

filters for absorbing odors and other impurities, thus reducing the amount of outside air necessary for ventilation.

Temperature and Humidity Control

Controls in a passenger car should be as automatic as possible. The regular train crew cannot be relied on to make adjustments for comfort of passengers. For this reason latest systems of temperature control have only an off-on switch to be operated by train crew. When the system is in operation, heating or cooling is provided automatically as required.

When heating, it is important that floor-heat finned tubing be controlled at stable temperatures. Wide fluctuation in its temperature is highly objectionable because of location close to passengers. Stable operation may be secured by controlling floor heat on basis of outside conditions (See Chapter 43 on zoning), and using an overhead air circulating system to maintain final car temperatures.

Because of window condensation and other problems, no attempt is usually made to raise relative humidity in a railroad car in winter time.

When cooling, the steam jet refrigeration system is controlled in an on-off manner. Some means are ordinarily provided for operating mechanical compressor systems at partial capacity. In this case split evaporators are used, and evaporator surface and compressor are reduced together under light load conditions.

Under very light cooling loads, relative humidity in a car tends to increase because of long off periods of refrigeration equipment. This can be prevented by starting refrigeration equipment on low capacity at an established outdoor air temperature, operating it continuously and using a heating coil in overhead system to re-heat sufficiently to maintain car temperatures. Under higher load conditions the heating coil becomes inoperative and compressor and evaporator capacity are increased as needed.

Room type sleeper cars introduce a further problem of providing individual adjustment of room temperatures. Sometimes this individual control is secured by adjusting air volume, but such adjustment is unsatisfactory for overall comfort, and may affect air supply to other rooms. Another method is to use the heaters at the floor to control room temperature but this tends to cause unstable and improper floor heat temperatures which may be objectionable to passengers. A simpler and basically more satisfactory system is to use a small booster heater in individual overhead air supply ducts to each room under manual control of occupant. In this case, floor heat and basic overhead systems are automatically adjusted for varying load conditions just as in a simple coach type car. A fixed amount of heat determined by occupant can be added by the room booster heater to maintain desired individual room temperature. Temperature lag is reduced in case of room boosters over use of gravity floor heating surfaces. Any adjustment of booster will give occupant immediate change in space conditions. The use of floor heat surfaces for room control may also mean low or excessive surface temperatures close to passenger, with resulting discomfort.

STREETCAR AND TROLLEY COACH HEATING AND VENTILATING

Streetcars and trolley coaches present a special problem in maintenance of satisfactory comfort conditions due to frequent opening of doors and highly fluctuating passenger load. Space limitations for ducts and a desire

to keep outlet grilles well above floor to facilitate car cleaning, add further problems to distribution system. Maintaining comfort conditions at driver's station cannot be overlooked since his term of occupancy is considerably longer than that of any passenger and because he is usually dressed more lightly than passengers. A separate source of heat is usually provided for operator and is under his control.

Heating and Ventilating

Recently-built streetcars and trolley coaches use heat from air blown over main accelerating resistors and track switch resistors to heat passenger space. In the modern streamlined streetcars, designated P.C.C., approximately 2400 cfm are drawn from car and blown over these resistors to dissipate their heat. In trolley coaches, an amount of 800 cfm is customary. The heated air is then delivered to passenger space or diverted to outside by means of dampers as required. If available heat from this source is insufficient, auxiliary electric heaters in supply ducts may be cut in. The air distribution system is 100 per cent recirculating when the maximum heating requirement is being met. At conditions other than maximum heating demand, part of air drawn from car is exhausted to atmosphere. Outside air enters car body, under these conditions, by infiltration at all cracks and through doors when opened at stops.

The most recently-built streetcars have added ventilating fans in roof structure to introduce outside air through ceiling diffusing grilles. By governing volume of fresh air introduced through these roof fans in coordination with heated air distributing system, it is possible to maintain slight pressurization of passenger space and avoid inrush of air when doors are opened to load passengers. The roof fans also provide an effective means of maintaining lower inside temperature during summer operation. Ventilation tests on P.C.C. streetcars indicate that with 90 F outside temperature and above, 12,000 cfm is required to provide sufficient air change to keep inside temperature within a few degrees of outside air temperature and to provide enough air movement over passengers for comfort. The best results have been obtained by operating ventilating fans with windows closed. New cars provided with adequate ventilating capacity have been built with fixed sash.

Control

Temperature control consisting of equipment especially designed to withstand vibration present on transportation equipment is used. Automatically operated dampers are used to control flow of heated air to passenger space or to direct heated air to atmosphere. An automatically operated rheostat or multi-point switch is used to vary speed of ventilating fans. Recent control system applications employ one thermostat to operate both heating dampers and ventilating fans in a modulating or graduated manner with compensating thermostat in heat supply duct to correct for wide fluctuations in air temperature available from resistors. Ventilating fans are usually stopped or operated at lowest speed during heating cycle, and then speed is gradually increased as car temperature rises above heating cycle control point.

PASSENGER BUS AIR CONDITIONING

The passenger bus designed for urban transportation operation presents a greater problem to designer of heating system than does the inter-urban bus. More frequent stops, and rapidly changing passenger load create this problem on urban vehicles. Provision of heat for driver independent