

control must automatically vary the heat input in coordination with the changes in air volume and demand for heat.

CALCULATING CAPACITIES

In calculating electric heating capacity one kilowatt is equal to 3413 Btu per hour or 14.2 sq ft equivalent direct steam radiation.

INDUSTRIAL USES FOR ELECTRIC HEAT

Electric heating is valuable for many industrial processes in both low and high temperature ranges. It is easily controlled and can be justified where savings in labor or improved quality of product outweigh the inherent higher cost per unit of heat as compared with other fuels. Important examples are metal melting and heat treating furnaces, ovens, dryers, laboratory equipment, cooking vessels, oil preheaters, catalysts, and countless other special uses.

RADIANT DRYING

Lacquers and similar surface films can be very effectively dried by radiation. Special electric lamp bulbs have been developed which give off a high percentage of infra-red and similar heat rays². These are mounted in very efficient reflectors. For continuous manufacturing processes these reflectors are mounted in tunnels through which conveyors pass. For local applications, as for example paint drying in automobile repair shops, they may be mounted on portable racks.

In the application of this type of drying the composition of the paint or lacquer is important. In general, lacquers and those enamels using synthetic resins react most favorably. Other applications include the drying of ink, glue, and water, the softening of celluloid and bakelite for punching or shearing, and a wide variety of other uses³.

Objects of relatively large surface area in proportion to their weight, and fabricated materials having a rather high heat absorption, may be satisfactorily heated by such a source.

ELECTRONIC HEATING BY INDUCTION AND ELECTROSTATIC MEANS

These methods differ radically from resistance heating as they employ high frequency radio waves to apply the energy which produces heat. High frequency heating has many important industrial uses and opens up a whole new field of special applications where extreme accuracy and speed are vital. Some spectacular results are being attained with this modern industrial tool. Skillful engineering design and experience are necessary to produce safe and satisfactory performance, but this technical assistance is now available from many sources.

Metals can be heated by induction. When the work is placed in a magnetic field within a high frequency coil, eddy currents immediately produce heat in the body of the metallic piece. The speed and intensity of this heating can be regulated by controlling the high frequency currents producing the magnetic field and the location of the spot heated by the position of the work piece within the coil. Induction heating is

²Infra-Red Lamps Speed Up Drying Operations (*Automotive Industries* 82:376-7; April 15, 1940). Invisible Rays Build Visible Profits, by H. M. Archer (*Electric Light and Power*, May, 1940). Radiant Energy Drying and Baking for Organic Finishing (*Metal Industry* 38:294-6; May, 1940).

³Infra-Red Heating, Section IV, Power Sales Manual (*Edison Electric Institute*).

very useful in special processes such as melting metals, brazing, forging, heat treating, etc. It is possible to apply localized heat so rapidly that conduction cannot draw the heat away before it has time to accomplish the desired purpose at a particular spot. One example is the rapid hardening of a tool edge or tip too quickly for scale to form.

Dielectric materials can be heated internally by introducing them into an electrostatic field between high frequency electrode plates. Foods can be sterilized, plywoods bonded, plastics heated, granular or crystalline materials dehydrated, and countless other products heated quickly and uniformly, although they are poor thermal conductors and resist heat applied to their exteriors. Electrostatic heating is ideally suited for continuous production processes as the materials can pass through the heating field quickly with very short exposures to the high frequency radio waves.

POWER PROBLEMS

The cost of electric energy varies because of several factors. Distribution costs differ for large and small users. The fact that electricity cannot be economically stored, but must be used as fast as it is generated, makes it impossible to operate electric plants at uniform loads; hence, even the time of use may affect the cost of electricity. Special low rates are sometimes available during certain prescribed hours of use.

Since the cost of production and distribution depends not only upon the quantity of energy used but also upon the maximum rate at which it is used, electric energy is often sold on a demand rate basis. In some cases, the demand charge is based upon the rated connected load, in other cases, upon the maximum demand as indicated by a demand meter.

Homes are almost universally supplied with lighting current of 115 volts, which can only be used economically for small heaters. Usually the service lines will not permit more than plug-in devices. The Underwriters permit approved heaters of 1320 watts or less to be plugged into approved baseboard receptacles, but such heaters cannot be served on a circuit supplying much other load without overloading the fuses. There is an increasing trend toward supplying homes with three wire 115-230 volt service. Where homes have such service, larger heaters can be installed. For industrial purposes, heaters should be designed to use polyphase power, which is usually supplied at 208, 220, 440 or 550 volts. All polyphase heaters should be balanced between phases. In ordering electric heaters the proper voltage must be specified as the heat produced will vary as the square of any variation in voltage.

REFERENCES

- Electric Elements Well Adapted to the Air Conditioning Heating Cycle, by L. P. Hynes (*Heating, Piping and Air Conditioning*, January, 1940, p. 29).
- Electric Heat for the Bathroom Floor (*Heating and Ventilating* 36:41; December, 1939).
- Electric Heat Spreads in Sunny Climes (*Barron's National Financial Weekly* 20:5; January 8, 1940).
- Electric Heating for Los Angeles Building (*Heating and Ventilating* 37:50-1; June, 1940).
- Dracker Apartments, West Los Angeles, Calif. (*Heating and Ventilating* 37:32; July, 1940).
- Electric Heat in California Homes, by P. F. Offerman, W. J. Walsh and H. H. Skilling (*Electrical West*, March, 1941, pp. 37-39).
- Radiant Heat, by F. W. Hutchinson (*Electrical West*, January, 1941, pp. 29-31).
- Electric Radiant Heat vs. Steam Convection, by Douglas Dow (*Electrical World*, August 10, 1940, pp. 61-62).