For all such buildings the downward system (Fig. 7) offers the best distribution without draft if a sufficient number of exhaust openings are placed under the seats. This method discharges the cooled air so that it filters through and mixes with the layer of heated air rising from the occupants.

The upward supply system allows the cooled air to remain partially undisturbed in the lower area and thus the heated air from occupants is not distributed until it rises near the exhaust openings.

Small theatres and similar buildings may be properly designed by distributing the air across the width of the building. The inlet opening locations should be as high as possible, with high velocities and multiple return openings in the floor under the seats, for best results.

Schools are often heated and cooled by unit ventilators. These units should be designed for high velocity and a deflection of approximately 40 deg from the vertical (Fig. 8), so that the air stream will not strike the ceiling and fall too rapidly, particularly when a large quantity of air is admitted from outdoors.

RAILROAD CARS

Although the general variation in the size of a railroad car is slight the construction often does not allow the best arrangement for air distribution, and consequently several alternate designs have been used. (See Chapter 13).

In early practice most cars were air conditioned with the bulkhead delivery system. This consisted of an inlet opening at each end of the car discharging the air towards 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 frequently unsatisfactory.

The side duct delivery system (Fig. 9) consists of a duct on each side of the car roof directing the air through about 12 inlet openings toward the middle of the car, where the two streams meet and deflect downward gradually filtering into the aisle. The inlet openings generally have a dimensional ratio of 3 and 4 to 1 with deflection to expand the air stream.

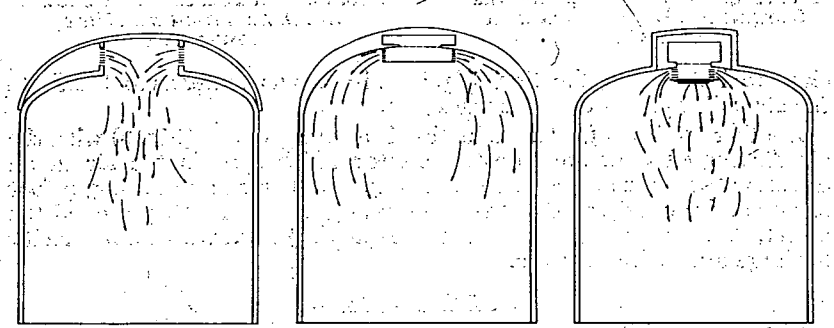

Fig. 9. Sections Through Railroad Car Air Supply Systems

This system is highly satisfactory if the volume is properly proportioned for the multiple openings.

Several center duct air distribution systems are used in connection with railroad car air distribution. One method consists of a continuous slot in the bottom of the duct to which is attached a flat plate so the air is deflected along the car ceiling. This is satisfactory from an air distribution stand point, but it is difficult to equalize the volume of air over the entire length of this slot.

Two other center duct installations are shown in Fig. 9. One shows the air distributed from the side of the duct through about 12 inlet openings which have a high dimensional ratio and an expanding deflection. This method of distribution causes the air to deflect downward on the outside wall of the car with the result that many passengers raise objections to the drafts. The other method, shown in Fig. 9, is to use a standard square or circular ceiling outlet in the bottom of the duct which allows the inlet air to be discharged on a deflector plate, which distributes the air along the ceiling in a widening circle at right angles to the inlet opening. Since the velocity is very low, most of the air drops into the aisle of the car.

Recirculated air from a railroad car usually consists of from 60 to 75 per cent of the air supplied and is picked up in the passageway ceiling of the car at one end. This results in all of the air being drawn across the floor of the car toward the exhaust opening. This opening should be large enough so that the velocity is not in excess of 400 fpm, and arranged so as to eliminate objectional drafts near this opening.

PROBLEMS IN PRACTICE

1 ● What are the essential differences between a high velocity long throw and short throw inlet grille opening?

Generally a high velocity long throw grille is used where a large compact mass of air is projected with a reduction in the periphery of the air stream, whereas with a short throw grille design the periphery of the air stream is expanded as much as possible to increase the scrubbing action between the incoming air stream and the stationary air.

2 ● Is the conventional warm air system, employing floor or baseboard supply registers, suitable for heating and cooling?

Floor or baseboard supply registers are suitable for heating service because the natural tendency of warm air is to rise. They are not suitable for cooling because the natural tendency of cool air is to stay near the floor and gradually work its way to the return registers, thus not cooling the air in the upper part of the room. See Fig. 4.

3 ● What type of air distribution system is suitable for heating and cooling a home?

In order to provide satisfactory cooling without drafts it is necessary to discharge the air at relatively high velocity toward the ceiling from a high point, as shown in Fig. 4. If the register is properly designed and the air capacity is limited to approximately 400 cfm, the cool air will mix with the air in the room before it drops to the occupied zone. However, care must be taken that discharged air does not impinge on beams which would cause the cool air to be deflected downward. This arrangement is also satisfactory for heating.

4 ● Why is the conventional low velocity side wall inlet unsatisfactory for cooling purposes?