lihood of vibration due to air flow or deflection due to air pressure. Elbows made without splitters and improperly shaped transformation sections produce high local velocities which are the cause of noise in duct work. The use of first-class duct construction with well designed transformation sections and splitters in elbows tends to maintain relatively uniform velocities with decrease in turbulence and in the noise produced.

Figs. 11 to 18 show acceptable construction details for rectangular ducts, elbows, transformation pieces or connections, and air splitters. Other methods are also acceptable, such as the use of angle iron stiffeners for large ducts. Good construction is essential to the elimination of duct noises and for the prevention of a flimsy installation.

Fig. 11 is an isometric view of a duct showing the location of the stiffening seams on the top and side panels. The cross seams should not occur at the same place but should be staggered as indicated. Heating units should be installed as shown in Fig. 13 with the duct connections making an angle of not less than 45 deg, but preferably 60 deg. Fan discharge connections should have a maximum slope of 1 in 7, as indicated in Fig. 15. Whenever a pipe or other obstruction passes through a duct

TABLE 3. RECOMMENDED GAGES FOR RECTANGULAR SHEET METAL DUCT CONSTRUCTION[a]

GAGE	WIDTH OF DUCT	SEAM	REINFORCED SEAM
26	Up to 12 in.		
24	13 in to 30 in.	1	
22	31 in. to 48 in.	1	
22	49 in. to 60 in.	1½	⅛ in. x 1⅜ in.
20	61 in. to 90 in.	1½	⅛ in. x 1⅜ in.

[a]If panels are not cross broken two gages heavier material should be used.

an easement should be placed around the pipe as indicated in Fig. 14. Air splitters should be installed in elbows as shown in Figs. 16 and 17. The recommended gages for rectangular sheet-metal duct construction are given in Table 3.

AIR DISTRIBUTION

Stratification and Diffusion

Air tends to flow parallel with or remain in its particular temperature stratum. If the air supplied by the ventilating system is warmer or cooler than the room air, it will tend to rise or fall. If entering at a fairly high velocity, the velocity will persist for some distance even if contrary to the effect of the temperature difference; if the velocity is high enough a considerable amount of local circulation is induced.

If relatively cool air is introduced through the ceiling of a warm room, there is a tendency for it to drop without much natural diffusion, and likewise warm air introduced near the floor will tend to rise without diffusion if the velocity is low; hence careful attention should be given to the location of air inlets and outlets and the velocity with which air is introduced. Since the effect of introducing air above the room temperature is

radically different from the action when introduced below room temperatures, different treatment is required for cooling systems than for warming.

Downward Air Distribution

The downward system of air distribution which consists of bringing supply air in at the ceiling and taking it away at or near the floor is in common use for auditoriums, theatres, department stores and other large spaces. The natural tendency for heat given off by the occupants to rise and carry with it the products of respiration, makes it impossible to secure proper air distribution by the use of supply openings in the walls or in the floor. Moreover, when cooling is being done the incoming air, even though slightly below the room temperature, produces chilling drafts. The downward system of air distribution often utilizes special devices to effect diffusion of the air in the desired directions and so that it falls uniformly at a low velocity.

Upward Air Distribution

Successful plants are in operation using the upward system of air circulation from hood openings in the floor under each seat, but success with this system is contingent on having a low rate of occupancy so that it is not necessary to use large air volumes or low temperatures.

Location of Inlets and Outlets

For school-rooms, offices and smaller spaces in general, satisfactory locations for the air supply inlet are:

1. Downward discharging grilles in the ceiling.
2. Horizontally discharging diffusers on side of room opposite windows.
3. Upward discharging grilles in the window stools.
4. Upward discharging slots in floor beneath radiators on the outside wall.
5. Upward discharging grilles 3 ft to 4 ft above the floor on outside walls, as with unit ventilators.

The location of exhaust outlets in auditoriums and class rooms vary. With downward distribution mushroom registers in the floor may be used, or side wall registers, or both. In schoolrooms side wall registers connecting with vertical flues are customary, either with gravity or fan exhaust.

If the space has little or no heat loss, the air may be introduced at a temperature very near the room temperature; inlets and outlets may be approximately opposite each other, and the system is likely to be successful whether upward or downward distribution is used, providing the inlet location and air velocities combine to avoid drafts. However, if large glass surfaces or radiators cause disturbance of the air flow, or if there is a considerable amount of heat from the occupants, or if there is a considerable difference between the entering air temperature and the room air temperature, greater care must be taken to insure proper distribution without drafts.

There are no set rules which may be followed implicitly for location of inlets and outlets. It is necessary to keep in mind the nature of the occupancy, the proportions of the space to be ventilated, the heat losses