

louvers and screens. Air quantities may be estimated on the basis of data given in Chapter 3. (See A.S.H.V.E. Ventilation Standards.)

2. *Warming Incoming Air.* The air is heated by passing it through specially designed convectors. The amount of heating surface to be provided in the unit is determined by the volume of air to be heated and the temperature range. If the unit is to be used for supplying air for ventilation only, the convector must be sufficient in capacity to maintain a final air temperature of about 70 F. If the unit is to be used for heating as well as for ventilation, the convector must be sufficient to maintain the necessary final air temperature for the conditions involved.

3. *Control of Temperature.* This is accomplished by varying the temperature of the air discharged from the unit (1) by the automatic operation of a mixing damper which controls the relative quantities of air being blown through the heating unit or by-passed around it, (2) by operation of valves on different layers of convector surfaces, or (3) by variation in the temperature of the circulating heating medium.

The outside air inlet damper and recirculating damper (where one is provided) should be so connected that there will be an uninterrupted supply of air to the fans at all times the unit is in operation. These dampers may be operated by hand or by pneumatic or electric motors manually controlled from some central point.

These dampers may also be linked together, in the form of mixing dampers and be controlled by a thermostat in the cold air intake, by a differential thermostat acted upon by both the cold air and the recirculated air, or by a thermostat in the two streams of air after they are mixed, so as to keep the relative proportion of air taken in from out-of-doors commensurate with outside temperatures and to prevent drafts of cold air being blown through the unit into the room.

Provision should be made for the inlet damper to close automatically whenever the fans are shut down, and not to open until the room is properly heated when the fans are again started. The minimum temperature of the air delivered by the machine should be regulated automatically by a thermostat in the outlet air which controls the temperature of the heated convector, or this minimum temperature may be maintained by properly mixing the inside and outside air by means of the mixing dampers under thermostatic control referred to above. Another thermostat in the recirculated air intake to the unit or elsewhere in the room controls by-pass dampers or the supply of heating medium, or both, so as to control the temperature of the air leaving the unit according to the heat requirements of the room. In addition to these thermostats, a room thermostat is needed to control any other heat sources for the room. (See Chapter 14.)

Thermostats for controlling by-pass dampers must be of the intermediate type to hold the dampers in intermediate positions to prevent objectionable drafts. When direct radiators are used in conjunction with unit ventilators, the control is usually arranged so as automatically to open the valves to the direct radiators when the room temperature falls about 2 deg below the setting of the thermostat for the unit ventilator. Another arrangement opens the radiator valve whenever the unit ventilator control reaches the full heating position. Further information on this subject is contained in Chapter 14.

4. *Distribution.* This function is governed by the proper selection and location of the unit. Diffusion and distribution are dependent upon a relatively high velocity air stream discharged in a generally vertical direction, and in order to insure satisfactory diffusion in the room the less the difference between the temperature of the air discharged from the unit and that of the room air, the better. With a final temperature above 110 F, excessive stratification of the air may be experienced. Troublesome drafts may be eliminated to a large extent if a static pressure is built up in the room.

5. *Recirculation of air* requires less fuel than does the use of all outside air and aids in heating up quickly. Certain units are designed to recirculate all air at all times, except when the admission of outside air is needed to regulate room temperatures. Under this arrangement, the outside air for ventilating purposes is obtained solely from infiltration, but the amount thus obtained may or may not be sufficient to meet legal ventilating requirements for public buildings. Recirculation of the air in schools is therefore prohibited by ordinance in many communities. Ventilating systems in schools should be arranged for taking in a sufficient quantity of air to constitute, with infiltration, not less than 10 cfm per occupant of a room.

6. *Quiet Operation.* Since the unit ventilator is generally set in close proximity to the room occupants, it must operate with exceeding quietness.

SPLIT AND COMBINED SYSTEMS

In a *split* system the unit is used primarily for ventilation. Air is delivered to the room at very near the room temperature, and enough separate direct heaters are placed in the room to warm it to the desired temperature, independently of the unit. Their principal advantage lies in offsetting the cooling effect of window and wall surfaces long before these can be heated to room temperature and in retaining heat for this purpose after the ventilation is shut down.

Where the unit ventilator selected has a capacity more than sufficient to warm the air needed to meet the ventilating requirements, a corresponding reduction may be made in the amount of direct heating surface installed. The greater the amount of excess capacity of the unit, the more efficient will be the temperature regulation of the room. The split system permits the heating of the room during failure of electric current, since the direct radiators will furnish heat, but it permits a careless operator to avoid operating the ventilating equipment.

A combined system employs the unit ventilator alone, its capacity being sufficient both for ventilation and for supplying the heat loss. Direct heating surface is omitted altogether. It becomes necessary then that the fan be running whenever the room is to be heated but this also gives assurance of ventilation, especially if automatic dampers are used in the air intake from out-of-doors and in the recirculating intake arranged so as to give a certain quantity of air from the outside (commensurate with weather conditions) whenever the unit is operating and after the room is heated. The cost of installation of a combined system is usually less than that of a split system and there is less danger of overheating, but if the electric energy fails there will be practically no heating.