

resistors is nickel-chromium wire or ribbon which, in order to avoid oxidation, contains practically no iron.

HEATING ELEMENTS

Commercial electric heating elements are divided into open type elements, enclosed type elements, and cloth fabrics. *Open type elements* have resistors exposed to view. The resistors may be coils of wire or metal ribbon, supported by refractory insulation, or they may be non-metallic rods, mounted on insulators. Open type elements are used extensively for operation at high temperatures when radiant heat is desired. They are also frequently used at low temperatures for convection and fan circulation heating, especially in large installations.

Enclosed type elements have metallic resistors embedded in a refractory insulating material, and encased in a protective sheath of metal. Fins or extended surfaces may be used to add heat-dissipating area. Enclosed elements are made in many forms, such as strips, rings, plates, and tubes. Strip elements are used for clamping to surfaces requiring heat by conduction, and in convection and fan circulation air heaters. Ring and plate elements are used in electric ranges, waffle irons, and in many small air heaters. Tubular elements may be immersed in liquids, cast into metal, and, when formed into coils, used in electric ranges and air heaters. *Cloth fabrics* woven from flexible resistor wires and asbestos thread, are used for many low temperature purposes.

ELECTRIC HEATERS

Electric heaters are classified according to the manner in which they deliver heat in practical use, that is, by conduction, by radiation, or by convection. The term *radiator* should not be used in electric heating, because of confusion between its established usage in fuel heating and the radiant principle of many electric heaters.

Among the uses of *conduction electric heaters*, which deliver most of their heat by actual contact with the object to be heated, are aviators' clothing, hot pads, foot warmers, soil heaters, ice melters, and pipe heaters. Conduction heaters are useful in conserving and localizing heat delivery at definite points. They are not suitable for general air heating.

Radiant electric heaters, which deliver most of their heat by radiation, have high temperature incandescent heating elements and reflectors to concentrate the heat rays in the desired directions. The immediate and pleasant sensation of warmth which is caused by radiant heat makes this type desirable for temporary use where the heat rays can fall directly upon the body. They are not satisfactory for general heating, as radiant heat rays do not warm the air through which they pass. They must first be absorbed by walls, furniture, or other solid objects which then give up the heat to the air. The location of radiant heaters is important. They should never face a window because some rays would pass through the glass and be lost. Figs. 1 and 2 show common types of portable and wall-mounted radiant heaters.

Convection electric heaters, designed to induce thermal air circulation, deliver heat largely by convection, and should be located and used in

much the same manner as steam and hot water radiators or convectors. They should have heating elements of large area, with moderate surface temperature, enclosed to give proper stack effect to draw cold air from the floor line (Figs. 3 and 4). The flexibility possible with electric heating elements should discourage the use of secondary mediums for heat transfer. Water and steam add nothing to the efficiency of an electric heater and entail expensive construction.

UNIT HEATERS

Fan unit electric heaters, having electric heating elements combined in the same enclosure with a fan or blower, are made in many styles and are excellent for general air heating. They should be located and used much

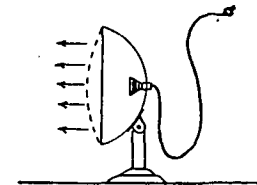


FIG. 1. PORTABLE RADIANT ELECTRIC HEATER

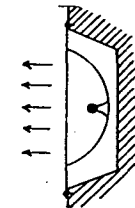


FIG. 2. RADIANT ELECTRIC HEATER RECESSED IN WALL



FIG. 3. CONVECTION ELECTRIC HEATER ON WALL SURFACE

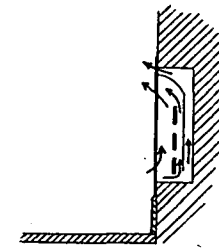


FIG. 4. CONVECTION ELECTRIC HEATER RECESSED IN WALL

as steam unit heaters. The warm air can be directed toward the floor, if desired, to give a positive circulation which will reduce stratification of air. Small units which are free from radio interference are used for homes; there are large units for industrial plants, substations, power houses, and pumping stations; portable units are useful for temporary work, such as drying out damp rooms, or for warming rooms during construction (Figs. 5, 6, 7 and 8).

CENTRAL FAN HEATING

Central fan electric heating systems have electric heating elements and fans or blowers to circulate the air through ducts, and in addition to the