An idea for producing even distribution of air consists of a perforated ceiling made of a suitable architectural surface and installed a small distance below the normal ceiling level of the room. In the space provided by this suspended ceiling a plenum chamber is formed into which the conditioned air is introduced. From the plenum space the air is permitted to diffuse through the large number of small ceiling openings into the room.

Railroad Cars

In the early practice of air conditioning railroad passenger cars a system of bulkhead distribution was used. This consisted of an inlet opening at each end of the car discharging the air toward the middle with the flow parallel to the long dimension of the car. This installation resulted in drafts in the middle of the car and was considered unsatisfactory. Later designs incorporate a duct delivery system on each side of the car roof directing the air through numerous inlet openings toward the middle of the car where the two air streams come in contact and deflect downward, gradually filtering into the aisle. At the present time, several center duct air distribution systems are used in railroad car applications. In some instances square or circular ceiling outlets connected to a center duct have been used, which distribute the air along the ceiling in widening circles and at right angles to the inlet opening. Another method consists of a continuous slot in the bottom of the duct to which is attached a flat plate so that the air is deflected along the car ceiling. Connected to the central supply system are small individual ducts to each sleeping compartment with adjustable directional outlets to control the desired air flow.

BALANCING SYSTEM

In designing an air conditioning system, it should be the aim of the engineer to so proportion the duct system that proper distribution of air to every outlet will be obtained. Since this is almost impossible to accomplish in practice, it becomes necessary to have means of balancing the system to secure the desired amount of air in each space. There are a number of ways in which this may be accomplished, some of which are listed:

1. Dampers on the supply grilles.
2. Dampers on the return grilles.
3. Dampers in the supply ducts.
4. Dampers in the return ducts.
5. Reducing the effective area of some outlets by blank-offs.
6. Combinations of dampers in both supply and return air.

Dampers on the supply grilles themselves are objectionable because of their effect on the air stream. Dampers on the return grilles are frequently helpful in building up a static pressure in the room to prevent infiltration of outside air, and at the same time reduce the volume of incoming air. However, it is frequently impossible to sufficiently reduce the incoming air by this method alone. A damper in the supply duct some distance

back of the outlet forms a very satisfactory means of regulating the flow without disturbing distribution across the outlet face. A damper in the return air duct has the advantage over one immediately behind the grille in that it does not tend to create high localized velocities through the grille as the latter might do if nearly closed. Blank-offs consisting of pieces of sheet metal covering a portion of the outlet face can frequently be used satisfactorily, although determination of just what is required is a matter of experiment, and the balancing of the system is not nearly so conveniently accomplished as with dampers. Dampers in both supply and return air form the most flexible means of controlling the supply to the room and the static pressure within the room. When feasible, these dampers, particularly those in the supply ducts, should be a substantial distance from the outlet, and ahead of the acoustic duct lining if used. Due consideration should also be given to the use of the several volume control and uniform distribution devices now available. See *Catalog Data Section*.

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PROBLEMS IN PRACTICE

1 ● What important factors are involved in the correct distribution of air to an enclosed space?

Not only is it important to distribute the air from the fan to the various spaces served by the system, but also the air must be properly distributed within the enclosed space to give complete satisfaction.

2 ● Upon what basis should the selection of supply outlets be based?

If possible, the selection should take advantage of the maximum velocity permissible from a noise standpoint.

3 ● What factors in grille design effect the length of air throw?

a. The temperature difference between incoming and room air, *b*. height of grille above floor, *c*. face velocity, *d*. core area, *e*. core aspect ratio, and *f*. design of grille.

4 ● How does the height of a supply outlet affect the temperature differential within a room?

In general, the higher the outlet is above the floor, the greater may be the difference between room air and incoming air temperatures.

5 ● Under conditions prevalent in a large room, how does the intensity of sound develop at an air outlet vary?

The intensity of sound energy is substantially proportional to the rate at which sound energy is generated and inversely proportional to the number of sound absorption units in the room.