

is closely interlocked with compressor demands, need for pre-cooling, battery charging, etc. It is difficult therefore to state the additional weight imposed on a car because of such a compression air conditioning system, but it is probably in the vicinity of 6000 to 8000 lb. These systems, depending mostly upon the locomotive for supplying power for operation, impose a load, including the power required to pull the weight added by the equipment, of from 5 to 10 per cent of the total locomotive power.

Several schemes for relieving the locomotive of this compression load are used. Some of the articulated trains, which run as unit equipment—the same cars always in the same train—employ a head-end, engine-generator combination for supplying power to compressor motors. In other cases, especially in many of the new streamlined trains, propane fueled engine-driven generators on individual cars are used to supply power to motors, as well as to supply all power for car lighting and accessories. Gas engine compressor combinations on individual cars provide attractive low weight equipment where automatic engine operation is permissible under all circumstances. Diesel-powered generator units have been used experimentally on individual cars for supplying electrical energy and in some cases waste engine heat has been used either for modulating refrigeration with a reheat cycle or for car heating purposes.

RAILWAY PASSENGER CAR HUMIDITY AND TEMPERATURE CONTROL

The temperature to be maintained in a car depends upon the outside temperature and the humidity desired inside the car. With a low humidity it is necessary to maintain a higher temperature to establish a desirable comfort condition. Little humidity control has been attempted on cars up to the present time. A certain degree of automatic humidity control is secured with cooling, but the relative humidity obtained depends largely upon the temperature of the evaporator, which should be below the dew-point temperature of the air. With certain outside atmospheric conditions it may not be possible to operate the conventional equipment with a sufficiently low evaporator temperature to reduce the humidity without dropping the temperature too low. One method has been developed whereby the evaporator temperature is carried below the dew-point a sufficient amount to insure dehumidification and then the cold air is heated to the proper temperature by passing it over coils through which part of the high temperature liquid from the condenser is by-passed. Such a system is costly and has not been generally applied. The reheat cycle obtainable from waste engine heat may be used to good advantage in reducing the humidity without reducing the dry-bulb temperature.

During the heating season humidification is desirable from a comfort standpoint, but unless properly controlled, condensation will appear on the windows. A steam or water spray controlled by a humidistat will provide the necessary moisture for humidification. There are several cars with this feature now in use.

Temperature control for the most part obtained by rugged thermostats and relays capable of withstanding vibrations attendant with mobile service is usual equipment.

Manual zone control for varying outdoor conditions, as well as controls which regulate the car temperature automatically in accordance with outdoor conditions, are employed.

Simplified controls from the standpoint of operation by train crews and

especially from the servicing viewpoint are very desirable. The control of summer temperatures is accomplished mainly by cycling the complete cooling system; however, modulation is being effected by using multiple evaporators in which a fixed portion may automatically be cut out of operation to suit the cooling capacity requirements and to keep the equipment in operation for longer periods.

With motor or engine driven compression equipment modulation of compressor capacity to suit the reduced evaporator capacity is accomplished by changing motor or engine speed, or by varying the number of compressor cylinders in operation.

Steam ejector equipment is provided with dampers which by-pass the air around the cooling coil during the off cycle to prevent re-evaporation of moisture from the coil during the off period.

For further information on controls, see Chapter 33.

PASSENGER BUS SUMMER AIR CONDITIONING AND VENTILATION

The highways in the United States are now traveled by about 3500 summer air-conditioned passenger buses. Many of the facts stressed in connection with the design and installation of summer conditioning equipment in railway cars are even more important in these newer vehicles. Weight and space limitations are more stringent, and the problem of circulating from 900 to 1200 cfm of air in coaches carrying from 25 to 40 passengers with about 35 cu ft of space per passenger without drafts is no easy one.

Some bulkhead delivery systems have been used, and while the overhead package racks have served to break up drafts to some extent, these installations are not gaining in popularity. Longitudinal ducts in the corners above the package racks are sometimes used to carry conditioned air to a series of outlet louvers along the top of the windows. Other designs provide for false spaces below the package racks which serve as ducts to distribute air to either entrainment grilles in the bottom of the racks or distributing slots at the edges of the package racks. Some coaches employ a false ceiling to provide a duct, with delivery taking place from numerous perforations in the ceiling.

Return air grilles and filters are usually located near the rear ceiling where the evaporator is placed. Outside air intakes and filters are located preferably near the front of the vehicle so as not to contaminate this supply with exhaust fumes and road dust. Of the 30 cfm circulated per person, about 8 to 10 cfm are outside air and the remainder is recirculated. Power for the motor driving the centrifugal fans is obtained from the bus battery.

More recently a coach design has been brought out which provides for a number of return air outlets below the seats; these permit return air to enter a longitudinal duct below the floor. The filters and evaporator are located in this duct near the front of the vehicle. In this instance a central heating coil utilizing waste heat from the coach engine is also located in this duct. Conditioned air is delivered through a pair of vertical ducts to a package rack distribution scheme.

Summer conditioning systems for these vehicles range in cooling capacity from 36,000 to 48,000 Btu per hour. Mechanical compression systems using dichlorodifluoromethane are used, and are powered by water cooled, gasoline engines of approximately 14 hp.

Complete systems add from 800 to 1300 lb to the weight of a coach.