F at the preheat coil discharge by operating preheat coil valve V-1. This serves as a low limit for the fan discharge temperature during heating operation. When V-1 is closed, thermostat T-1 then gradually opens maximum-outdoor-air damper D-2 and closes return-air damper D-3 proportionately. At 55 F outdoor temperature D-2 is wide open and D-3 is closed. Exhaust air damper D-4 opens and closes in synchronization with