stripping and storm sash. Unless the heat losses of a building to be heated by electricity are reduced to a low point, the cost will be excessive as compared with other fuels.

STORAGE SYSTEM OF ELECTRICAL HEATING

Recently there has been developed a new system for applying electricity to house heating whereby it has become possible to purchase current at low cost. Advantage is taken of the high capacity of water for storing heat from electric energy purchased from the utility company.

Large tanks of water are heated at night when the energy is available at a lower cost, and this stored heat is drawn upon as required through the day. Such a system has been applied to houses provided with hot water, steam and warm air heating systems.

Power companies in various parts of the country are investigating and sponsoring development of off-peak electrical house heating and are preparing to support its widespread use. The nature of the load and its bettering effect on the power factor curve is favorable both to the public utility and the consumer.

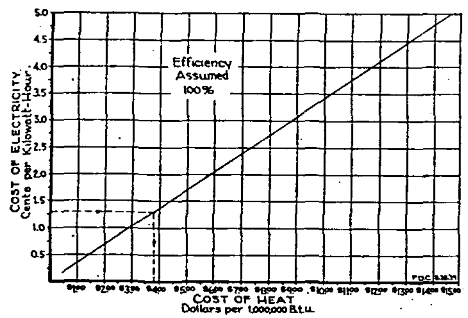

FIG. 1. CHART FOR ESTIMATING COST PER 1,000,000 B.T.U. FOR ELECTRICITY

The characteristics of the electric heating load, when used with the thermal storage system are ideal from the electrical operating standpoint. The units are non-inductively wound so that the load is unity power factor, and the load is timed so as to be used exactly at the time specified by those responsible for the operation of the systems. It is, therefore, corrective in its effect and tends to fill up the valleys in the load curve. It corrects the inherent peak characteristics of the domestic load in that it places a load at hours when otherwise a resident would use no electricity. The electricity is taken at the hours when the electric light and power company most desires load and the result of the energy—the stored heat—is used during the day when it is needed to heat the house.

Cost of Electricity

The public service companies assign the periods during which electricity may be used for such heating, and charge usually a base rate of about 1 cent per kilowatt-hour. Even this rate does not make electricity a price-competitor of oil and gas for heating, but is low enough to attract consumers.

Hot Water System

The tank used with these storage systems is heavily insulated and is equipped with built-in electrical heating elements. The size of the tank is a function of the heat loss of the building and of the length of the periods allowed by the utility company, during which electricity may be used for heating. The water in the tank is warmed to a temperature of about 300 deg. fahr. It is then circulated, usually by an electric pump through the heating system in the building, the regulation of the flow of the water in the system being thermostatically controlled.

Warm-Air System

The scheme developed for warm-air heating systems makes use of the same kind of tank. A housing is built around the tank, from which radiate the supply ducts to the registers in the rooms. The return air ducts from the house are connected back to the tank housing. An automobile-radiator type of unit heater is mounted within the housing with its flow and return connections joined to the top and bottom of the hot water storage tank. The fan on the unit heater is controlled by the house thermostat, which causes the desired day and night temperatures to be maintained in the rooms.

Because a fan is used to circulate the warm air, the effect of a fan-furnace system is obtained, and it is possible to use small ducts and of such shapes as will accommodate themselves architecturally to the structure of the house, which of course cannot usually be done with warm air where the circulation is solely by gravity.

Domestic Hot Water Heaters

The storage principle for using electricity at off-peak periods is also applied to domestic hot water heaters. Installations of this type of electrical heating have been made in many houses in the middle west during the past four years.

HEAT EQUIVALENTS OF ELECTRICITY

Fundamental Equations

The relation between electrical energy and heat and power is given by the following equations:

1 horsepower $= 746$ watts.
$= 33{,}000$ ft. lb. per minute.

1 B.t.u. $= 777.64$ ft. lb.

1 horsepower-hour $= \dfrac{33{,}000 \times 60}{777.64} = 2{,}546$ B.t.u. per hour.

1 watt-hour $= \dfrac{2{,}546}{746} = 3.415$ B.t.u. per hour.

1 kilowatt (kw) $= 1{,}000$ watts.
$= \dfrac{3{,}415}{160} = 21.3$ sq. ft. of hot water radiation based on a heat emission of 160 B.t.u. per square foot.
$= \dfrac{3{,}415}{240} = 14.2$ sq. ft. equivalent of steam radiation, based on a heat emission of 240 B.t.u. per square foot.