TABLE 2. RECOMMENDED RETURN INTAKE FACE VELOCITIES

INTAKE LOCATION	VELOCITY OVER GROSS AREA FPM
Above occupied zone	800 up
Within occupied zone, not near seats	600–800
Within occupied zone, near seats	400–600
Door or wall louvers	200–300
Undercutting of doors (through undercut area)	200–300

RETURN AND EXHAUST INTAKES

The *selection of return and exhaust intakes* depends on: (1) velocity in occupied zone near intake; (2) permissible pressure drop through intake; and (3) noise.

1. *Velocity*. The control of the room air motion for the maintenance of comfort conditions depends on the proper selection of the *supply* outlets. The effect of air flow through return intakes upon air movement in the room is slight. Air handled by the intake approaches the opening from all directions and its velocity decreases rapidly as the distance from the opening increases. Therefore, drafty conditions will rarely be encountered near return intakes. Recommended return intake face velocities are given in Table 2.

2. *Permissible Pressure Drop*. The permissible pressure drop will depend on the choice of the designer. Table 3 gives pressure drop through plain lattice intakes as a function of free area and face velocity.

Proper pressure drop allowance should be made for control or directive devices.

3. *Noise*. The problem of *noise* generated by return intakes is the same as that for supply outlets. In computing resultant room noise levels from the operation of an air conditioning system, the return intake must be included as a part of the total grille area. The major difference between the supply outlets and return intakes is the frequent installation of the latter at ear level. When so located, it is recommended that the return intake velocity be not in excess of 75 percent of the maximum permissible outlet velocity.

The *location of return and exhaust intakes* does not critically affect air motion, unless room air velocities in the occupied zone near the intake exceed comfort limits. The locations of return or exhaust intakes are, however, important for obtaining the desired room temperature equalization.

Ceiling locations for exhaust outlets are recommended for bars, kitchens, lavatories, dining rooms, club rooms, etc. where warm air will rise to the ceiling level. In heating installations, location of the return grilles in the ceiling or high on the wall is not recommended, as it may result in stratification of the conditioned air, and—depending on the relative location of supply and return outlets—in short-circuiting. (Refer to section Outlet Location and Selection).

Some ceiling outlets combine the supply and return openings in a single

TABLE 3. APPROXIMATE PRESSURE DROPS FOR LATTICE RETURN INTAKES
Inches Water Gage—Standard Air

PER CENT FREE AREA	FACE VELOCITY, FPM						
	400	500	600	700	800	900	1000
50	0.06	0.09	0.13	0.17	0.22	0.28	0.35
60	0.04	0.06	0.09	0.12	0.16	0.20	0.24
70	0.03	0.05	0.07	0.09	0.12	0.15	0.18
80	0.02	0.03	0.05	0.07	0.09	0.11	0.14

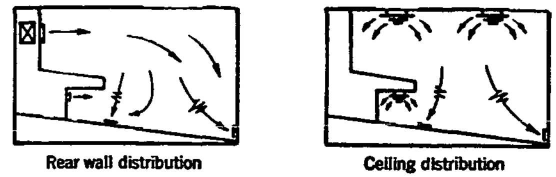

FIG. 15. AIR DISTRIBUTION METHODS FOR THEATERS, CHURCHES, AND AUDITORIUMS

unit. This method is used for heating as well as for cooling applications. However, the application for heating is more critical and requires consideration of ceiling height, amount of outside wall area, and number of air changes required. In some cases, stratification of warm air may cause short-circuiting. (Refer to section Outlet Location and Selection).

Floor locations of returns are used in heating installations for ceiling or side wall supply. When located so that air is drawn across exposed walls, the performance of the system may be somewhat improved. In general, floor locations tend to collect dirt and refuse.

Wall and door locations of exhaust outlets depending on their elevation, have the characteristics of either floor or ceiling returns. In large buildings with many small rooms, the return air may be brought through door grilles or door undercuts into the corridors, and then to a common return or exhaust. The pressure drop through door returns should not be excessive; otherwise the air distribution to the room may be seriously unbalanced with the opening or closing of the doors. Outward leakage through doors or windows cannot be counted upon for dependable results.

SPECIFIC APPLICATIONS

For *theaters and auditoriums* the air distribution methods used are the downward distribution system with ceiling diffusers, and the horizontal distribution system with ejector nozzles or wall diffusers. Fig. 15 shows both methods. Ceiling distribution is accomplished by ceiling outlets under main ceiling and balcony. It is indicated when main ceiling or balcony is cut up by architectural treatment or beams. The only critical points are under the balcony, and (occasionally) above the very rear of the balcony, where ceiling heights are low and where direct impingement of air is sometimes a hazard.

Wall or ejector distribution is particularly applicable for relatively long and narrow theaters. It is essential with this type of distribution that there

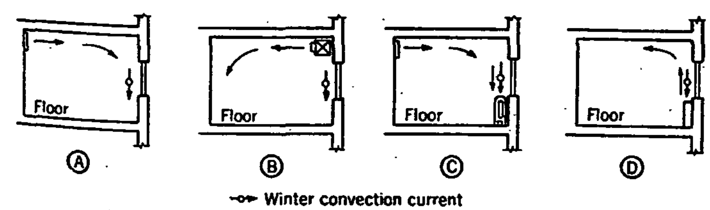

FIG. 16. DISTRIBUTION METHODS FOR SMALL ROOMS

A. Satisfactory for cooling. Unsatisfactory for heating in severe climates where the outside temperature is consistently below 40 F, and single glass and uninsulated walls are prevalent.
B. Performance approximately that of A when small diffusers are used in bottom of the duct.
C. Satisfactory for cooling. Satisfactory for heating if direct radiation is properly controlled.
D. Satisfactory for both cooling and heating. The air should be discharged slightly away from the wall and for low velocities, should be fanned out parallel to the wall.