although there may be some penalty on efficiency, operating or maintenance expense, or overall performance.

Indoor temperatures usually specified are shown in Table 2 of Chapter 12, subject to the indicated notation concerning effect of radiant or panel heating. Moreover, allowance is required for radiation effect of cold surfaces if there are large windows, and for the continuing trend toward adoption of higher indoor temperatures. Concerning outdoor temperature for design, attention is directed in the case of electric heating systems to the cautionary remarks relating to winter climatic conditions in Table 1 of Chapter 12. Judgment must be exercised in choice between values *In Common Use* and *TAC 97.5 Percent Basis*, which show differences as large as 15 deg for some cities. If indoor temperature is taken at 70 F, it may be inadvisable to select outdoor temperature as high as the TAC 97.5 percent figure.

Many electric heating systems are of decentralized type, with a thermostat provided on each convector or for each room as recommended by manufacturers of such heating equipment. This practice compensates for variability of heat contributed by auxiliary sources such as sunshine, lighting and appliances. It also gives opportunity for *diversity* of power demand, *i.e.*, the non-coincidence of electric load from all the convectors, panels or heating units of an installation. Manual switches are also commonly provided in such decentralized installations to permit cutting off heat or reducing temperature in rooms when not occupied. Such decentralized operation, advocated as an economic measure with electric heating, requires that consideration be given to adequate capacity for warm-up, as against the uniform-temperature operation with a fully centralized system.

It is essential that buildings intended to be heated electrically should be well constructed, with adequate thermal insulation having impervious vapor barriers, and with storm windows or double-glazed window units and weather stripping to minimize heat loss and air infiltration. Open fireplaces should be eliminated wherever possible, because they induce excessive infiltration. The relatively high electric cost for thermal energy, about $6.00 per million Btu at $0.02 per kwh, for example, as compared with about $1.20 for oil at $0.12 per gal when utilized with 70 percent efficiency, gives economic justification for substantial expenditure to reduce heat consumption. The large majority of dwellings heated economically by electricity have heat factors (quotient of seasonal energy consumption in kilowatt hours, divided by degree-days and by volume of gross heated space expressed in thousands of cubic feet) between 0.2 and 0.3. The features necessary to hold consumption within these limits result in construction that for 5000 degree-day climate with 0 F outside design temperature, gives a calculated heating load of 4000 to 5000 Btu per hr per 1000 cu ft gross volume. Heat factors up to 0.4 are not uncommon, but experience shows that such high heat requirement may result in excessive operating cost.

INDUCTION AND DIELECTRIC HEATING

These methods, employed for industrial processes requiring extreme speed or close control of heat location, do not lend themselves to space or water heating. However, since they are sometimes proposed for consideration, the operating principles are described briefly.

Any electrically conducting material placed in an alternating magnetic field develops eddy currents that generate heat. The rate of internal heating is so high that conduction away from the zone to be treated does not unduly lower the temperature. The field is created by coils connected to an alternating-current power source such as motor-generator set, a mercury arc, or an electronic-tube or spark-discharge oscillator, producing frequencies usually between 250 and 10,000 cycles per second, but for some applications up to 500,000 cps. The coils are generally copper tubes through which cooling water is circulated. Induction heating apparatus must be specifically designed for each application such as melting metals, brazing, heat treating internally or in zones, and surface hardening without oxide scale formation or distortion.

Dielectric heating, for materials that are non-conductors of electricity and are poor thermal conductors, requires a high-frequency electrostatic field produced at high voltage and very high frequencies reaching 50 million cps. The method is well adapted to continuous-flow production process including manufacture of bonded plywood, drying of deep-pile fabrics, dehydration of granular or crystalline materials, and sterilization of foods.

POWER PROBLEMS

Rates for Electric Service

The cost of electricity varies due to several factors. The main elements are the annual charges, including taxes, on capital invested and those expenses necessary to keep the electric utility system at all times in a state of *readiness to serve* the load. The cost of generating the energy is secondary. Electricity is not stored, but must be produced instantaneously when and as required by the user. Consequently, the time of power use, both daily and seasonally, and relation between rate-of-use or demand and the energy consumed within a period (commonly known as load factor) have large effects on costs and the rates charged. Special low rates sometimes are available during certain prescribed *off-peak* hours of use, when the system load is low.

Space heating is a load whose magnitude is determined basically by weather, and is affected to a much lesser extent by the electric customer's use of his premises. Most of the heating loads in a region occur simultaneously, thereby tending to create peaks for which the capacity of the electric system must be adequate. Accordingly, rates contain in one way or another, charges both for demand and energy. Demand may be indicated directly by a demand meter or be derived from manufacturers' rating data shown on nameplates of the heating equipment. In block-type rates, where demand is not specifically mentioned, it is in part reflected by higher charges per kilowatt-hour in the earlier blocks.

Control of Electric Demand

To obtain electricity for space heating at minimum cost, it is necessary to keep the user's kilowatt demand as low as possible, by provisions in original design of the installation and by judicious methods of operation. Excess heating capacity should be avoided, but without jeopardizing satisfactory performance in cold weather. A variety of control methods can be applied to minimize both demand and consumption. Decentralized control with a thermostat in each room or on each heating unit, together with manual switch to cut off any unoccupied room, is one method. Sequence switching whereby electric service to individual rooms or circuits is shifted