valve to be operated directly by the water pressure in the pump discharge line. This automatically shuts off the steam when the water circulating pump is not in operation.

10. Based on the fact that the spray water in the air washer pan has practically the same temperature as the air leaving the washer, dew-point control can be accomplished by installing thermostat *E* in the water pan.

11. Where cold well-water is used for dehumidification, it is admitted to the spray through a three-way valve similar to *V* which is operated by thermostat *E*.

12. Control of steam heat is shown entirely by valves, although it is usual to install a by-pass damper around each heating unit and to operate it, either with or without a damper over the face of the heating unit, in conjunction with the valve.

PROBLEMS IN PRACTICE

1 ● How may temperature control be obtained in a room heated by a radiator with a constant steam supply?

By a thermostat handling an individual radiator valve pneumatically or electrically, or by a self-contained radiator valve.

2 ● How may temperature control be obtained in a room heated by a unit heater?

With constant steam supply, the unit heater motor may be started or stopped by a thermostat, either directly or through a relay. With intermittent steam supply, operation of the motor by thermostat can be limited to the time that steam is available, by using a reverse-acting temperature or pressure limit switch.

3 ● How may temperature control be provided in a room heated and ventilated by a unit ventilator which includes two extended-surface units?

Operation of the unit for service during occupancy of the room may be manual, by switch, or by time clock. When the desired temperature level is reached, the outside air intake may be controlled by a damper motor coupled with the fan motor circuit by means of a thermostat. The outside air damper will operate to a given position in either case.

Air passing through the unit may be preheated through the first heating coil to a definite temperature by a control valve on the steam supply governed by a temperature controller reacting to the temperature of the air on the outlet side of the convector. The second heating coil may provide the necessary heating capacity, and the steam supply to this coil may be modulated, either manually or automatically, in accordance with the temperature required in the room.

4 ● How may temperature control be obtained in a room heated by a duct system?

Air may enter the room from the central fan system at a predetermined minimum temperature. Heaters placed in the duct to bring the air up to this temperature should be equipped with face and by-pass dampers which may be adjusted by a positioning damper motor to give temperature control.

5 ● How may temperature be controlled in a room cooled by a unit cooler?

Practice indicates that a thermostat should provide for the automatic operation at all hours of the fan and control valve on the refrigeration source, but that there be a manual switch to enable the fan to operate continuously during occupancy.

6 ● How may temperature control be obtained in a room cooled by a self-contained mechanical unit?

The fan operation may be controlled by a manual switch, while a room thermostat in conjunction with a solenoid valve may regulate the flow of the refrigerant to the coil. The thermostatic circuit might be operative only when the fans are running; and the compressor might be controlled by refrigerant pressure.

7 ● How may temperature control be obtained in a room heated by an automatically-fired warm air furnace?

A room thermostat might control the combustion unit; and a limit switch in the top of the furnace unit, when at a low setting of its control might operate the fan whenever there is a rise of temperature, and when at a high setting of its control it might shut off the combustion unit. A room humidity control operating a solenoid valve on the water supply to the humidifier, or operating a relay on the recirculating pump motor to the humidifier, may be connected in parallel with the fan motor. Humidification may be supplied only when heat is supplied and when the humidity control acts in conjunction with a time switch.

8 ● How may humidity be controlled in a unit humidifier for a steam or hot water heating plant?

Since heat is required for evaporation, a temperature limit switch, preferably of the immersion type, may be placed in the heating supply riser to cause the unit to be inoperative when heat is not available. A room humidity control will operate a solenoid valve on the water supply to the sprays. Both the solenoid valve and the humidity control may be electrically wired in parallel with a fan motor, and be subject to the temperature limit switch.

9 ● Discuss a control system, including control of humidity, for the heating cycle of a central fan system of air conditioning.

During the heating cycle it is necessary to vary the amount of outdoor air drawn into the system in accordance with the temperature of that air. It is also advisable to adjust the volume of return air when mixing it with the outdoor air so that the resultant mixture will be of constant volume delivered to the preheater coils at some predetermined constant temperature.

By placing a temperature controller in the conditioner just ahead of the preheating coil, the temperature of the air delivered at that point may be measured, and by connecting this controller to a damper motor attached to the intake damper this damper can be operated by a temperature variation at the controller. The intake damper is so linked to the return damper that the combined volume of air delivered through the ducts of the system is constant. At a fall in outdoor temperature, this arrangement will move the intake damper to a closed position and the return damper to an open position, whereas the reverse will hold true when there is a rise in outdoor temperature.

If conditions prevent such mechanical linkage, it is possible to use two damper motors connected so they are operated individually but in inverse ratio.

The operation of the preheating coils should be dependent upon humidity conditions in the occupied spaces, and the humidity controller should be installed where conditions are representative of the humidity throughout the section, because air leaving the preheating coils is immediately passed through a spray where it becomes saturated with moisture. If the air is cold, it will absorb so little moisture that when it is delivered to the conditioned spaces its relative humidity will be low. When the compensated humidity control calls for additional moisture, the steam control valve in the preheater line should be opened to allow more steam to flow through the coils.

Whenever the preheating coils are being heated the spray should be in operation, but when the coils are cut off the air is sufficiently moist and the spray should be closed down. This necessitates an inter-connection between the control valve on the preheater and the spray pump on the water supply. Water is supplied to the spray during the heating cycle from a recirculating water tank beneath the sprays.

The reheating coil determines the dry-bulb temperature of the delivered air, so if the conditioner is equipped with both face and by-pass dampers on this coil it is obvious that these dampers should be controlled by a thermostat located at some representative position in the space being supplied with the conditioned air. If this thermostat is in turn connected with auxiliary apparatus which will vary the damper settings, it will be possible to pass more or less air through the reheater as the temperature falls or rises.

A low-limit temperature control might also be mounted in the discharge duct as a precaution against blowing cold air into the space. Such control would actuate the dampers of the reheater when the duct temperature fell below a predetermined minimum regardless of the demands of the master controller.