whenever the relative humidity rises above some predetermined point such as 60 per cent even though the thermostat is satisfied. This control is desirable on damp days or in conditions where the humidity load may become excessive, but its operation will result in excessive cooling unless some means of reheating is provided.

Unit Ventilators

There are various types of unit ventilators available but in general all types are designed to draw air from the outside or to mix outside and recirculated air, heat it and introduce it into the room under control of a thermostat.

In the application of control to unit ventilators the essential requirement is that the action be graduated to prevent sudden changes in the temperature of the discharged air and where direct radiation is used in conjunction with the unit that the cycle of control be so arranged that steam will be admitted to the direct radiation only when the unit is unable to carry the heating load. This arrangement prevents the unit from delivering air at low temperatures to offset the overheating effect of the direct radiation and results in the delivery of a higher percentage of tempered air.

There are two general types of control applied to unit ventilators as follows:

1. The mixing or by-pass damper type of unit is provided with a damper, equipped with a damper motor, which, under control of the thermostat, passes air through and around the heating element in such proportion as to maintain a uniform room temperature, the two streams of cold and tempered air being mixed and diffused at the ceiling. A control valve may also be used on the steam supply to the heating element of the unit and should be arranged to throttle the steam supply when the damper approaches a position to by-pass all of the air.

The outside air damper of this type of unit is usually provided with a damper motor and controlled by a remote manual switch to assume either a fully open or fully closed position.

2. The recirculating type of unit ventilator is equipped with a control valve on the steam supply to the heating element of the unit and with a damper motor on the outside air-recirculating air damper, both under the control of the room thermostat. Some units are so arranged that a mixture of outside air and recirculated air passes through the heating element and others so that only the recirculated air is heated.

The fundamental requirements of control as applied to this type of unit is that the steam supply to the direct radiation, the steam supply to the unit ventilator and the mixing of outside and recirculated air be accomplished in a definite cycle or sequence to meet the requirements of the particular unit used and differs from the mixing damper type of unit in that the percentage of outside air and recirculated air delivered by the unit is determined by room temperature. The damper motor is sometimes arranged so that a fixed minimum quantity of outside air is delivered continuously as soon as the room has reached a predetermined temperature. A limit thermostat, either in the mixing chamber or in the discharge of the unit, is sometimes used in conjunction with the room thermostat, so arranged that the action on either the control valve or the dampers, or both, is stopped when a predetermined minimum temperature has been reached in the unit discharge, to prevent delivery of air at a lower temperature.

For additional information on the control of unit ventilators when installed and operated under various types of applications refer to Chapter 22.

All Year Conditioning Units

It is desirable to provide for automatic change-over between the cooling and heating cycles in the control system for all year conditioning units because of the probable necessity of changing over a large number of units if done manually.

A control system for an all year conditioning unit providing for the automatic change-over is shown in Fig. 7. Operation of the control equipment is as follows:

1. *During the Heating Cycle.* Combination controller T_1 measures the temperature in the space being conditioned and opens control valve V_2 so as to admit steam to the heating coil whenever heat is required so as to maintain a fixed temperature in the space. Combination controller T_1 also measures the relative humidity in the conditioned space and opens

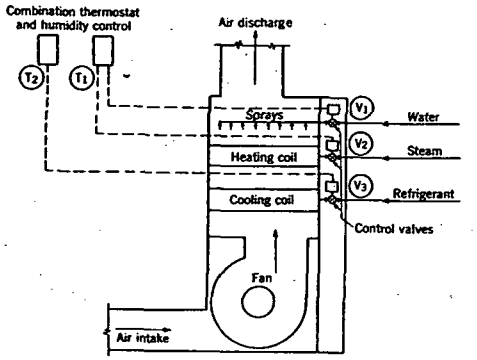

FIG. 7. ALL YEAR AIR CONDITIONING UNIT WITH COMPLETE AUTOMATIC CONTROL

control valve V_1 so as to admit water to the sprays whenever moisture is required in the space.

2. *During the Cooling Cycle.* Combination controller T_2 measures the temperature and humidity in the conditioned space and opens refrigerant control valve V_3, thereby admitting refrigerant to the cooling coil whenever cooling is required to maintain the temperature or relative humidity within predetermined maximum limits.

The temperature control point of controller T_1 must be set at a lower point than that of controller T_2 in order to provide for the automatic change-over between the cooling and heating cycles. As an example, controller T_1 might be set at 72 F and controller T_2 at 76 F. As the temperature in the space approaches 72 F, it would indicate a change from the cooling to the heating cycle and when the temperature in the space approaches 76 F, it would indicate a change from the heating to the cooling cycle, and the corresponding controllers would assume command. In the same way, the relative humidity control point of controller T_1 would be set at a lower point than that of controller T_2. As an example, T_1 might be set at 35 per cent and T_2 at 60 per cent.