(*black*) types and the general construction already described. A metal inner liner or reflector, usually placed between resistors and casing, provides a secondary air passage to promote circulation and reduce casing surface temperature at the rear. Depending on ratio of horizontal to

TABLE 1. PRINCIPAL TYPES OF ELECTRIC HOUSE HEATING SYSTEMS

A. Radiators, Convectors, Unit Heaters—Built-In and Portable
   1. Metallic resistor, high- or low-temperature
   2. Glass unit with metal frame
   3. Baseboard-type resistor
   4. Resistor with fan, including unit heater
   5. Resistor with focusing radiation reflector
   6. Steam radiator with immersion electric element
   7. Resistor unit placed in window-type air-conditioner

B. Panel-Type Installations
   1. Ceiling panel
      a. Rigid composite panels containing electrically conductive rubber
      b. Flexible composite sheets containing embedded metallic filaments or conductive rubber
      c. Electric conductors embedded in plaster on lath
   2. Wall panel
      a. Rigid panels, as for ceilings
      b. Flexible sheets, as for ceilings
   3. Floor panel
      a. Electric conductors embedded in concrete slab
      b. Soil heating cable under ceramic tile

C. Central Hot-Water Systems
   1. Water from electric heater pumped to radiators or convectors in rooms
   2. Same, with thermal storage for off-peak operation
   3. Fuel-fired boiler converted to electricity

D. Central Warm-Air Systems
   1. Resistance-element bank in housing or air duct
   2. Fuel-fired furnace converted to electricity

E. Heat-Pump Systems
   1. Warm-air distribution through ducts, like D-1
   2. Hot-water distribution, like C-1 or 2
   3. Radiant panels, like B-1 or 2, but with embedded tubing to act as refrigerant condenser
   4. Modification of window-type air conditioner by addition of refrigerant reversing valve and controls

vertical dimension, pattern of face grille, and arrangement of resistors and deflector, the convection heat delivery constitutes between 40 and 60 percent of total output.

Ratings usually are from 1000 to 8000 watts (3400 to 27,300 Btu per hr) with some models down to 500 and up to 15,000 watts. Voltages are the standardized values between 110 and 240. Similar models equipped also with air circulation fans of axial type, are available; these give convection heat delivery up to 80 percent. Other types, using the same components but without a fan, are arranged as *floor furnaces* to be installed

between floor joists. A manual switch and thermostat integral with the unit are optional.

Portable units of the foregoing types, except floor furnaces, are obtainable with plug-in extension cords for convenience and occasional service. Ratings are 500 to 1200 watts at 110 volts; special models rated up to 5000 watts are also made, but can be used only on branch circuits having special wiring and receptacles.

Convector Type Unit

The location of built-in electric heating units of convector type, generally along the exterior walls beneath or alongside windows, is governed by the same principles that determine arrangement of steam and hot-water convectors, with respect to movement of warm and return air. Positions on interior walls are sometimes permissible, so long as interference from opened doors and from furniture placement is avoided. A thermostat of high-sensitivity type and a conveniently located manual switch are recommended for each unit or at least each room.

Radiant Convector Unit

Glass electric heating units, sometimes designated as radiant panels, depend on the heating effect produced by passage of current through a thin coating of conductive material fused to one face of a panel of $\frac{1}{4}$-in. thick special glass. The conductive layer may be sprayed-on aluminum or *printed* metallic oxide patterned to form a grid several thousandths of an inch thick, or fused-on material to give a uniform coating less than 0.0001 in. thick over the entire active face of panel. Normal glass operating temperatures are 300 to 400 F, with maximum permissible temperature around 650 F.

Electric wiring connections are made to the panel coating at its opposite extremities by wires soldered to the coating, by metal strips held in place with springs, or by other methods that assure low electrical resistance. The panel is supported on insulators within a metal frame which also carries a reflector behind the glass and is arranged to provide space for air circulation. A protective guard prevents accidental contact with the hot glass.

Glass units have standardized ratings, usually 1000 watts, with smaller units extending down to 200 watts, for the common voltages ranging between 110 and 240 volts. Starting current for some types exceeds running current by 10 and by 50 percent. Frame sizes vary from about 30 x 24 in. for 1000-watt size to 42 x 6 in. for 300-watt baseboard model; frame types are for either recessed or surface mounting. Thermostats integral with the frame assembly are optional. Portable units equipped with plug-in extension cords are of similar construction.

Baseboard Type Unit

Metal casing proportioned to resemble and replace the conventional wood baseboard along plastered or masonry walls, contains 2 or 3 resistors placed horizontally, one above another. These usually are of low-temperature type, with ratings 80 to 120 watts (270 to 400 Btu per hr) per linear foot of baseboard unit, at 240 volts. The maximum surface temperature is 140 to 160 F. The vertical dimension is 6 to 8 in. above floor line, and the projection from face of plaster about 1.5 in. Placement within the room and method of control follow the same principles that apply to hot-water type baseboard installations described in Chapter 22