9 ● Why are metal surface cooling elements instead of liquid spray chambers used in the design of most unit air conditioners and unit coolers?

The first cost of the surface cooling type of unit is considerably less than the cost of spray type equipment. Further, the requirements of many industrial air conditioning jobs and of all comfort cooling jobs where unit equipment is applicable can often be effectively met with the use of surface type units, with a reduction in the space required for making the installation. Where space conditions are especially limited, the cross-sectional area of the surface cooler can be reduced because the resulting increase in velocity over the coil surface increases the effectiveness of the surface, whereas an increase in velocity through a liquid spray would reduce its effectiveness.

10 ● Why are air conditioning units with metal cooling surfaces not desirable for all industrial jobs?

Wherever unusually close control of relative humidity is required, a spray type unit will prove to be more satisfactory. Relative humidity control and accurate temperature control, however, can be maintained without difficulty with the use of metal surface units.

11 ● Why is accurate control of relative humidity with surface coolers more or less complicated?

A surface cooler cannot add moisture to the air, and moisture is removed only when the surface temperature is below the entering dew-point temperature. Any change in condition of the entering air will result in a change in the dry-bulb depression of the leaving air. This change in entering condition requires not only a readjustment of the air volume but also a change in the coil temperature, if accurate control over the relative humidity is to be maintained.

12 ● What in general are the characteristics of unit conditioner operation using surface coils?

For a constant entering dry-bulb temperature and a constant refrigerant temperature any increase in the entering wet-bulb temperature will produce a rise in the leaving dry-bulb temperature with an accompanying reduction in the wet-bulb depression of the leaving air. The sensible heat removed by the unit decreases and the latent heat increases, while the total heat removed also increases. When the dry-bulb temperature of entering air is increased, with constant refrigerant temperature and constant wet-bulb temperature of entering air, the wet-bulb depression of the leaving air increases, and since it is this depression which determines the maintained relative humidity it must be carefully considered when selecting the unit.

13 ● If a drop in the dry-bulb temperature of entering air reduces the capacity of the unit, is there not danger of selecting a unit which is too small, if its selection should be based on an excessive entering dry-bulb temperature?

Yes. If the total cooling load is largely internal (such as from occupants and lights) as distinguished from the cooling load of outdoor air, and the unit is selected on the basis of a too high dry-bulb temperature of entering air, then, in the event of under capacity, it might be possible to maintain the room temperature by reducing the quantity of outdoor air. But this increases the recirculated air taken into the unit, reducing the dry-bulb temperature of entering air and, therefore, reducing the sensible heat capacity of the unit. This reduction in capacity may offset the gain obtained by reducing the amount of outdoor air taken in. Further, since the total tonnage required for any installation is equal to the total internal heat load plus the total heat removed from the outdoor air, and since the outdoor air might have a wet-bulb temperature equal to the designed wet-bulb but less than the designed dry-bulb temperature, then the sensible heat capacity of the unit will be less than that required. It follows that unit air conditioners and coolers should not be selected on a basis of the maximum possible dry-bulb temperature of entering air.

Chapter 13

RAILWAY AIR CONDITIONING

Ventilation, Heating, Cooling, Calculation of Cooling Load, Humidity Control, Temperature Control, Power Supply, Costs

THE general principles of air conditioning as applied to buildings also apply to railway cars, but due to space and weight limitations and the severity of the service, equipment designed for stationary work in buildings is seldom suitable for car installations. Equipment for railway use must be safe, reliable, compact, light in weight, accessible for inspection and repairs, as nearly automatic in operation as possible, and have low initial, operating, and maintenance costs. To properly air condition a car, ventilating, filtering, heating, cooling, humidifying, and control equipment must be provided together with an adequate power supply. Air from the interior of the car is mixed with air from the outside and passed through the air conditioning unit where it is heated or cooled, humidified or dehumidified and delivered to the interior of the car through suitable ducts and grilles.

VENTILATION

One of the important problems in connection with air conditioning of cars is that of ventilation. In non-air conditioned cars, ventilation is accomplished by exhaust fans, roof ventilators and open doors and windows. This provides an ample supply of outside air and in addition a large amount of smoke and dirt which may be excluded in an air conditioned car.

An average car contains approximately 5000 cu ft of air which is being contaminated by the occupants who are continually liberating heat, carbon dioxide, moisture, odors, and some organic matter from the breath, skin and clothing. The heat and moisture can be removed by cooling and dehumidifying, but the others can be handled only by proper ventilation. In the average car from 2000 to 2500 cfm of air should be delivered by the air conditioning unit. Some of this air may be recirculated, but a portion of it should be brought in from the outside. The amount of outside air required depends upon the type of car (dining, club, cafe), number of passengers, air temperature, humidity, smoke, and odors, and will vary from 15 to 90 per cent. This percentage of outside air should be kept as low as possible to still maintain the air in the proper condition in order to minimize the heating or cooling load.

In equipping old cars, the air is often distributed to the car from the conditioning unit through one or two side ducts, built on the outside of