it is necessary that the unit heaters draw air from outside in enough volume to provide a rapid air change and that they operate in conjunction with ventilators or fans for exhausting the moisture-laden air. See discussion of condensation in Chapter 4.

There are three major factors to consider in the application of unit heaters, namely: (1) location of unit, (2) air distribution, and (3) heating medium.

Heaters may be distributed through the central portions of a room discharging toward exposed surfaces, or may be spaced around the walls, discharging along the walls and inward as well, especially when there are considerable roof losses. In general, it is better to direct the discharge from the unit heaters in such fashion that rotational circulation of the entire room content is set up by the system rather than to have the heaters discharge at random and in counter-directions.

Various types and makes of unit heaters are illustrated in the *Catalog Data Section* of this edition. As hot blasts of air in working zones are usually objectionable, heaters mounted on the floor should have their discharge outlets above the head line and suspended heaters should be placed in such manner and turned in such direction that the heated air stream will not be objectionable in the working zone. In the interest of economy, however, the elevation of the heater outlet and the direction of discharge should be so arranged that the heated air shall be brought as close above the head line as possible, yet not into the working zone. In general, the higher the elevation of the unit, the greater the volume and velocity required to bring the warm air down to the working zone, and consequently, the lower the required temperature of the air leaving the unit.

### Direct-Fired Units

The previous discussion related generally to units in which steam or hot water is used as the heating medium. Electric unit heaters are used where electric power is abundant and cheap or where other forms of fuel are scarce and expensive. The low first cost, easy control, and inexpensive installation of this type of unit permits their use where heating is required for short periods of time (see Chapter 44).

A development in gas burning equipment is the direct-fired industrial unit air heater. Direct-fired oil and coal units are also available. These heaters are of the warm-air type and are equipped with fans which cause the air to pass over the heating surfaces at a fairly high velocity and then direct the warm air into the space to be heated. Partial or complete automatic control also may be secured on appliances of this type. This type of heater is often used for temporary heat during building construction or where the installation of a steam or hot water plant is for some reason not justified. For permanent installations, it is usually advisable to provide an exhaust duct from the gas-fired unit heaters to remove products of combustion from the occupied space. While this is not necessary in large open industrial plants, in smaller closed rooms, it becomes essential.

Where high pressure steam is available it is sometimes used to drive a steam turbine direct-connected to the unit heater. The exhaust from this





turbine, reduced in pressure, is then passed into the heating coil where it is condensed and returned to the boiler.

## UNIT VENTILATORS

Unit ventilators are similar in principle and design to unit heaters. They are used to supply air with a discharge temperature at or slightly higher than room temperature. Also they are provided with an arrangement for introducing outdoor and recirculated air in varying quantities. If the unit is only used for circulating air, then radiators or some other equipment must be provided for heating the room. Unit ventilators are intended primarily for schools, offices, and semi-commercial establishments. A typical unit ventilator is illustrated in Fig. 9. A roof ventilator

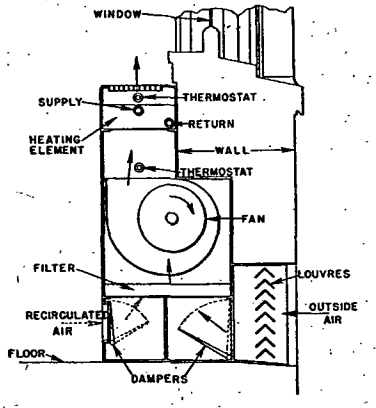


FIG. 9. TYPICAL UNIT VENTILATOR SHOWING ONE OF MANY ARRANGEMENTS OF DAMPERS AND HEATING COILS

used for exhausting air is sometimes termed a unit ventilator. For information on roof ventilators, see Chapter 42.

### Ratings

Unit ventilators are customarily furnished with two ratings, one established by measuring the air quantities with an anemometer and the other by condensation. The latter is determined on the basis of standard air. For the former, capacities vary from 750 to 10,000 cfm. Each size may be equipped with radiators for various rates of condensation, to give different final temperatures for a given air capacity and entering temperature, thus enabling the engineer to select the unit best adapted to the heating and ventilating load. Relatively low final temperatures are conducive to the smallest temperature variation throughout a room. Table 3[5] shows the air handling capacities by the two methods of rating and also approximate heating data.

[5] A.S.H.V.E. Standard Code for Testing and Rating Steam Unit Ventilators (A.S.H.V.E. TRANSACTIONS, Vol. 38, 1932, p. 25).