Chapter 48

TRANSPORTATION AIR CONDITIONING

Railway Passenger Car Ventilation, Method of Air Distribution, Air Cleaning, Winter and Summer Air Conditioning, Humidity and Temperature Control, Summer Air Conditioning for Buses and Automobiles, Airplane Air Conditioning

THE principles of air conditioning applying to stores, restaurants, hospitals, theaters, and homes are in general applicable to railway passenger cars, buses, automobiles, and ships. However, the equipment used for mobile applications must meet additional requirements. Especially important are features of lightness, compactness, and accessibility for quick inspection and servicing. Freedom from vibration which could be transmitted to the passengers is essential. (For Air Conditioning of Ships see Chapter 49.)

RAILWAY PASSENGER CAR VENTILATION

In non-air-conditioned cars, ventilation is accomplished by exhaust fans, roof ventilators, and by opening doors and windows. This practice provides an ample supply of outside air but does not prevent the entrance of smoke, cinders, and other dirt.

An average passenger car contains approximately 5000 cu ft of air and may seat 80 passengers, who are continually liberating heat, carbon dioxide, moisture, odors, and some organic matter from their breath, skin and clothing. The heat and moisture can be removed by cooling and dehumidification, but the other constituents can be successfully handled only by proper ventilation and air cleansing. In the average car, from 2000 to 2500 cfm should be circulated by the air conditioning unit. Some of this air may be recirculated, but a portion of it should always be brought in from the outside. The amount of outside air will vary from 15 to 90 per cent of the total air circulated depending upon the type of car, number of passengers, air temperature, humidity, odors, and smoking.

Careful attention must be exercised in specifying the rate of outside air taken in so as to fit the type of service adequately and yet not to supply more ventilation than is necessary. Conditioning this outside air is a major factor in determining the size of summer and winter equipment. With present average ventilation requirements, about 30 per cent of the cooling capacity and sometimes as high as 50 per cent of the heating capacity are necessary to handle the outside air load.

For normal conditions, 10 cfm of outside air per passenger is sufficient. When smoking is permitted, at least 15 cfm should be admitted. In some of the dining cars and de luxe sleeping cars, outside air rates as high as 20 and 30 cfm per occupant are used.

Method of Air Distribution

Railway cars present critical problems in air distribution because the air space per passenger is small and the sun load is great. Three principal methods are used to distribute the air to the interior by fans or blowers:

1. A ceiling duct lengthwise along the center of the car.

2. One or two side ducts built on the outside of monitor-roofed cars, or on the inside of turtle-backed or arch-roofed cars.

3. A perforated ceiling supplied by an overhead duct. From one-half to the full area of the ceiling is used for distribution of air although practical considerations generally limit the available area to about two-thirds.

Delivery grilles and plaques designed to give considerable entrainment and mixing are often used to prevent cool drafts.

Smoking rooms present a special problem. The cloud of smoke that usually hangs near the ceiling can be broken up by directing the incoming air along the ceiling at a velocity somewhat higher than that used for the rest of the car. The air should be exhausted through the washroom or lavatory. For compartments an adjustable supply grille of suitable size and design should be provided and provision should be made in the door or partition for the removal of used air.

Lower berths should be provided with an adjustable air outlet which will discharge air at low velocity in any desired direction.

Recirculating air grilles are usually of the straight flow type. Outside air intakes are usually located in the vestibule, on the side of the car, or on the roof, depending upon location of cooling coils. On many of the recently air-conditioned cars, there are no dampers or shutters at the outside air intakes; the percentage of outside air is controlled by adjusting the flow through the recirculating grille.

A considerable number of coach cars is now being equipped with return air ducts fitted in the structure of the baggage racks. Part of the air circulated is returned to the blower unit through these ducts and part through the car body. This arrangement reduces the velocity of air returning through the car body and removes smoke fumes at the source.

Air Cleaning

All air circulated by the blower is filtered before passing over the cooling coils. In some cars the outside and recirculated air is filtered separately before mixing, while in others the air from the two sources is mixed before passing through a common filter. Filters in use are made of metal, wool, cloth, spun glass, hemp, paper, hair, and wire screen. Most filters have a viscous coating of oil for greater cleaning efficiency. Some types may be cleaned, retreated, and re-used while other types are discarded when dirty.

Activated carbon units sometimes are used in addition to the regular filters for adsorbing odors and other impurities, thus reducing the amount of outside air necessary for ventilation.

Trials are also being made of electric precipitation for air cleaning. In this system the coarser particles are removed from the air by mechanical separation, the finer materials being precipitated by electro-static action.

RAILWAY PASSENGER CAR WINTER AIR CONDITIONING

The majority of cars in service use steam from the locomotive or from an oil-fired boiler for winter heating. In some instances electrical energy from a generating set or motive power supply is utilized for heating. In still other cases electrical energy and waste heat from individual car engine-generator sets are employed. The peak heating loads may vary from 150,000 to 250,000 Btu per hour, depending largely upon the amount of insulation used in the car, the type of windows (whether single or double glazed), and the ventilation rate.

From 30 to 50 per cent of the total heat required is supplied by means of finned tempering coils or resistance heaters located in the outside air