Another type of baseboard unit has glass panels 6 to 8 in. high and 30 to 42 in. long, with surface operating temperature kept below 250 F.

Resistor with Focusing Reflector

An example of the focusing-reflector-type heating unit is the copper-bowl parabolic or circular *glow* heater for portable use. This has an incandescent wire-coil resistor on a conical ceramic core, screwed into a lamp-type central receptacle. Usual ratings are 500 to 1650 watts for 120 volt service. Heat emitted by radiant effect is 75 to 85 per cent of total delivery.

For permanent installation, low-temperature focusing units are made with tubular resistors mounted within sectional trough-type reflectors resembling industrial fluorescent lighting fixtures. They may be suspended from ceiling or bracketed from a wall. Rated capacities are 200 to 1500 watts per linear foot of unit. Installations of this kind are mainly in public and industrial buildings, to handle the perimeter heat loss at windows, doors or wall openings. In a modified form, such units are employed for infra-red heating and drying in industrial processes.

Steam Radiator with Immersion Element

For portable use, radiators (convectors) of light-weight 2-column construction are equipped with an immersion element screwed into a bottom opening at one end. Usually, after charging with water and antifreeze compound the radiator is sealed. A safety valve or thermal relief plug is provided, to protect against excessive pressure in case heat dissipation is unduly curtailed by clothing, bedding or other insulating material placed over the unit. The steam-and-water intermediate heat-transfer medium has no effect on overall thermal efficiency, but gives the unit operating characteristics adapted for certain applications.

Many recent models of window-type air conditioners are provided with resistors, enabling them to be used also for heating service in moderate weather. Electric input for heating is usually kept the same as for cooling. Consequently, the units normally give only convenience heating and are intended for use at times when the main heating system is shut down.

Ceiling Panel-Type Installations with Conductive Rubber

Panels of laminated construction containing electrically conductive rubber, with rating of 22 watts (75 Btu) per sq ft, for 115 and 230 volt service, are built in standard sizes 3 x 4 ft, 4 x 4 ft, and 4 x 6 ft. They consist of a layer of special rubber about $\frac{1}{64}$ in. thick sealed between layers of phenolic resin-impregnated electrical insulating paper. The assembly is covered on each side with a sheet of aluminum foil. Overall thickness is $\frac{1}{16}$ in.; weight is 0.4 lb per sq ft. Metal strips embedded along edges of the rubber sheet serve as potential leads. Electric terminal blocks are provided on each panel and standard raceway mouldings are furnished for wiring connections. An earlier type of construction using asbestos-board backing to form rigid panels $\frac{1}{4}$ in. thick has been discontinued.

Under normal operating conditions that cause cycling under thermostatic control, the surface temperature is about 100 F. When panels are turned on in a cold room or with continuous operation, the maximum temperature reached is 120 F.

The position of panels on the ceiling of a room should be as near as possible to exposed walls, especially at windows and doors, to counteract

cold-wall effect and to keep the occupants never farther than 3 ft horizontally from a heated area. The preferred location is with the terminal-block edges close to the walls and with 1-ft spaces between panels. Since it is not permissible to cut heating panels, the entire pattern for ceiling must be planned in advance both for appearance and for economy. Attachment to ceiling plaster, plaster-board or other smooth surface is made by a special adhesive applied on the ceiling along a $1\frac{1}{2}$ in. fastening margin, provided around the four sides of each panel, which carries a dry adhesive tape bonded to the panel. Lighting fixtures must not be fastened or cut into the active area of a panel.

Adequate thermal insulation above panels is mandatory to protect all wiring from excessive temperature and to assure economical heating service. The minimum thickness of mineral or fiber insulation (glass or rock wool, cellulose fibers, loose asbestos, etc.) is 4 in. at top story and 2 in. for intermediate floors, whereas 6 in. and 3 in., should be the minimum corresponding thicknesses of expanded mica insulation.

A thermostat of high sensitivity type with an integral manual cut-off device should be provided in each room. To obtain economy of operation, a time switch or clock is advocated for lowering the room temperature to 55 F at night or when rooms remain unoccupied.

Ceiling Panel-Type Installations with Embedded Conductors

Resistors or *cables* for embedding in plastered ceilings to form panel-type heating installations are electrically insulated with a special compound resistant to high temperature, water absorption, aging effects, and chemical action with plaster, cement and soil. Cable units are furnished in standardized lengths from about 75 to about 1800 ft, rated from 200 to 5000 watts per unit, for 120 or 240 volts. They have an outside diameter about $\frac{1}{8}$ in., the maximum safe operating temperature is about 165 F, and the test voltage is 2500. Non-heating leads 7 ft long are attached to each unit, allowing the unit to be terminated at thermostats or in switch boxes without causing erratic operation of thermostat by heat from cable. Units are identified in regard to rating, by label and by color code. It is not permissible to alter the length of cable or leads, nor to install any cable unit lacking a visible identification label.

For plastered ceilings, the lathing used is of gypsum or other non-metallic fire resistant type. The cable is secured to lath with staples spaced not over 16 in. apart. Each element is tested after fastening on lath and after the first plaster coat for continuity of circuit and for insulation resistance of at least 100,000 ohms measured to ground.

The minimum spacing between cable passes or turns should be $1\frac{1}{2}$ in. Leads from cable to junction boxes should be placed in loom. A clearance of at least 2 in. is required from any metal lath, such lath being permissible only for reinforcement along corners at walls. Clearance is likewise necessary at any metal objects, and this applies also to non-heating leads, as a precaution against magnetic hum. Cables must be kept away from local areas of ceiling that would be additionally heated by recessed or surface-type lighting fixtures. All general wiring for power and light is run above thermal insulation over the heat panel areas, or at least 2 in. above the heated ceiling surface.

Plaster should be applied in three coats with the first coat trowled in the same direction as the elements. A superfine sand finish is recommended, since a putty finish coat has a tendency to crack. While new