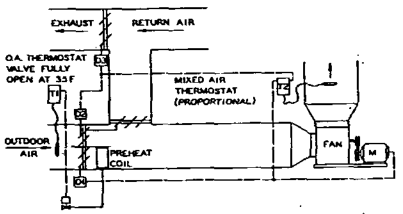

Fig. 14 .... Control of Preheat Coil From Outdoor Air With Damper Control From Mixed Air

overheating problem outlined for Fig. 13. Here a mixed-air thermostat operates an outdoor-air bypass damper in conjunction with the exhaust- and return-air dampers. The use of bypassed outdoor air makes it possible to control the mixed-air temperature without endangering the preheat coil. A minimum quantity of outdoor air is assured by use of a two-position face damper on the coil.

Steam-distributing type coils can be controlled by a proportional-type thermostat set for 55 F or higher and located downstream from the coil to operate a valve in the steam supply line. Where a temperature rise of more than 30 deg is required, two or more coils in series should be used, each having a separate valve. This arrangement is shown in Fig. 15. The valves should be arranged to operate in sequence, with the valve on the upstream coil opening first.

Hot water preheat coils should be controlled by face and bypass dampers operated by a thermostat downstream from the coil, with continuous water circulation when the outdoor air is below freezing. A pressure switch to stop the fan in case of pump failure is often employed. Further freeze protection can be accomplished by a thermostat in the coil outlet arranged to stop the fan if the water temperature drops to 35 F. In all applications where face and bypass dampers are used, precautionary measures must be taken to prevent stratification of the mixture beyond the coil. One method is to locate the bypass damper above the face damper so that the cooler bypassed air will tend to drop while the warmer air through the face damper tends to rise thereby mixing the air by gravity.

Heating Coil Control

Heating coils when used for tempering air for ventilation can be controlled by a proportional type of insertion

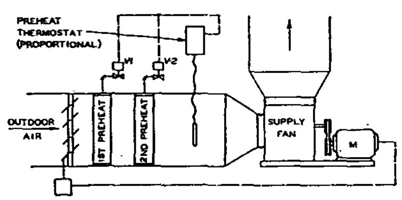

Fig. 15 .... Proportional Control of Two Preheat Coils in Sequence

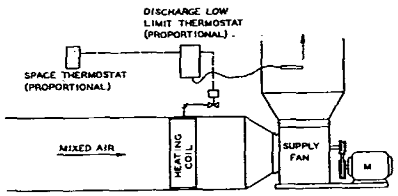

Fig. 16 .... Control of Heating Coil From Space and Discharge Air Using Valve

thermostat, preferably located in the fan discharge where the air is usually least stratified. This thermostat operates the heating coil valve or valves, or face and bypass dampers, to maintain a constant discharge air temperature. When face and bypass dampers are used it is good practice to have on the coil a valve which closes as the face damper closes to prevent overheating due to damper leakage or heat picked up by air wiping the exposed coil face.

Fig. 16 shows a typical control arrangement for a heating coil when the fan system is used for heating as well as for ventilation. Here a room or a return-air thermostat controls the heating coil valve until the space temperature is satisfied. A discharge duct thermostat then assumes control of the valve to maintain the desired minimum air discharge temperature. With this system no portion of the air entering the coil should be less than 32 F.

Fig. 17 shows an arrangement using face and bypass dampers on the heating coil and two-position control of the valve. It should be noted that without a low-limit controller the air entering temperature must be the desired minimum discharge air temperature.

Fig. 18 offers a typical water coil control application. The room or the return-air duct thermostat operates the three-way mixing valve until the space temperature is satisfied. The discharge duct thermostat then takes over the valve control to maintain the desired minimum air discharge temperature.

Cooling and Dehumidification Coil 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

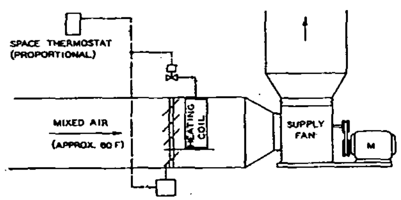

Fig. 17 .... Control of Heating Coil From Space Temperature Using Valve and Face and Bypass Dampers

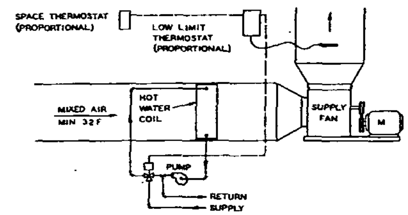

Fig. 18 .... Control of Hot Water Coil From Space and Discharge Air Using Mixing Valve

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; or control a back pressure regulating valve 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 38.

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. When cooling capacity is controlled only by a dry-bulb thermostat the amount of dehumidification will vary with the sensible cooling demand. When independent dehumidification is required it is necessary to employ some form of reheat.

Fig. 19 shows a simple arrangement where chilled water is supplied to the coil at a constant temperature and the water volume through the coil is varied. The space or return-air thermostat modulates the three-way valve to increase or decrease the volume of water through the coil. Although this arrangement provides constant flow through the chiller, it should be noted that throttling of chilled water to the coil causes higher coil temperatures with light

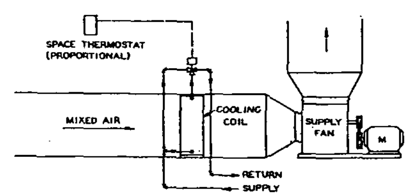

Fig. 19 .... Control of Chilled Water Coil From Space Temperature Using Mixing Valve

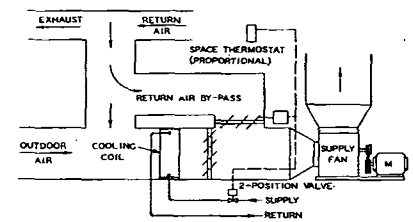

Fig. 20 .... Control of Chilled Water Coil From Space Temperature Using Return Bypass Damper and Valve

sensible cooling loads which may result in unsatisfactory humidity conditions.

Fig. 20 shows a control system using two-position control of a cold water coil valve and modulating control of a return-air bypass damper. Here the cooled air through the coil is mixed with bypassed return air to satisfy the space thermostat demands. When the return-air bypass damper is fully opened the water valve can be closed. It is often desirable to omit the valve control and instead maintain a constant flow of chilled water through the coil. This provides some dehumidification with light sensible cooling loads.

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.

Humidity Controls

Fig. 21 shows a simple method of humidity control employing a room or a return-air duct humidistat to control a valve supplying steam to an evaporator pan type humidifier. Additional control provides for closing the valve

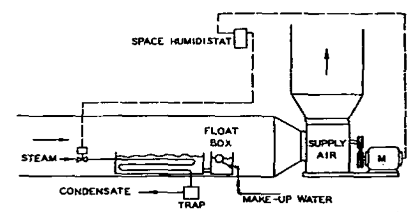

Fig. 21 .... Control of Pan Humidifier