low speeds and located in the lower part of the cabinet, the back of the cabinet being connected to the outside through rust-proof louvers and screens. Air quantities may be estimated on the basis of data given in Chapter 2. (See A.S.H.V.E. Ventilation Standards).

2. *Warming Incoming Air.* The air is heated by blowing it through specially designed extended heating surfaces. The amount of heating surface to be provided in the unit is of course 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 heating surface must be sufficient 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 heating surface must be sufficient to maintain the necessary final air temperature for the conditions involved.

3. *Control of Temperature.* This is accomplished by controlling the temperature of the air discharged from the unit in one of two ways: *first*, 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; and *second*, by dividing the heating unit into two or more sections and controlling (*i.e.*, throttling) the steam so that the proper amount of steam will be supplied to as many sections as required.

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 controlled from some central point such as the engineer's office, or automatically at the unit itself. Provision should be made for the inlet damper to close automatically whenever the fans are shut down. The temperature of the air from the machine should be regulated automatically by thermostats in the room which control the position of the by-pass dampers below the heating elements, or the number of sections to which steam is supplied. In addition to the room thermostat, a thermostat is frequently provided in the air stream from the unit to maintain a minimum air stream temperature. 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 final temperature of the air discharged from the unit must be kept as low as possible. 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, which can be done only if the vent from the room is small.

5. *Recirculation* reduces fuel consumption and aids in heating up rooms. 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 the infiltration, but the amount thus obtained is ordinarily insufficient to meet legal ventilating requirements. Recirculation is therefore prohibited by ordinance in some communities.

6. *Quiet Operation.* The unit ventilator is generally set close to the occupants of the room where activities are being carried on which preclude the use of noisy equipment. Quiet operation is therefore imperative.

SPLIT AND COMBINED SYSTEMS

In the *split* system the unit is used primarily for ventilation, delivering the air to the room at very near the room temperature, sufficient separate direct heaters being placed in the room to heat it to the desired temperature, independently of the unit. With the split system the separate direct heaters tend to improve the air circulation and diffusion within the room, since they constantly pull the cold air from the floor, warm it and use it to counteract the window chill.

Where the unit ventilator selected may have 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 and this also gives assurance of ventilation. The cost of installation of a combined system is usually less than that of a split system and there is less danger of overheating.

Central fan systems (Chapters 9 and 22) as well as unit ventilator systems may be designed for split or combined operation.

LOCATION OF UNIT VENTILATOR

The location of the unit ventilator in a room is important. Wherever possible it should be placed centrally on an outside wall. It is difficult to obtain proper air distribution if the unit is erected either on an inside wall or in a corner of the room. Standard units discharge the air stream upward, but for special cases units may be installed to discharge air horizontally. Units may be set away from the wall or partially recessed into the wall to save space without materially affecting the results. The air inlet may enter the cabinet at the back at any point from top to bottom; all units, however, should be arranged to operate with free air inlet and free discharge.