ELECTRIC HEATING

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PREFACE

The utilization of electricity for heating purposes on a large scale is a development so recent that little information on the subject has yet been published outside of the trade periodicals. The wealth of printed matter concerning electric lighting practice only emphasizes the dearth of data regarding electric heating. Yet heat by wire seems destined to a far greater future than light by wire, not only as regards the amount of current consumed, but also in the intrinsic value of its service to mankind.

In his capacity as a load builder for central stations the author was early confronted with the lack of recorded facts about the how and why of electric heating. For his personal needs he correlated widely-scattered notes, simplified the technical treatment so that it would be intelligible to the sales prospect and brought into convenient form much of the knowledge required by the salesman of electric heating appliances.

This information has been so useful to the author that it was thought that it might also be of service to others in the industry, particularly since the electric cooking load has become so desirable to the central station. Hence this book.

Briefly, it aims to set forth in a practical way the many uses to which electric heat may be applied. The advantages and disadvantages of various kinds of heating loads are compared and many types of heating devices are explained. The relative operating costs of

electric and fuel-heated apparatus are shown by tables and simple calculations. Suggestions are given regarding approved methods of installing and using domestic and commercial ranges, bake ovens, water heaters and industrial heating devices.

Acknowledgement is here made of the courtesy of many manufacturers in supplying cuts used to illustrate typical equipment.

E. A. WILCOX.

San Francisco, July, 1916.

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ELECTRIC HEATING

CHAPTER I.

HEAT ENERGY AND ELECTRICITY.

Demand for Heat.—The demand for heat is greatest in temperate climates where it is essential to life, health, and comfort. Economic development has progressed more rapidly in the colder climates and has brought about numerous and important social and industrial uses of heat greatly in excess of the relative increase in population.

Advantages of Electric Heat.—This demand for heat, the great lack of efficient fuel apparatus, and the many disadvantages of fuel combustion, have opened up a large field for the utilization of electric heat. Electric energy may be transformed directly into heat energy at one hundred per cent efficiency. Its use presents no such difficult problems as are inherent in the utilization of fuel. It does not vitiate the atmosphere. It is clean, safe, and sanitary. Greater quantities and more intense heat can be produced in a given space electrically than by any other means. It produces heat directly where it is to be applied. It can be measured, and controlled both as to temperature and quantity, more readily than can any other form of heat energy. It eliminates the disadvantages of fuel storage and transportation. The losses of heat that obtain in the combustion of fuel are enormous. From an economic standpoint, our rapidly depleting natural fuel resources make the use of hydroelectric energy as a heating medium a real aid to efficient progress.

Nature of Heat.—Consideration of the nature and scientific properties of heat is necessary to a thorough understanding of this subject. It is a form of energy

having two essential qualities corresponding to intensity and quantity. The intensity is measured by temperature and the quantity is measured by the British thermal unit, (i.e., heat unit, or B.t.u.)

Temperature Measurement.—The property of heat called temperature is proportional to the heat intensity, and may be measured with a thermometer or a pyrometer. The sensation of feeling heat in various bodies has reference not to the actual quantity of heat in them but to their relative temperatures.

Many types of thermometers have been developed for various temperatures and classes of work, but the Centigrade and Fahrenheit scales are applied to most of those employed in modern practice. In the Fahrenheit thermometer the freezing point of water is taken at 32 degrees and the boiling point of water is taken at 212 degrees, the distance between these two points being divided into 180 degrees. In the Centigrade thermometers the freezing point of water is taken at 0 degrees and the boiling point at 100 degrees.

Temperature Fahrenheit $= 9/5 \times$ temperature deg. C. $+ 32$ deg.
Temperature Centigrade $= 5/9 \times$ temperature deg F. $- 32$ deg.

Measurement of Heat.—Heat cannot be measured directly by a thermometer but it may be measured by noting the amount that some standard is raised in temperature. Water has been universally adopted as the standard and heat is measured by its power to raise the temperature of a given weight of it. The standard unit for heat measurement, therefore, is the amount of heat required to raise the temperature of one pound of water one degree Fahrenheit, and is termed the British thermal unit.

Specific Heat.—The capacity for absorbing heat under changing temperatures varies greatly with different bodies. The same amount of heat that would raise one pound of water one degree, for instance, would raise about eight pounds of iron one degree in temperature. Specific heat is the term used to express this property of bodies. It may be defined as the number of B.t.u., or fraction thereof, required to

raise the temperature of one pound of any substance one degree Fahrenheit.

A clear conception of the use of this unit of measurement is essential to the designer of heating apparatus, since it indicates the capacity for absorbing heat for a given temperature change. All the heat taken up in raising the temperature of a substance is given off when the body cools. The total heat absorbed by a body is equivalent to the product obtained by multiplying temperature difference, weight, and specific heat. It will be noted from the table in the back of the book that the specific heat of water (i.e., its heat absorbing power) is greater than that of most known substances.

Thermal Capacity.—The thermal capacity of a substance is the quantity of heat required to raise its temperature one degree. It is the product of its specific heat and mass. As the specific heat of water is unity, fifteen pounds of water has a thermal capacity of $15 \times 1 = 15$ B.t.u. Likewise the specific heat of cast iron being .1298, fifteen pounds of iron has a thermal capacity of $15 \times .1298 = 1.947$ B.t.u.

The Calorie.—Heating calculations are frequently expressed in calories instead of British thermal units. The French thermal unit, or calorie, is that quantity of heat required to raise the temperature of one kilogramme of water one degree Centigrade. It is equivalent to 3.968 British thermal units; or one British thermal units is equal to .252 calorie.

Mechanical Equivalent of Heat.—Heat and mechanical energy are mutually convertible. The number of foot-pounds of mechanical energy equivalent to one British thermal unit is the mechanical equivalent of heat. It has been established experimentally that one B.t.u. is equal to 778 foot-pounds, and on that basis it has been calculated that one horsepower is equivalent to 2545 B.t.u. per hour.

Relation to Electrical Units.—Where resistance is offered to the flow of an electric current the electric energy is converted into heat energy. The heat gen-

erated is proportional to the resistance of the conductor, the square of the current strength, and the length of time the current flows. It has been established experimentally that one ampere of current flowing through a resistance of one ohm for one hour will generate 3.412 B.t.u.. Since one ampere flowing one hour through a resistance of one ohm is equivalent to one watt-hour, 3.412 B.t.u. equals one watt-hour ($EIT = RI^2T$) or 3412 B.t.u. equals one kilowatt hour.

If it is desired to raise a certain quantity of a substance through a certain temperature range the number of kilowatt hours required for the operation may be calculated as follows:

$$\text{Kw-hr.} = \frac{\text{Degrees rise F.} \times \text{Pounds} \times \text{Specific Heat}}{\text{\% Efficiency} \times 3412}$$

Divide the number of kilowatt hours determined by the above calculations by the number of hours allowed for the operation and the result will be the kilowatts of heater capacity required for performing the work.

Latent Heat.—The quantity of heat which is absorbed by a body in a given state in converting it into another state without changing its temperature is termed its latent heat.

Latent heat of fusion is the heat absorbed in changing a body of a certain weight from a solid to a liquid without changing its temperature. When the operation is reversed the same quantity of heat is given off as was previously absorbed.

Latent heat of evaporation is the heat required to change a unit weight of a solid or liquid at a given temperature into a gaseous state at the same temperature. It is the heat that disappears during the change and which will reappear if the operation is reversed. Whereas it requires only 180 B.t.u. at atmospheric pressure to heat a pound of water from the freezing to the boiling point (termed sensible heat), it requires 970 B.t.u. (latent heat of evaporation) to convert the same quantity of water into steam at 212 degrees F.

The total heat of evaporation is the sum of the sensible heat and the latent heat of evaporation.

Radiation.—Heat passes from warm to cold bodies by three general methods,—radiation, conduction, and convection. Radiation of heat takes places between bodies at all distances apart and the heat rays proceed in straight lines until intercepted or absorbed by some object. The amount of heat transmitted varies inversely as the square of the distance from the source. The rate at which heat is given off or absorbed depends upon the character of the surfaces of the bodies as well as upon their relative temperatures. Dark and rough surfaces radiate and absorb heat more readily than smooth and polished ones. Radiant heat passing through air or other gases does not affect their temperature to any appreciable extent.

Conduction.—The transfer of heat between two bodies or parts of a body in direct contact with one another is termed conduction. It differs from radiant heat in that it does not necessarily travel in straight lines, and in its gradual rather than instantaneous transfer. The quantity of heat conducted is proportional to the cross sectional area, to the temperature difference, and to the character of the material.

Metals are, in general, better conductors of heat than other materials, although they vary to a very great extent. The conducting power of stone is less than one per cent that of copper, and iron is about 3500 times as good a conductor as air.

Convection.—The transfer and diffusion of heat in a fluid mass through the motion of the particles of the mass is termed the convection of heat. The particles must be in constant motion in order to insure uniform temperature of the mass. When the particles come into contact with hot bodies the mass will be warmed in proportion to the freedom of circulation in the fluid.

Air is usually heated in a room by circulation of the air particles and bringing them into contact with heated surfaces. The better the circulation of air

against these surfaces the more uniform will the room temperature become.

Comparisons of Fuel and Electric Heat.—The relative heating values of fuels are often compared with electric heat. For instance, it may be shown that with coal having a heating value of 14,000 B.t.u. per pound and costing $5 per ton, manufactured gas having a heating value of 600 B.t.u. per cu. ft. and costing $1 per thousand cu. ft. and electricity having a heating value of 3412 B.t.u. per kilowatt hour and costing one cent per kilowatt hour, one cent will buy 56,000 B.t.u. of coal heat, 6000 B.t.u. of gas heat, and 3412 B.t.u. of electric heat. However, the fact must not be overlooked that all fuel apparatus is naturally less efficient than electric apparatus. With average efficiencies of say 10 per cent for coal, 20 per cent for gas, and 70 per cent for electric apparatus, the purchasing power of one cent under the above assumed prices and heating values would be 5600 B.t.u. of coal heat, 1200 B.t.u. of gas heat, and 2388 B.t.u. of electric heat.

The following table will be of assistance in making hasty comparisons of the B.t.u. value of fuel and electric heat. Efficiencies lower than 50 per cent are seldom, if ever, encountered in electric applications and are therefore omitted from the table.

B.t.u. Purchasing Power of One Cent.

Efficiency of Apparatus in %.....	100	75	50	30	20	10
14,000 B.t.u. Coal—						
$ 5.00 per ton.....	56,000	42,000	28,000	16,800	11,200	5,600
$10.00 per ton.....	28,000	21,000	14,000	8,400	5,600	2,800
600 B.t.u. Gas—						
$1.00 M. cu. ft.....	6,000	4,500	3,000	1,800	1,200	600
$1.50 M. cu. ft.....	4,500	3,375	2,250	1,350	900	450
Electricity—						
1c per kw.-hr.....	3,412	2,559	1,706	....	....	...
2c per kw.-hr.....	1,706	1,279	853	....	....	...
3c per kw.-hr.....	1,137	853	568	....	....	...
5c per kw.-hr.....	682	512	341	....	....	...

Actual experience proves that many careful calculations do not work out in practice. One might assume from the above figures, for instance, that the cost of using a gas range would be at least five times as

great as the cost of using a coal range. We know, however, that the average cost for cooking is less with gas than with coal under the prices assumed.

Cost should not be the only consideration in determining the best method to adopt. Improvement of product, elimination of waste, increased safety, saving of labor and skill, greater comfort and cleanliness, possibility of performing new and otherwise impossible operations, are all essential economic advantages that accrue to the user of electric heat.

CHAPTER II.

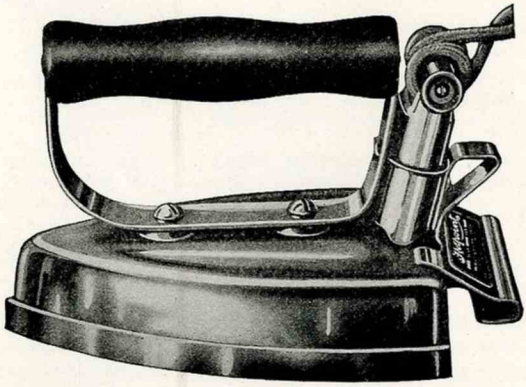
DOMESTIC LAMP SOCKET HEATING DEVICES

Importance of Labor Saving Devices.

When we look back and think of how the housewife of the past was hampered in the performance of her duties, and compare these difficulties with her present day opportunities of making housework an enjoyable pastime, we naturally wonder whether it is possible for the future to bring forth conditions which will be any more ideal.

The various household labor saving devices which have so enormously transformed economic conditions are here classified, as well as possible, to set forth their chief points of superiority. Although a single device may produce only a small revenue, taken collectively these devices are of ever increasing importance in the production of profitable central station incomes.

Electric Irons.—These were the first heating devices to come into universal use. They are now manufactured in many sizes, shapes and capacities and sold

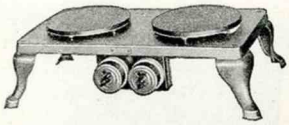


Hot Point Iron.

in greater quantities than any other electrically heated device known.

The principal advantages of the electric iron over the old fashioned sad iron are saving in time and steps, even heat distribution, freedom from smoke, grease and soot, absence of excessive heat, and ease with which it may be used in any part of the house. Irons varying in weight from 3 pounds to 9 pounds and in capacities from 200 watts to 675 watts are available for domestic use.

Electric Stoves.—Both the disc and open coil type are manufactured in various sizes and capacities. The disc stove has a metallic heating surface and delivers

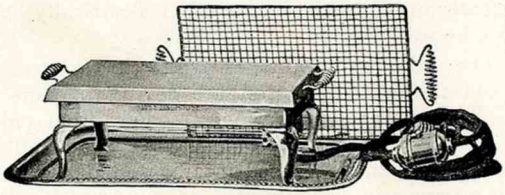


G. E. Twin Plate Disc Stove.

heat to the utensil by conduction. The open coil stove gives off radiant heat from exposed coils which are usually imbedded in grooves of porcelain or mounted above metallic reflectors.

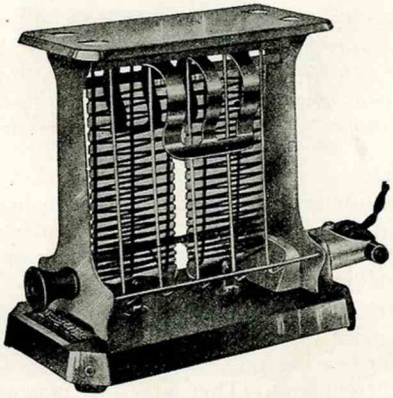
Electric stoves are useful for many household purposes in place of gas or alcohol burners. They are suitable for heating water for various purposes, or for doing light cooking. They are safe, convenient and durable. For domestic lamp socket use they are seldom larger than six inches in diameter and 600 watts in capacity.

Toaster Stoves.—Two distinct types are made—horizontal and vertical. Toast made on the horizontal type will be produced quickly but will not be toasted through so well unless the bread be dry. Toast made below radiant coils or in the vertical type toasters will be produced slowly but will be toasted thoroughly. Vertical toasters are usually provided with a warming shelf on top to keep toast or other food warm.



Westinghouse Horizontal Toaster Stove.

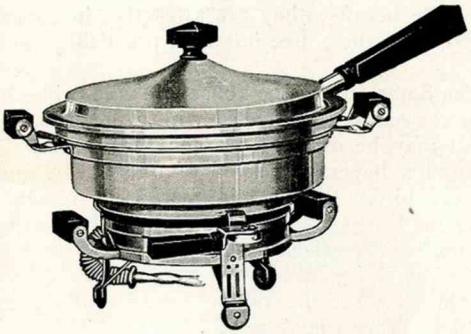
One great advantage of electric toasters is that they may be used on the dining room table instead of in the kitchen. From 400 to 600 watts are usually required for operating toasters.



Hot Point Vertical Toaster.

Chafing Dishes.—These frequently have an outer pan in addition to the food pan for use as double boilers. The food pans are made in two and three-pint sizes. The capacities vary from 250 to 600 watts. A wide variety of styles and ornamental types are available.

Electric chafing dishes are obviously safer to operate than alcohol or other flame types, and furthermore they give off no disagreeable odors or fumes.



Universal Chafing Dish.

Coffee Percolators.—Coffee made in an electric percolator is rich in flavor, free from grounds, and contains less caffein and other harmful elements than boiled coffee. Starting with cold water, strong coffee may be prepared in from ten to fifteen minutes.

Hot Point Percolator.

Electric percolators in all styles, shapes and character of ornamentation and in sizes varying from four to nine cups are available. They usually require from 450 to 600 watts. They are ideal for use on the dining

room table because they are attractive in appearance and also keep the coffee hot with practically no attention.

Tea Samovars.—The housewife who prides herself on her tea-making is pleased with a device where the tea-ball may be drawn up when the infusion is just right and a beverage served of fine flavor, and free from the bitter tannic acid taste that results from boiling tea-leaves in an ordinary pot. It is especially desirable for the afternoon tea because it can be operated in the living room. It furthermore does away with the disagreeable odors, fumes and dangers of alcohol or other fuel types.

Tea samovars are usually made in 5, 6 and 7 cup sizes and in capacities varying from 400 to 500 watts.

Tea Kettles.—Two and three pint sizes are usually made, requiring from 400 to 550 watts for operation. They are convenient and dainty for heating water for the tea service. They make an attractive addition to the table and possess the charm of a modern household luxury.

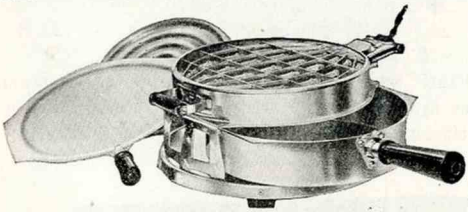
Simplex Dining Room Set.

Table Cooking Outfits.—Single disc stoves supplied with a variety of hollow-ware utensils are called unit-sets, dining room sets or combination stoves. Coffee percolators, tea samovars, chafing dishes, nursery milk warmers, frying pans, tea kettles, griddle plates, and other utensils are included in the various sets.

These devices bring electric cookery within reach of every one and encourage a better understanding of

its cleanliness, and convenience. For the hostess who does her own cooking the table cooking outfits are ideal. They are an ornament to any sideboard or table.

Electric Grills.—Many handy devices for cooking on the dining room table, or in the sick room, and which are attractive and convenient, are made by various heating appliance manufacturers. The Hotpoint El Grillo is a useful table device. It may



Hot Point Grill Stove.

be used for light toasting, frying and broiling as well as for boiling. Two of these operations may be carried on at one time as the utensils may be placed both above and below the glowing coils. It has a capacity of 600 watts and the dimensions of the heating element and pans are 4¼ by 8½ inches.

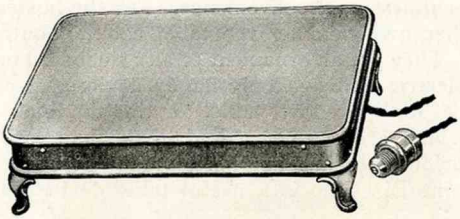
The Westinghouse toaster stove is really a small complete cook stove. It may be used for broiling, frying, toasting, boiling or making griddle cakes. The stove is 5¼ by 9 by 3⅝ in. high and consumes 500 watts.

The General Electric radiant grill may be used for frying, stewing, toasting, and broiling. This device consumes 600 watts.

Food Warmers.—Food warmers are made in a variety of portable styles, shapes, and sizes, and may be used on the table or sideboard.

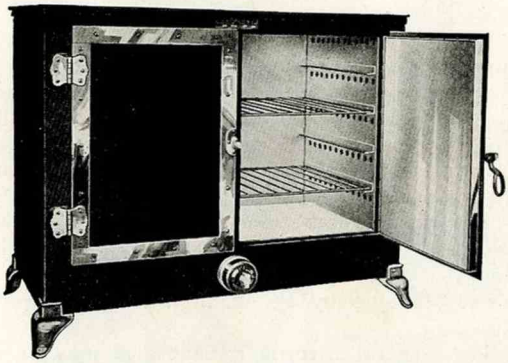
Simplex nickel or silver plated food warmers of the following sizes and capacities are available:

Oval shape, 10 in. by 14 in.	170 watts
Oblong shape,	
10 in. by 14 in.	200 "
10 in by 18 in.	250 "
Oblong shape (extra heavy)	
10 in. by 14 in.	200 "
10 in. by 18 in.	250 "
10 in. by 26 in.	400 "



Simplex Food Warmer.

Plate Warmers and Hot Closets.—A variety of shapes and sizes of plate warmers and hot closets are manufactured to order to fit available spaces, or standard portable types may be used.



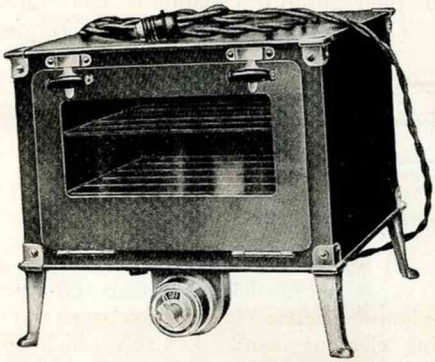
Hughes Plate Warmer.

In estimating the size of a plate warmer closet a shelf space of at least 10½ in. should be allowed for ordinary dinner plates and a height of 6 in. for twelve in a pile.

On account of the relatively low temperature required inside the oven, the current consumption is usually low, especially if the walls are well insulated against heat losses.

Bake Ovens.—Devices like the small Hotpoint lamp socket bake ovens (El Bakos) are useful for light

baking operations. The inside dimensions are 11 in. by 10½ in. by 7½ in. and they consume 600 watts on the high heat. They are of steel construction with nickel



Hot Point El Bako.

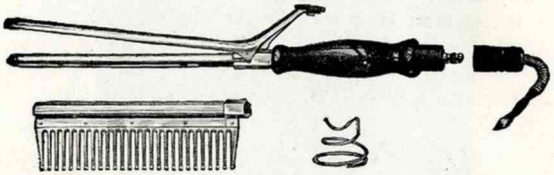
trimmings and the walls are lined with mineral wool to retain the heat. These ovens have practically all the inherent advantages of larger electric ovens.

Simplex Nursery Milk Warmer.

Nursery Milk Warmers.—These consist of a water vessel and cover, a milk bottle, and a nipple. They are designed for quick heating and are made in capacities varying from 300 to 500 watts. They are ready for use at any time—day or night. The 500 watt size

will heat a bottle of milk in about four minutes or boil a pint of water in about six minutes.

Curling Iron Heaters.—These are desirable on account of their absolute cleanliness, convenience, and safety. They are made in capacities varying from



Universal Curling Iron and Hair Dryer.

60 to 90 watts and in plain or ornamental types. The Westinghouse electric curling iron is equipped with a heating element inside the iron which consumes 15 watts.

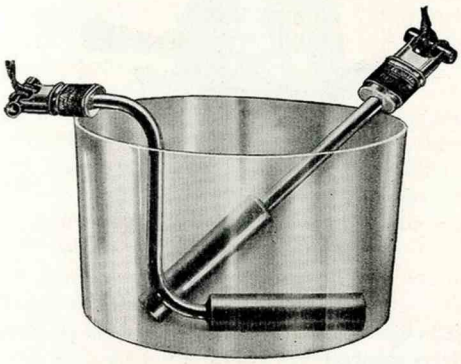
Warming Pads.—For local applications of heat to the body electric pads are rapidly superseding the hot water bottle and similar devices. These pads are

Simplex Warming Pad.

usually made of soft padded cloth although some of the new Hotpoint pads are made of either rigid or flexible metallic materials. The Westinghouse pads are 11 in. by 15 in. and have an outer rubber cover. The Simplex pads have an eiderdown cover and are made in two sizes, 12 in. by 15 in. and 15 in. by 24 in.

The American warming pad is 12 in. by 13 in. Warming pads are generally provided with regulating switches giving three degrees of heat. The capacities vary according to dimensions from 50 to 100 watts maximum. The American sweating blanket is 5 ft. long by 18 in. wide and requires 800 watts.

Immersion Heaters.—These appliances are useful in the home that is not provided with a constant supply of hot water. By fastening to the lamp socket and submerging the heater in water or other liquid the sub-



Hot Point Immersion Heaters.

stance can be brought to a boil very quickly. Inasmuch as the heating element is placed directly in the liquid the efficiency of operation is high. They are handy for shaving and similar purposes. Heaters of various shapes and capacities are available.

Other Household Devices.—A few of the better known heating and cooking devices are mentioned for reference purposes.

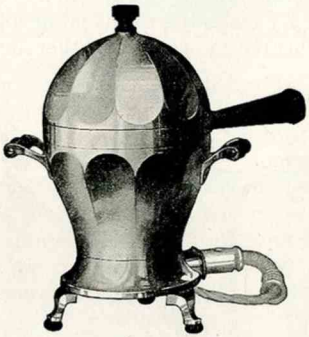
Egg boilers are convenient because they can be used on the table and given personal supervision.

Fry pans and saute pans designed for use on the dining room table are useful.

Soup tureens are handy for keeping soups and other prepared foods at the proper temperature for serving.

The Hotpoint utility outfit which comprises a three pound iron provided with a stand on which it may be inverted for cooking, and a receptacle for inserting a curling iron is useful for the roomer or traveler.

The foot warmer is a handy device for use in rooms with cold floors. If placed under a desk or



Universal Egg Cooker

table it will keep an occupant warm even when the room is comparatively cold.

Air radiators of both the radiant and convection types are useful in small rooms and in cold corners. A separate chapter is, however, devoted to the subject of air heating.

CHAPTER III

INSTALLATION OF HEATING APPARATUS.

Correct Installation.—This is essential for ranges, water heaters, and other heating devices. If wires are too small, the service will be poor. If the appearance of the work is not good, the user will be dissatisfied. If proper protection against electric shocks is not afforded, the customer may be in constant fear. If a range, for instance, is not placed in such a position that it can be conveniently operated by the cook or housewife, she may form mental prejudices that will be difficult to overcome. Intelligent supervision and careful inspection of all heating installations will be of mutual benefit to all concerned.

Wiring for Heating Apparatus.—The Code of the National Board of Fire Underwriters should be adhered to as closely as possible in wiring for heating apparatus. Furthermore, local city and state rulings have a distinct legal status the importance of which should not be overlooked. Unfortunately the National Code rulings which apply to the installation of heating service are in some cases burdensome, and in others not strict enough.

All wiring should be done in a neat and workmanlike manner so that an electric installation will not detract in any way from the appearance of the premises. Electric ranges, water heaters, and other heating devices on the market usually look attractive, but if they are not properly connected and installed the general appearance may be bad.

Carrying Capacities of Wires.—The allowable carrying capacity of conductors operating under pressures of 120 volts, two-wire, and 120-240 volts, three-wire, are given in Table I for convenient reference.

Table I.

Maximum Allowable Wattage Carrying Capacity.

Size B. & S. Gauge.	Area Circ. Mils.	—Rubber Covered— 120 volt. 2-wire.	120-240 v. 3-wire.	—Weather Proof— 120 volt 2-wire.	120-240 v. 3-wire.
0000	211,600	27,000	54,000	39,000	78,000
000	167,800	21,000	42,000	33,000	66,000
00	133,100	18,000	36,000	27,000	54,000
0	105,500	15,000	30,000	24,000	48,000
1	83,690	12,000	24,000	18,000	36,000
2	66,370	10,800	21,600	15,000	30,000
4	41,740	8,400	16,800	10,800	21,600
6	26,250	6,000	12,000	8,400	16,800
8	16,500	4,200	8,400	6,000	12,000
10	10,380	3,000	6,000	3,600	7,200
12	6,530	2,400	4,800	3,000	6,000

Wires of sufficient size to conform to the allowable carrying capacities in the above table will conform to the Underwriters' Code but may prove too small to insure good service. This will be true if the run is a long one because in the above table no account is taken of its length.

Table II shows the drop in voltage (below 120) that may be figured per hundred feet of both two and three-wire circuits. The calculations are based on an assumed pressure of 120 volts for two-wire service and 120-240 volts impressed on a three-wire circuit.

Table II.

Wattage Load on End of Line.

No. B. & S. Gauge	2500 2-wire.	2500 3-wire.	5000 2-wire.	5000 3-wire.	7500 2-wire.	7500 3-wire.
0000	.204	.102	.409	.204	.619	.306
000	.258	.129	.515	.258	.774	.386
00	.325	.162	.650	.325	.975	.487
0	.410	.205	.819	.410	1.229	.615
1	.517	.258	1.033	.417	1.550	.775
2	.651	.326	1.303	.651	1.954	.977
4	1.036	.518	2.071	1.036	3.107	1.553
6	1.647	.824	3.294	1.647	4.941	2.471
8	2.618	1.309	5.237	2.618	7.855	3.927
10	4.164	2.082	8.329	4.164	....	6.246
12	6.623	3.312	....	6.623	....	9.935

No. B. & S. Gauge	10,000 2-wire.	10,000 3-wire.	15,000 2-wire.	15,000 3-wire.	25,000 2-wire.	25,000 3-wire.
0000	.818	.409	1.238	.619	2.044	1.022
000	1.030	.515	1.548	.774	2.576	1.288
00	1.200	.650	1.950	.975	3.250	1.625
0	1.638	.819	2.458	1.229	4.096	2.048
1	2.066	1.033	3.100	1.550	5.166	2.582
2	2.606	1.303	3.908	1.954	6.515	3.257
4	4.143	2.071	6.214	3.107	....	5.178
6	6.588	3.294	9.882	4.941	....	8.235
8	....	5.237	....	7.855	....	....
10	....	8.329	....	....	....	....
12	....	....	....	....	....	....

Correct Voltage.—For heating apparatus this is important. Many complaints may be obviated by supplying energy at a pressure as near as possible to the rated voltage of the apparatus. Low voltage results in slowness of operation, and excessively high voltage is likely to cause burn outs.

Assume a heating element rated at 1100 watts and 110 volts is supplied with energy at a pressure of 100 volts. The resistance of the element is therefore: $R = E/I = 110/10 = 11$ ohms.

At 100 volts pressure the quantity of current flowing would be $I = E/R = 110/11 = 9.1$ amperes and the wattage dissipated in heat would be $W = EI = 9.1 \times 100 = 910$ watts. The efficiency of operation of the element, therefore, would be $910/1100 = 82.7$ per cent, whereas the voltage was supplied at only $100/110 = 91$ per cent of the normal rating.

Voltage readings should always be made at the terminals of the heating device at no load and at full load, otherwise the drop in voltage in the service leads or interior wiring may be overlooked, and a wrong impression gained.

Methods of Wiring.—How to wire a building for heating service should be carefully considered before the actual work is undertaken. Exposed wiring with knobs and cleats is safe and cheap but is seldom used because of its unsightliness. Moulding work is sometimes installed in old buildings but unless the work is done extremely well it may look unattractive. The concealed knob and tube method is often used in both new and old buildings and the work may usually be done at reasonable cost. Rigid or flexible conduit, or steel armored conductor wiring are generally considered to be the best, although the most expensive methods.

Exposed Knob and Cleat Wiring.—This is often used in wiring for heating and cooking service and in places where appearance is of little consequence it is one of the cheapest and best. The wires may be single braid rubber-covered or slow burning weather-proof.

In cellars or other places exposed to moisture rubber-covered wire must be used.

Wooden Moulding Wiring.—Where a neat appearing low-priced job is required this construction may well be used. Its use in damp places is however prohibited by the Underwriters. Single braid rubber-covered wire is required. For first class work hard wood moulding, matching in finish the trim of the room, can be used.

Wiring in Metal Moulding.—As this is restricted to circuits carrying not more than 1320 watts it is seldom employed for heating or cooking circuits. Single braid rubber-covered wire may be used for this class of work. Metal moulding must always be grounded permanently.

Concealed Knob and Tube Wiring.—In frame buildings where a low cost of installation is essential the wires may be installed within floors and partitions. Wires can ordinarily be concealed in this manner more cheaply than by any other method. Single braid rubber-covered wire may be used.

Rigid Iron Conduit.—This is approved for both exposed and concealed work. Ordinarily it is probably the best, although the most expensive. Double braid, rubber-covered wire must be used in rigid conduit. The same conduit may contain as many as 4 two-wire or 3 three-wire circuits. Stranded wire in sizes larger than No. 6 is customarily used for rigid conduit work. Rigid conduit must be permanently grounded.

Table III.

Size of Wire, B. & S. Gauge.	Size of Conduit, Inches. Two Wires in Conduit. Short Run.	Medium Run.	Long Run.	Three Wires in Conduit. Short Run.	Medium Run.	Long Run.
10	½	¾	¾	¾	1	1
8	¾	¾	1	1	1¼	1¼
6	1	1	1¼	1	1¼	1¼
4	1	1¼	1¼	1¼	1¼	1½
2	1¼	1½	1½	1¼	1½	2
1	1¼	1½	2	1½	2	2
0	1½	2	2	2	2	2
00	1½	2	2	2	2	2½
000	2	2	2	2	2½	2½
0000	2	2	2½	2	2½	3

Table III shows the size of double braid rubber-covered wires that can readily be pulled into conduit.

Flexible Metallic Conduit.—For all kinds of exposed or concealed work such construction is often preferable to rigid conduit. The installation of flexible conduit can be made easier, quicker, and more cheaply than can riged conduit. The same code rules apply to flexible as to rigid conduit. It must be securely grounded. Double braid rubber covered wire is required. Flexible metallic conduit may be used to advantage in finished houses and in frame buildings.

The sizes of wire that may be accommodated in flexible steel conduits are given in table IV.

Table IV.

Nominal Inside Diam. In Inches.	Largest Wires Accommodated. One Wire.	Two Wires.	Three Wires.
½	8	12	..
¾	2	10	12
1	00	0	8
1¼	200,000	4	6
1½	400,000	1	3
2	800,000	200,000	00

Flexible Steel Armored Conductor.—Here a cable consisting of rubber-covered wires is protected from injury and to a certain extent from dampness by two layers of flexible steel armor. It may be obtained leaded or unleaded. The leaded cable differs from the unleaded in that it has a lead covering between the wire and the steel armor to protect it from excessive dampness. Both the leaded and the unleaded cables are made with single and multiple conductors of almost any gauge wire. The leaded cable is approved for all classes of work, open or concealed, in fireproof or non-fireproof buildings, and in new or old houses. The unleaded cable is approved and may be used for open or concealed work in places not subject to moisture.

For wiring old buildings steel armored conductor can be used to great advantage. It can be run with utter disregard to contact with pipes or other materials and may be fished for long distances. It can be installed quicker and with less cutting away of the walls and floors than either rigid conduit, flex-

ible tubing, or concealed knob and tube work. Steel armored conductor should always be carefully grounded.

The Main Entrance Switch.—For three-wire heating circuits this should always be of the fused type with the neutral fuse coppered.

Control Switch.—Heating devices should be provided with control switches that will indicate at a glance whether the circuit is open or closed. The switch should be mounted on the device or on the wall immediately adjacent to it so as to be easily accessible. It should be of the enclosed knife blade or snap switch type and so designed as to entirely disconnect the heat-type appliance at the wish of the operator.

Grounding.—The frames of all heating appliances, especially those of the larger types, should be carefully grounded, whether they are connected to two-wire or three-wire circuits. Satisfactory grounding may be accomplished by connecting the frame of the device to a water pipe. If the appliance is operated from a three-wire grounded neutral system the frame may be connected to the neutral wire. In case of doubt as to the character of the ground on such a system, the neutral may be grounded, in turn, to some convenient water pipe inside the building.

When a rigid or flexible metallic conduit or steel armored conductor job is installed, the frame of the device may be grounded to the conduit or steel armor; provided, of course, the conduit or armor is itself grounded elsewhere.

Ranges in Apartment Houses and Flats.—In this case separate circuits from the main switchboard are necessary. Each circuit must be fused but in the case of three-wire circuits the neutral should be coppered.

Main service wires and switches supplying group cooking loads are never called upon to carry the entire connected load. Apartment houses equipped with ten or more ranges are never known to have a demand greater than one-fourth the connected load. The larger the number of ranges supplied from a single

service the less will be the demand in proportion to the load connected. This is a condition seldom met with in supplying other classes of electric service and one for which no provision has been made in the Underwriters' Code. It is obvious, however, that to install service leads, main switches, fuses, etc., of sufficient carrying capacity to handle the total connected load would be of no advantage, and would involve needless expense.

The Proper Position for a Range.—The range should be located where it can be operated with ease and convenience. If it is placed where the light is bad, in an inaccessible corner of the kitchen, or where the cook or housewife has to walk back and forth a greater distance than that to which she has been accustomed, a serious prejudice may be created in her mind. An electric range is often installed in a kitchen by the side of a coal, gas, wood, or oil range, the latter being left in, either for auxiliary use or for want of a better place for storing the old equipment. When this condition is met, every endeavor should be made to secure permission to place the electric range in the most advantageous position. Otherwise the customer will have a tendency to use the appliance most favorably located for most of her work.

CHAPTER IV

ELECTRIC COOKING.

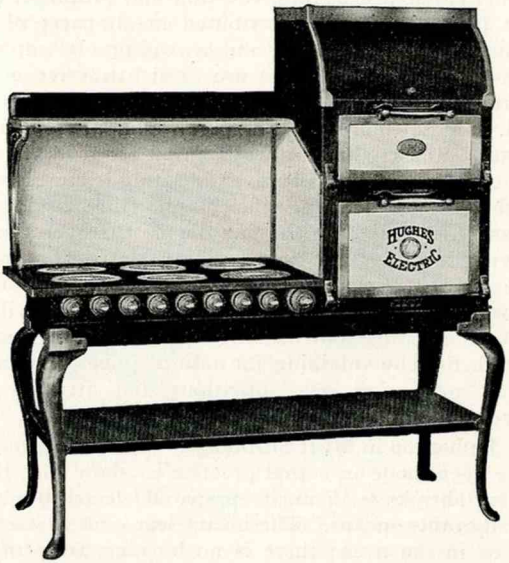
The March of Progress.—Modern civilization's advance may be clearly indicated by the progress in methods of cooking. Wood was the first material to be used as a fuel. Water was boiled in a kettle suspended over a log fire and meats were broiled on a spit, or roasted in the embers, for many hundreds of years. When it was found that coal produced a more uniform and hotter fire, and was far more desirable than wood, another era of progress was marked. The old fashioned fire place gave way to the more modern kitchen range. Then came fuel gas, which may be considered a product of coal, and the gas stove made its appearance. Although the use of gas obviously involved more danger and was somewhat more expensive, it was found to be quicker and far more convenient.

Crowning success was achieved, however, when the electric method was perfected, and the bridging of space between the historic fuel fire and the modern heat produced without flame was accomplished.

Advantages of Electric Cooking.—The extent of the improvement brought about by the electric range is almost unbelievable. The heat is under absolute control. The operator knows and commands the temperature at all times. The wasting of heat has been reduced to a minimum. The units or burners generate the heat right where it is used, and very little loss takes place. The heat utilized in the oven is generated on the inside, and as its walls are heavily insulated with material of low thermal conductivity, there is practically no opportunity for useful energy to escape.

Facility of Operation.—The electric range is easier to operate and can be regulated with a much greater degree of accuracy and certainty than the fuel range.

Being clean, safe and labor-saving, its use promotes greater cleanliness and comfort. It produces no excess heat, smoke or fumes to vitiate the atmosphere, and does away with the constant attention and anxiety of the fuel fire. Cooking utensils, furthermore, may always be kept clean and free from smoke and soot on both the inside and outside.



Hughes No. 60 Range (for Large Family Use).

Uniformity is attained in the electric range because it will always produce the same results under the same operating conditions. For instance, the oven has to be opened but twice for each operation—once when the food is inserted, and again when the cooking is completed. The operator has only to watch the clock while the food is cooking. This advantage partially removes the objection that many persons have to a low oven, which, with fuel stoves, requires constant bending over to examine the condition of the

food. Any housewife, of even moderate intelligence, should be able to master the essential features of the operation of an electric range in a short time by simply reading the card of instructions that is sent out by the manufacturers with each range.

Special Advantages.—The individual operations in which the electric range outclasses every known type of fuel stove, are baking, roasting and broiling. The heat being uniformly distributed in all parts of the oven, insures even baking and browning. It will bake bread, cake, and pies that are most attractive in appearance. They will always have just the right color, will contain more nourishment, and remain fresh longer. Roasts should always be prepared in an open pan containing no moisture, and basting is unnecessary in the electric oven. Sufficient moisture and meat greases will collect in the pan during the operation to prevent burning, and to provide material for gravy. The roast itself will come out of the oven uniformly browned on top, bottom and sides, if no basting is done. In both roasting and broiling operations the meat is seared, thereby retaining its natural juices, and making it more delicious, nutritious and attractive to serve.

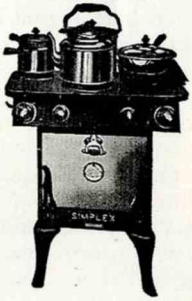
Reduction in Meat Shrinkage.—Many experiments have been made in actual practice to show that there is less shrinkage in meats prepared electrically than by any other means. The meats sear over as soon as placed in the oven; there is no burning away of the fats and juices; and a saving of from 15 per cent to 18 per cent in the actual weights of the meats is effected. The tremendous economy in household expense that is made possible by the use of the electric range is apparent if we consider a family whose meat bill has averaged $15 per month and a saving made of 15 per cent in the meat shrinkage by the use of electricity. Meat costs in this family would be reduced $2.25 per month with the exercise of no additional self denial.

Assume an eight pound roast is placed in a 1600 watt electric oven and roasted 2½ hours. The current

consumption at high heat would be 4 kilowatt hours, but by proper manipulation of the oven switch not over half this amount, or 2 kilowatt hours, would be actually consumed. The saving in weight of the meat over gas or coal cooking would amount to at least one pound. With current costing three cents per kilowatt hour and meat twenty cents per pound the actual saving to the housewife in cooking the roast electrically would be as follows:

1 lb. of meat saved at 20c	$ .20
2 kw-hr. at 3c cost	.06
Actual saving	$0.14

Model G Hot Point Range.



Simplex 5-K Range.

Important to Use Proper Utensils.—Only flat bottomed utensils should be used for surface cooking on the electric range. Air is a poor conductor of heat, and consequently, the closer the heating unit can be brought to the bottom of the utensil, the greater will be the efficiency of operation. The necessity is particularly apparent in ranges making use of an element of the enclosed type, where the heat is transmitted to the food from a hot surface through the bottom of a utensil. If direct metallic contact is not secured the efficiency will be tremendously impaired; slow operation will result; and the housewife will become displeased.

Agate or enameled ware should never be used on enclosed type elements. Iron, copper, or aluminum

vessels will be found far more efficient. On the other hand, agate, enameled ware, and black bottomed iron utensils have been found very satisfactory for use with open type elements. Polished metallic bottom surfaces reflect and do not take up the heat from a radiant type element as do black surfaces. Contrarywise, highly polished sides and tops retain heat in a utensil much more efficiently than do dark or rough surfaces. If the bottom of any kind of utensil is corrugated, hollowed out or warped it cannot be expected to give satisfactory results.

Economy in Range Operation.—Food prepared on the cooking surface will not burn on the inside of the utensil as long as any moisture remains in the vessel, because heat is applied only at the bottom and never at the sides. For this reason, the amount of water usually required to keep food from burning may be reduced and the operations performed more easily and quickly. The food will be steamed thoroughly, and the natural sweetness and flavor will be cooked into the food, rather than boiled out into the water poured away. Water absorbs more heat than any commonly known substance, and a little economy in the use of water will effect considerable saving in both heat and electricity.

Users of electric ranges should be encouraged to use water drawn from the hot water storage supply for cooking purposes. Water taken from the top of a tank is obviously purer than that taken from the water mains because the tank acts as a natural settling basin for the collection of all impurities and sediment. If hot water is used in preparing foods, the operations may be done more quickly, and considerable saving in current consumption effected.

One very common method of effecting economies in the operation of a range, is to place as many foods as possible in the oven instead of on the cooking surface. The oven, being heavily insulated, retains practically all the heat generated and the usual losses that attend cooking on the surface units are thereby done away with.

Water for laundry work, washing, bathing, and other domestic purposes cannot be heated as economically on an electric range surface as by other means. If the housewife desires, however, she may successfully boil clothes by placing an ordinary copper bot-

Hughes Junior Range (for Early Training of Housewife).

tom boiler over two of the range discs. Quicker action will result if the boiler is kept covered, and a heavy paper wrapped about the sides of the vessel.

The saving that may be effected by skilful use of the individual three-heat switches is often little understood by the average woman. She should be trained to know that the low heat consumes but one-quarter, and the medium heat one-half as much current, as the high heat. Food brought to the boiling point on high heat should be retained at this temperature at

low or medium heat. A boiling temperature higher than 212 degrees F. cannot be obtained in an open vessel and food will cook just as quickly when boiling slowly as when boiling rapidly.

Elimination of Kitchen Chimneys.—If fuel is burned in a kitchen a chimney is naturally required. On the other hand the expense of installing a chimney may be obviated by using an electric range. Even with gas the harmful products of combustion must be removed as shown by the following from page 20, Technical Paper 109, U. S. Bureau of Mines:

"Natural gas, when burned with sufficient oxygen for complete combustion, forms carbon dioxide and water vapor. Each cubic foot of natural gas burned produces a little over 1 cubic foot of carbon dioxide and a little more than 2 cubic feet of water vapor. Carbon dioxide is an irrespirable gas and should not be allowed to accumulate in a room. Water vapor also should be removed, because it has a depressing effect if present in still, warm air in sufficient proportion and tends to make the walls, ceilings, curtains and other objects in a room dirty because the dust is entrained by it and settles on the objects."

"The only way to remove these two gases is by means of a vent leading from the stove to the house chimney. It is absurd for any manufacturer of stoves to claim that these two gases are practically absorbed or eliminated in any other way."

Operation by Servants.—Care should be exercised in placing a range in the hands of a professional cook. This type of individual is frequently a difficult person to handle. He seldom favors anything new. He is prone to form intense prejudices; and will often refuse to make an intelligent investigation of new apparatus, especially when he has not been previously consulted. He is always a very powerful factor in matters concerning the management of a kitchen, and his position should not be overlooked.

If he dislikes equipment placed in his charge he may damage it, refuse to handle it properly, or cause the operating cost to run up excessively. Disastrous results are certain to accrue if the cook's attitude is unfavorable.

Repeated experience has proved that the housewife who does her own cooking is the most desirable user of an electric range. She will be, as a rule, thoroughly alive to its advantages, will practice the many little economies that are possible, and will generally become a "booster" for electric cooking.

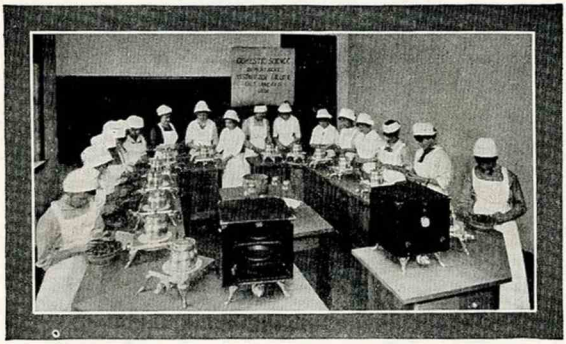
Attention to Range Users.—When ranges are first installed the users should receive very careful attention. It must be remembered that the manipulation

General Electric No. S-3 Range.

of an electric range is entirely new to the average housewife. If something about the apparatus is out of order; if the best results are not secured at the start; or if some of the many little economies that may be practiced are overlooked and the first month's bill proves higher than has been anticipated, an erroneous mental impression may be formed that may prove difficult to correct. If troubles are not rectified or explained away, they will become magnified as time passes, and the housewife may finally become seriously prejudiced. Furthermore, every electric range placed is naturally watched by the many friends, relatives and neighbors of the user. In as much as it is generally conceded that the best advertising medium

is the satisfied customer, it is well worth while to give the user early and painstaking attention.

Electric Cooking in Schools.—The encouragement of electric cooking in the domestic departments of educational institutions will foster the more rapid introduction of electric ranges in the homes. In order that correct impressions may be created in the minds of the students, it is highly important that the equipment be intelligently selected, that the apparatus be properly installed, and that the service be the best attainable.



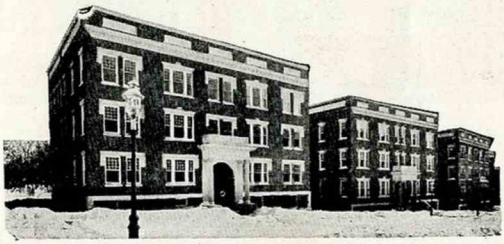
Domestic Science Classroom, Westminster College, Salt Lake City.

For classroom work, small rather than large individual disc stoves should be installed, because only a small amount of food need be prepared at one time. Double boilers and frying pans should be provided with each stove, and these utensils should be of a size to fit and of a kind that will operate properly with the particular type of disc stove that is installed. Small individual bake ovens are comparatively inexpensive, occupy little space, produce excellent results, and may be recommended for well-equipped departments.

In some school where domestic science is taught complete electric cooking equipments have been provided and meals prepared and served cafeteria style during the noon hour periods. The income from the

nominal charge made for these meals has been adequate, in a number of instances, to pay the operating cost of the electric kitchen, as well as of the entire department.

Other institutions have gone further, and arranged for the use of electric flat irons, water heaters, and other labor-saving devices. At least one complete electric range should be made the part of any modern domestic science room equipment. The comparatively few hours during which classes are in session make the operating cost of electrically operated installations very small. Although the income from this class of

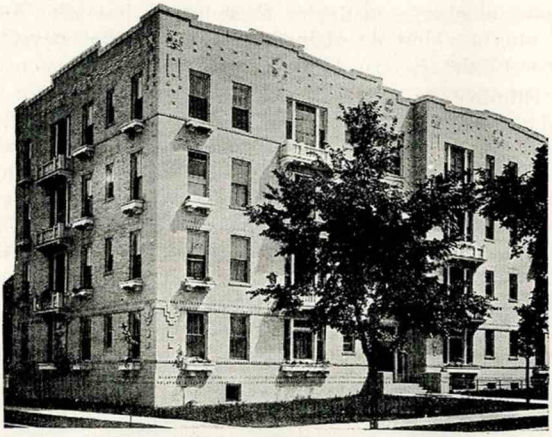


McDonald Apartments, Boston, Equipped with Hughes Ranges.

business is not large, the load is of an off-peak character, and the results are far-reaching. The favorable impression created by equipping domestic science departments in this manner cannot but have a beneficial effect upon the school and a credit to the individuals in charge.

Electric Cooking in Apartment Houses.

Adaptability of Electric Range.—The electric range seems to be peculiarly adapted for use in apartment houses. The character of construction of the buildings, the mode of living of the tenants, and the many recognized advantages of the electric range make it much superior to the fuel burning stove. A resume of the most essential qualifications of this type of apparatus and the better conditions that may be brought about where it is installed for apartment house cooking service should not be out of place in these pages.



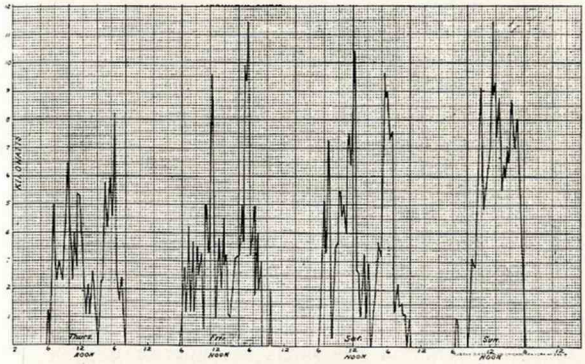
Jensen Apartments, Great Falls, Mont. (Equipped with Simplex Ranges.)

Economy in Space.—In the design of the modern apartment house every foot of space is valuable and the architect must plan to utilize it to the best advantage. His efforts in this direction seem to have resulted in the laying out of very small kitchens which are often stuffy and poorly ventilated. The electric range is best fitted to meet these recognized conditions for several reasons: It is compact in construction, and as the exterior never becomes hot enough to burn the woodwork it may be placed against the wall and thereby take up less space. The unbearable heat of a fuel range in a small kitchen is eliminated. There is no combustion in the electric range and it neither throws off poisonous fumes nor takes up the life-giving oxygen from the air.

Expense Saved.—The initial outlay required for the installation of chimneys and gas plumbing may be entirely eliminated. When the building is once occupied the periodical expenditures incident to repainting, retinting and repapering, may be cut in half. The very nature of the electric range, which creates no products of combustion, and which overcomes the

smoke, moisture and grease nuisances peculiar to the fuel range, makes the frequent refinishing of interiors unnecessary.

Elimination of Hazard.—Where fuel stoves are used there is constant danger of fire. Gas offers the menace of asphyxiation and explosion. The careless opening of a valve, a temporary cut-off of the main supply, or a little mistake of the cook or housewife may



Typical Apartment House Cooking Load Curve, 24 Ranges, 75 kw. Connected, Maximum Demand 11½ kw.

result disastrously. In as much as the electric range produces no flame, and neither utilizes nor gives off any explosive or poisonous gas, its use does away with all danger of loss of life or property.

Convenient for the Tenant.—On account of the absence of soot and burned foods, the utensils used on an electric range are easier to cleanse both inside and outside. Silverware in an apartment house never tarnishes as it does where gas is used. Unlike gas, electricity throws off no sulphur fumes.

Another condition that goes to make the electric range popular, is that an auxiliary supply of hot water is usually available for use in the apartment house, and may be utilized for cooking operations to attain quick results.

Desirable Central Station Load.—From an operating standpoint the apartment house business is very desirable for the central station company. The load is, for the most part, of an off-peak character. The load factor and diversity factor are both unusually attractive. The maximum demand is frequently shown to be not over one-sixth of the connected load. Compared with apartment house lighting and elevator loads the business is obviously more desirable.

Preparation of Food.

Knowledge of Cooking Valuable.—For those interested in the sale of electric ranges or in the building up of electric cooking loads, a general understanding of how foods are prepared, why it is necessary to cook them, and the best methods to employ, will be of value. If one endeavors to interest a housewife in an electric range, he should know something about the use to which it is to be applied, otherwise he will not readily gain her confidence. Anyone familiar with the following paragraphs as well as with the natural advantages of electric heat, will be able to show the average housewife wherein electricity is superior to fuel heat in performing the various cooking operations suggested.

Reason for Cooking.—The cooking of food has much to do with its nutritive value. Many articles which are quite unfit for nourishment when raw are nutritious when cooked. It is also a matter of common experience that a well cooked food is wholesome and appetizing, whereas the same material badly cooked may be both unhealthful and unpalatable.

Purposes of Cooking.—There are three chief purposes of cooking. The first is to change the mechanical condition so that the digestive juices can act upon the food more freely. The second is to make it more appetizing by improving the appearance or flavor, or both. Food which is attractive to the taste quickens the flow of saliva and other digestive juices, and thus aids digestion. The third is to kill any disease germs, parasites, or other dangerous organisms it may con-

tain. This is often an important object, and applies to both animal and vegetable foods.

Cooking of Meats.—For the most part meat is either boiled, stewed, fried, broiled or roasted. In general, it is probably true that cooking diminishes the ease of digestion of most meats. It may also remove considerable quantities of the nutrients.

Boiling of Meat.—If it is desired to heat the meat enough to kill bacteria in the inner portions of the cut, the piece must be exposed to the action of heat for a long time. If it is brought slowly to a boil, a good broth will be obtained, but the meat will be tough and tasteless.

If a piece of meat is plunged into boiling water or very hot fat, the albumen on the entire surface of the meat is quickly coagulated and the crust thus formed resists the dissolving action of water and prevents the escape of the juices and flavoring matters. Thus cooked, the meat will possess the desired meaty taste but the resulting broth will not be considered good.

It is impossible to make a rich broth and have a juicy highly flavored piece of meat at the same time. If the meat alone is to be used, it should be plunged into boiling water and kept at that temperature for about ten minutes, after which the cooking should be continued at about 180 degrees F. until the tissues become tender.

Stewing of Meat.—If both the broth and the meat are to be used, the process of cooking should be quite different from that of boiling. In stewing, the meat should be cut into small pieces so as to present relatively large surface area and, instead of being quickly plunged into hot water, should be put into cold water, in order that the juices and flavoring materials may be dissolved. The temperature should then be slowly raised until it reaches about 180 degrees F. where it should be kept for several hours. Treated in this way the broth will be rich, and the meat tender and juicy.

Roasting of Meat.—The principle difference between roasting and boiling, is in the medium in which the meat is cooked. In boiling the flesh is surrounded

by hot water, whereas in roasting it is surrounded by hot air and acted upon to some extent by radiant heat. In both operations, if properly conducted, the meat fibers are cooked in their own juices.

When the meat only is to be eaten, either roasting, broiling, or frying in deep fat is a more rational method than boiling, for the juices are largely conserved in the meat.

Cooking of Vegetables.—Vegetables baked, roasted, fried or boiled, are used for preparing a large variety of dishes. The most common method of cooking is that of boiling in water. The steaming of vegetables is often resorted to, but the results are similar to those of the boiling process.

The simpler the method of cooking and serving vegetables the better. A properly cooked vegetable will be palatable and readily digestible. Poorly cooked, water soaked vegetables generally cause serious digestive disturbances. All vegetables should be thoroughly cooked, but the cooking should stop while the vegetable is yet firm. As long as the vegetable is kept at a temperature above 125 degrees F. changes continue to go on in the vegetable substance. The most marked of these are in the starch, and in the odor, color, and flavor of the vegetable. Overcooking changes and toughens the texture of vegetable foods, destroys the coloring matters, and volatilizes or otherwise injures the substances which contribute to its flavor.

Cooking of Breads and Pastries.—In breads, cakes, pastries and other foods prepared from flour, the aim is to make a palatable and higher porous substance that can be more easily digested than the raw materials could be. Sometimes this is accomplished simply by means of water and heat. The heat changes part of the water content into steam, which, in trying to escape, forces the particles of dough apart. The protein (gluten) of the flour stiffens about the tiny bubbles thus formed and the mass remains porous even after the steam has escaped. More often, however, other ingredients, such as yeast and baking powder,

are used to "raise" the dough. The baking powder gives off carbon dioxide gas, and the yeast causes fermentation in the dough and produces carbon dioxide. This gas acts the same as steam, only much more powerfully.

Baking of Bread.—Bread is placed in the oven as a heavy uniform mass, and comes out a light body of increased volume with a crisp, dark exterior—the crust—and a firm, spongy interior—the crumb. The crumb naturally heats more slowly than the crust. The moisture which it contains prevents its temperature from rising much above the boiling point of water (212 degrees F.) When first put into the oven the yeast begins to work but a temperature of 158 degrees F. kills it. The gas in the dough, however, continues to expand, and forcing its way outward, enlarges the loaf and gives it a spongy appearance. Meanwhile the crust becomes hard and dark and the heat changes its starch into stiff gum and sugar and dries out the moisture. The brown color is due to chemical changes known as "caramelization."

Baking Temperatures.—The heat in the oven should not be too great, or the outside of the bread will harden too quickly, and the crust will be thick and hard before the interior is done. Furthermore, the gas expanding in the crumb will be unable to escape through the crust and will lift up the latter, leaving great holes beneath it.

The temperature of an oven and the time required for baking depends upon the size of the loaves and the character of the dough. Small biscuits or rolls can stand a much hotter oven, and quicker baking, than large bread loaves. For ordinary purposes, a temperature of from 400 degrees to 500 degrees F. is satisfactory for a pound loaf of bread. An experienced cook can tell when an oven has reached the proper heat by inserting his hand, but a pyrometer, (as a thermometer for measuring high temperature is called) makes a much better guide for the ordinary operator.

CHAPTER V

THE ELECTRIC RANGE.

Demand for Domestic Ranges.—Interest shown in the domestic range is increasing more rapidly than in any other single heating appliance. In line with the attention now being given to this type of apparatus, and the rapidly growing market for it, the manufacturers of heating apparatus are making many improvements in both their original designs, and character of product. A number of concerns which have heretofore confined their activity solely to the production of fuel stoves, have taken up the manufacture of electric ranges. The result of these developments has been a 50 per cent reduction in range prices during the past five years, greater reliability in the heating units, a larger diversity of designs from which choice of equipment can be made, and simpler and more desirable standards of construction.

Essential Qualifications of the Electric Range.—The features of the domestic range which make its use desirable to the customer, the central station, and to those having the marketing of the product in hand, are generally agreed upon by all who have given the subject their serious consideration. The range, first of all, must be of substantial and durable construction, and of pleasing appearance. The designs must be standardized as rapidly as possible with the economic object in view of lower costs and increasing production. Simplicity of operation and ease of handling and cleaning are also essential. The heating elements must be rugged, reliable and efficient. Furthermore, they should be so designed as to be easily, quickly, and cheaply renewed whenever troubles develop. The ovens must be well insulated with heat resisting material, readily accessible, and easily cleaned. Some provision for broiling, either in the oven or on the cooking surface, is generally considered necessary.

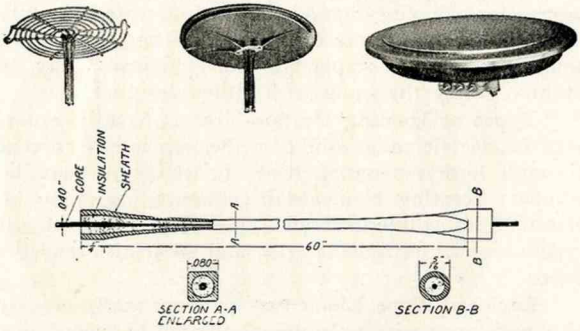
It is of interest to note that the early types of ranges were so designed as to keep down the connected load and the central station demand as much as possible, whereas the present tendency is to neglect this phase of the design in favor of larger capacity units capable of doing quicker work. This is a step in the right direction. The natural diversity of the range load, and the short period demands which it creates are of little moment in comparison with the necessity for greater speed of operation. Furthermore, there is no reason for believing that a range of high rated capacity will consume any more energy in performing its work than one of lower capacity. The efficiency may be approximately the same with either design.

Types of Heating Units.—Heat is usually generated in electric range units by the passage of current through high resistance wires or strips of metallic ribbon. Heating elements in common use may be classified into three different types—first, the enclosed type, second, the radiant type, and third, the reflector type.

Enclosed Type Elements.—These usually consist of a resistance wire or ribbon, enclosed between mica or asbestos strips, or surronded with an enamel or other electric insulating material of high thermal conductivity. The element is usually enclosed within, bound upon, or otherwise imposed against, a metal disc or grid which takes up the heat, and in turn dissipates it. The heat generated in such a unit is transmitted from the metal surface to the cooking utensil and thence to the food by conduction. When this type of unit is used in an oven, however, the heat is transmitted to the food through the air by convection.

It is obvious that this type of element takes a little longer to start heating than do open elements, because the mass of material of which it is composed has to first absorb a certain quantity of heat before it can begin throwing it off. It is claimed, however, that this type of element will lose less of the heat generated during a longer period of operation than the open coil element. There are certain apparent advan-

tages in having the hot wires hermetically sealed, such as the prevention of oxidation and mechanical injury, but unless the insulating materials are able to withstand extreme temperatures they are liable to serious damage, if the voltage is higher than normal, or if the element is connected for a long period without some means of carrying away the excess heat that is generated. Most enamels melt before they reach a temperature of 1650 degrees F. (Cherry red).



Process of Manufacture of General Electric Sheath Wire Heating Elements.

Radiant Type Units.—These are usually coils of high resistance wire laid in grooves, or supported on the surface of insulating material. Current passing through this wire brings it to a high temperature, and the heat is transmitted for the most part as radiant heat direct to the utensil or the food to be cooked. Some of the heat, however, is absorbed by the insulating support and some is given off as convected heat both from the support and from the wire itself, the percentage varying with the design of the unit and its composition. In a well designed unit much of this convected heat is finally taken up by the food.

Radiant type units begin to throw off a large amount of heat almost as soon as the current is turned on. The heat in the coils, is visible on account of the high temperature. The nature of the radiant heat

given off makes it possible to use the ordinary kitchen utensils to better advantage on the open than on the enclosed type elements. The coils being exposed, however, and the supports, as now manufactured, being somewhat brittle, this type of unit is to some extent liable to mechanical injury, short circuits, and grounds. It is also harder to keep clean than the enclosed type element.

Hughes Open-Type Element.

Reflector Type Element.—Use is here made of the heat reflection principle. It usually consists of exposed coils of wire surrounded by air and supported adjacent to a bright metallic reflector. Part of the heat generated in the coils passes directly to the cooking utensil or to the food in the same manner as from the ordinary radiant type element. Another portion of the heat travels in the opposite direction until it reaches the polished surface, where it is reflected back on its course to the cooking utensil. A small percentage of the energy is, of course, given off as convected heat and some passes away through the reflector.

This type of element heats quickly, makes possible the use of most ordinary kitchen utensils, and pro-

duces a visible heat in the coils. It is, however, more subject to mechanical injury than the enclosed type element. The reflectors, although they can be easily and cheaply replaced, are also likely to become discolored and become inefficient on account of the intense heat. The future development of a cool reflector, however, may do away with the latter objection.

Types of Electric Ranges.

A large variety of electric ranges are manufactured in this country. They are available in many styles and capacities, and at various prices. Each of them has been developed with certain individual characteristics in design or operating features, having some advantages over those of other makes, but all of which could not possibly be incorporated in any single design. This chapter is therefore devoted to descriptions of the most prominent makes of electric ranges in order to convey a general understanding of the design, construction and individual characteristics of the types now available.

Hughes Ranges.—This make of electric range has been on the market for a number of years. It is made in a large variety of shapes and sizes, in either the high oven, low oven, or cabinet types, and in capacities ranging from 4140 to 10,340 watts. The frame is constructed of black heavy gauge sheet metal supported on cast iron legs. The legs, top, and fittings are nickel finished in most of the designs. The general construction is rugged and of handsome appearance.

The heating elements are of the open or radiant type and consist of coils of resistance wire held in place below the cooking surface by means of a grooved composition block. This block is in turn, surrounded by another block of asbestos compound having high thermal resistance. The units may be easily removed with a screw driver and pliers.

The oven is thoroughly insulated with mineral wool. The interior of the oven is finished in black enamel. The doors are of the drop shelf type and are usually trimmed in nickel and white porcelain enamel

Thermometers are fitted in these doors. There are two heating elements in the oven—one in the top, and the other in the bottom. Each of these units is regulated by a three heat switch. The top unit is used for broiling. An enameled tray and rack for this purpose are provided with each range. Some of the higher priced ranges are supplied with white porcelain enamel splashers around the cooking surfaces, which add materially to the appearance of the equipments.

HUGHES RANGES.

No.	Type. Style.	Oven— Wattage.	Oven— Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
C-2	Cabinet	2-880	18x12x12	1	1500	
				1	880	4140
C-3	Cabinet	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
C-4	Cabinet	2-1100	18x18x12	1	1500	
				1	1100	
				1	880	5680
C-18	Low oven	2-880	18x12x12	1	1500	
				1	880	4140
No. 27	Low oven	2-880	18x12x12	1	1500	
				1	880	4140
No. 30	Low oven	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
No. 33	High oven	2-880	18x12x12	1	1500	
				1	1100	
				1	880	5240
No. 37	Low oven	2-1100	18x18x12	1	1500	
				1	1100	
				1	880	5680
No. 40	Low oven	2-1100	18x18x12	1	1500	
				1	1100	
				2	880	6560
No. 44	High oven	2-1100	18x18x12	1	1500	
				1	1100	
				2	880	6560
No. 47	Cabinet	2-1100	18x18x12	1	1500	
		Warmer-	21¼x20x9	1	1100	
				1	880	5680
No. 48	Low oven	2-1100	18x18x12	1	1500	
				2	1100	
				3	880	8540
No. 50	Cabinet	2-1100	18x18x12	1	1500	
		Warmer-	21¼x20x9	1	1100	
				2	880	6560
No. 56	Cabinet	1-1800	18x18x8	1	1500	
		2-1100	18x18x12	1	1100	
		Warmer-	21¼x20x9	2	880	8360
No. 60	Cabinet	1-1800	18x18x8	1	1500	
		2-1100	18x18x12	2	1100	
		Warmer-	21¼x20x9	3	880	10340

Hughes No. 50 Cabinet Range.

Simplex Ranges.—These ranges were first put on the market about nineteen years ago. The modern domestic types usually consist of an oven, a broiler, and several disc heaters. They are made up in either the low oven, or cabinet type, and in capacities ranging from 3100 to 8200 watts. They are finished in black japan. The general construction is rugged and compact.

The heating units are of the enclosed type, the resistance wires being embedded in enamel, and fused to the under side of the cast iron discs. The discs protrude slightly above the top of the range, and are provided with a simple locking device by which the utensils are clamped fast to the heating surface to insure good contact. The units are fastened to the frame with thumb screws. The utensils included

with each range are made of heavy copper, nickeled outside and tinned inside.

The broiler is mounted on the cooking surface. It consists of a corrugated heating plate slightly inclined toward the front, from which an outlet carries off the juices for serving with the meat. A separate smooth top fits on the broiler for making griddle cakes, etc.

The oven is made of Russia iron with japan finished iron frame and nickel plated trimmings. The walls are heavily insulated with corrugated asbestos and provided with a vent. The heating elements in both

SIMPLEX RANGES.

No.	Type. Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
4K	Low oven	1300	15x12x11½	1	440	
				2	735	3210
5K	Low oven	1300	15x12x11½	1	440	
		1300	9x12 broiler	1	735	3775
6K	Low oven	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	4515
7K	Low oven	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	4810
8K	Low oven	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	5250
9K	Low oven	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
				1	1100	5910
14K	Low oven	2400	21½x19x13	1	440	
		2200	12x18 broiler	1	735	
				1	1100	
				1	1300	8175
21K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	
		200	15x15x7 warmer			4715
22K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer			5010
23K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer			5450
24K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
		200	15x15x7 warmer	1	1100	6110
31K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	1	735	4515
32K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	4810
33K	Cabinet	1600	15x18x11½	2	440	
		1300	9x12 broiler	2	735	5250
34K	Cabinet	1600	15x18x11½	1	440	
		1300	9x12 broiler	2	735	
				1	1100	5910

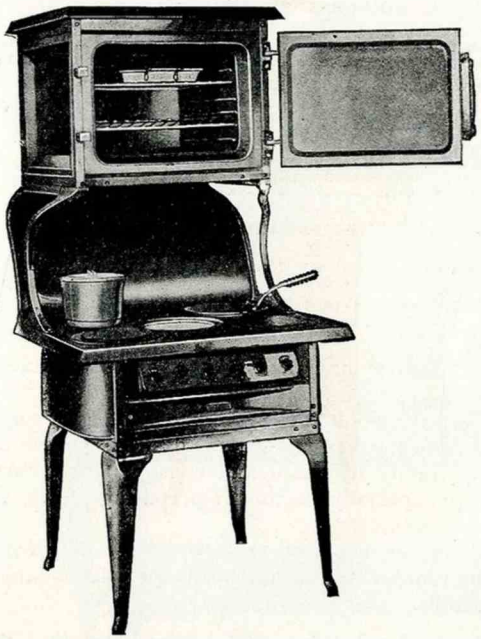
Simplex No. 7-K Range.

top and bottom are of the enclosed grid type, and are controlled by a single three-heat switch. The oven door is of the drop shelf type, fitted with an indicating thermometer.

General Electric Ranges.—Ranges of this make have been on the market for a considerable time and the makers may be credited with having done a great deal of development work. These ranges are now manufactured in two standard types—the "R" type and the "S" type, either of which are available in either the high oven, low oven, or cabinet styles.

The "R" type was first developed. It is of heavier and better construction, provided with special "Calorox" oven insulation, and is likewise more expensive.

The "S" type is a later development. The frame of the range is made by a fuel stove manufacturing concern. The heating units and other electrical features are provided by the General Electric Company.



General Electric No. R-2 Range.

The ovens are equipped with separate top and bottom heating elements and provision made for broiling inside. The standard oven dimensions on each range is 18 in. by 18 in. by 12 in.

It is of interest to note that all the heating elements used on ranges made by this company have been of the enclosed type. The "D" type unit which has been discarded for some time, consisted of a ribbon wire resistance clamped between mica strips and fastened to the bottom of the element. The units used on the "R" and "S" type units are made up by pouring molten iron around sheathed wire. This so called "sheated wire" consists of a small hollow wire enclosing a fine resistance wire, the space between being filled with an insulating material of high thermal con-

GENERAL ELECTRIC RANGES.

No.	Type. Style.	Oven— Wattage.	Oven— Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
R-1	Low oven	2-1000	18x18x12	2	1000	
				3	200*	4600
R-2	High oven	2-1000	18x18x12	2	1000	
				3	200*	4600
R-3	Cabinet oven	2-1000	18x18x12	2	1000	
		1-300	warmer	3	200*	4900
R-4	Cabinet oven	2-1000	18x18x12	2	1000	
				3	200*	4600
S-1	Low oven	1-1000	18x18x12	3	1000	
		1-1500				5500
S-2	High oven	1-1000	18x18x12	3	1000	
		1-1500				5500
S-3	Cabinet oven	1-1000	18x18x12	3	1000	
		1-1500		1	200*	5700
	(*cookers)					

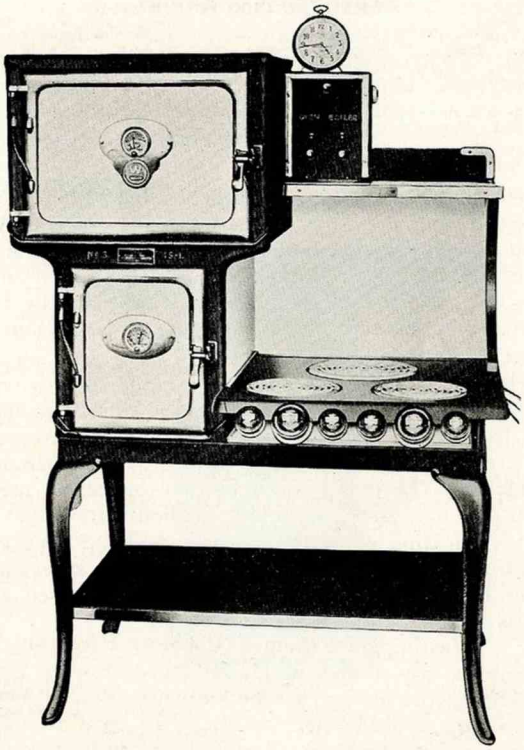
ductivity (presumably aluminum or other metallic oxide).

Vegetable cookers may be substituted for any one or all of the top heating units if desired. These cookers are heavily insulated and consume little current. They are especially useful for preparing stews, vegetables, cereals, etc.

All the elements on the stove have plug connections and may be changed by anyone without the use of any tools.

Westinghouse Ranges (Copeman Patents).—These ranges are at present manufactured in two standard styles—the low oven type known as the 2-19, and the cabinet type known as the 3-19. Either of these ranges may be obtained in either plain or nickel finish, and may or may not be provided with the special automatic feature. The cabinet type is always equipped with white porcelain enamel splashers around the cooking surface. The construction of both ranges is substantial. The legs and frame are of cast iron, and other parts of sheet steel.

Open or radiant type elements consisting of coils of resistance wire, held in place in spiral grooved composition blocks are used. The cooking surface on each of these ranges consists of two 8 in. 1000 watt units, and one 10 in. 2000 watt unit. The latter is so connected that the low heat utilizes the inner third



Westinghouse 3-19 Automatic Range.

of the surface, medium the inner two-thirds of the surface, and high the entire 10 in. surface.

The ovens are thoroughly insulated with mineral wool. The oven doors open to the side. The interior dimensions of the oven are 18½ by 13½ by 16 in. The cabinet type range is provided with a small boiling oven (10⅜ in. by 13½ in. by 11½ in.) in addition to the large oven. Provision is made also for broiling in the large oven.

Either type range may be equipped with a relay, whereby the current will be automatically turned off

WESTINGHOUSE RANGES.

Type. No.	Style.	Oven Wattage.	Oven Dimensions.	Cooking Elements.	Surface. No. of (of Each) Wattage.	Total Wattage of Range.
No. 3-19	Cabinet	2-1000	18½x13½x16	1	2000	
		1-850	10⅜x13½x11½	2	1000	6850
No. 2-19	Low oven	2-1000	18½x13½x16	1	2000	
				2	1000	6000
No. 406	Low oven	1-1000	16x12x11½	2	1000	
		1-660				3660

when the ovens reach a certain desired temperature. The cabinet type range, furthermore, may be equipped with a clock device, whereby the current may be automatically turned on in the oven at any desired time.

The number 406 range is smaller than the two standard styles and of less expensive construction.

Olston Ranges.—These ranges have been on the market for several years and are made in one-oven, two-oven, and three-oven types and in capacities varying from 1980 watts to 4620 watts. They are constructed of sheet iron, enameled in gray, and trimmed in nickel. The ovens are mounted on sheet metal legs, and are easily accessible without stooping.

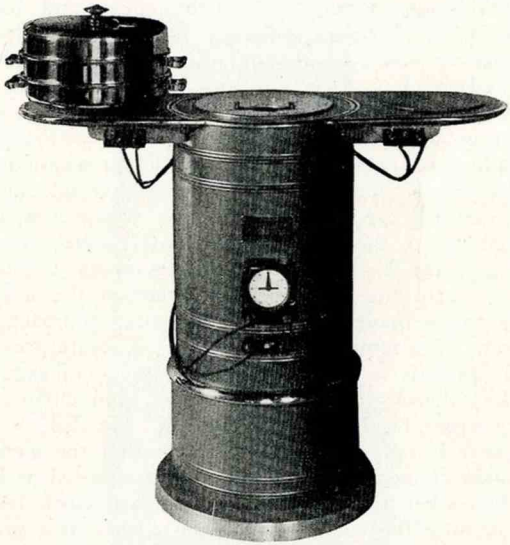
No heating elements are furnished for top cooking, but flush receptacles for attaching disc stoves and other heating devices, are provided. The oven elements are of the open type.

OLSTEN RANGES.

No.	Type. Style.	Oven Wattage.	Oven Dimensions	Total Wattage of Range.
1	Low	1930	11½x11½x18	1980
2	Low	2970	(11½x11½x18 (11½x11½x18	2970
3	Low	4620	(11½x11½x18 (11½x11½x18 (13⅝x12½x21)	4620
4	Wall type.	Same as No. 1.		
5	Wall type.	Same as No. 2.		

The ovens are heavily insulated with mineral wool and are provided with drain cups to collect the excess moisture caused by condensation. The doors open to the side. The ovens are controlled by flush snap switches and the temperatures are regulated by thermostatic devices, which automatically maintain any desired temperatures for which they are set. When

the required heat is generated, the current switches off, and when the oven cools a few degrees, the current is switched on, thus maintaining a constant temperature. Pilot lamps, mounted over the temperature control dials, indicate at all times whether or not current is being consumed.



No. C Good Housekeeping Cooker.

Good Housekeeping Cooker.—This device, which has been on the market for several years, has been known as the automatic steam cooker, or the Berkeley cooker. Although the principle of operation has not been changed, its mechanical construction has been greatly improved.

The cylindrical outside shell is 14 inches in diameter and made of polished sheet steel. The cast iron base and top are trimmed in nickel. Two 8 inch enclosed type disc elements of 1000 watts capacity each, may or may not be mounted on the cooker surface. The top of the cooker is 31½ in. from the floor. A

GOOD HOUSEKEEPING COOKER.

No.	Type. Style.	Cooker Pot—— Wattage.	Dimensions.	Cooking Surface. No. of Elements.	Wattage (of Each)	Total Wattage of Range.
A	Cooker	550	14 gallons	None		550
C	Cooker	550	14 gallons	2	1000	2550

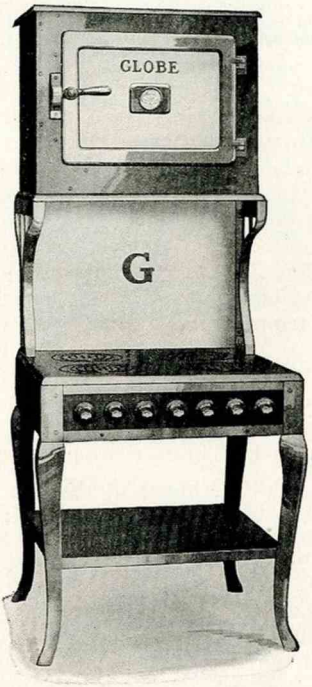
small ovenette, for use over one of the discs, may be obtained with the cooker. The space provided in the cooker is approximately 13 inches deep and has a capacity of about 14 gallons. The walls and cover are heavily insulated with mineral wool and granulated roasted cork.

The cooking compartments consist of two cylindrical copper jackets welded one within the other with a slight space between, from which the air is exhausted, and a small quantity of water and ether introduced. An enclosed type heating element of 550 watts capacity is fastened to the bottom of the outer jacket. A diaphragm, the buckling of which, actuates a contact lever controlling the flow of current in the heating element, is made a part of the outer compartment jacket. At a temperature of 250° F., a steam pressure of 15 pounds is produced causing the diaphragm to buckle, thereby actuating the lever, and cutting off the current to the heating element. At 220° F. the pressure is reduced with the result that the element is again connected. This action is continued as long as the cooker is in service. An automatic clock device, for turning the current on in the cooker at a predetermined time, is also provided with each equipment.

Globe Ranges.—The Globe Stove and Range Company which has confined its efforts to the production of wood, coal and gas stoves, for many years has recently taken up the manufacture of electric ranges. Those which have thus far been placed on the market possess several novel and attractive features. The desire of the average women for bright enamel and nickel trimmings has been catered to in the finish of the ranges. The sheet metal parts are made of twenty gauge Armco iron with white enamel on one side, and ground coat on the other.

The ovens are insulated with three inches of "Sil-o-cel" and lined with sixteen gauge Armco iron.

One-quarter inch steam packing gaskets insulate the oven from the front frame of the stove, and also separate the inner and outer casings of the door. Heavy latches used on the oven doors make them practically air tight.



Globe No. B-5 Range.

The heating elements used in the oven are of the enclosed type in the bottom, and of the open coil radiant type in the top, for broiling operations. The top surface elements are unique in that they combine, in a measure, the features of both the open and en-

closed types. Resistance wires, wound in flat helical coils, are fastened in grooved porcelain plates, and protected with thin cast iron plates. These plates are grooved to correspond with the position of the

GLOBE RANGES.

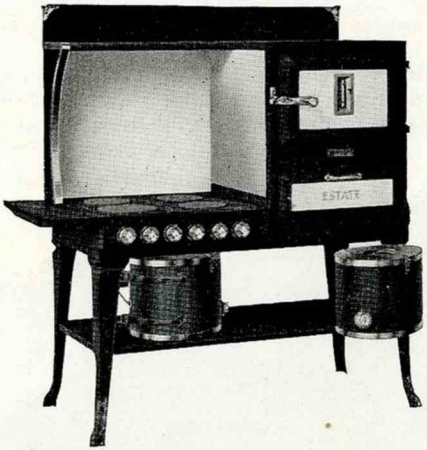
No.	Type. Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
A2	Low oven	1-1500) 1-2000)	19¼ x19¾ x13	2	1500	
	Low oven	1-1500) 1-1000)	11½x19¾ x13	2	800	10,600
A3	Cabinet	1-1500 1-1000	11½x19¾ x13	2 2	1500 800	7,100
A4	Low oven	1-1500 1-1000	11½x19¾ x13	2 2	1500 800	7,100
B1	Low oven	1-1500 1-1000	13¼ x13¼ x19¼	2 2 1	1500 800 330	7,430
B2	Cabinet	1-1500 1-1000	13¼ x13¼ x19¼	2 2 1	1500 800 330	7,430
B3 Special	Low oven	1-1500 1-1000	13¼ x19¼ x13¼	2 1	1500 800	6,300
B3	Low oven	1-1500 1-1000	13¼ x19¼ x13¼	2 1	1500 330	5,830
B4 Special	Cabinet	1-1500 1-1000	13¼ x19¼ x13¼	2 1	1500 800	6,300
B4	Cabinet	1-1500 1-1000	13¼ x19¼ x13¼	2 1	1500 330	5,830
B5	High oven	1-1500 1-1000	13½x19½x13½	2 1 2	1500 330 800	7,430

wires. It is therefore apparent that a utensil placed over one of the heating elements is heated by both radiant and conducted heat.

Estate Ranges.—The Estate Stove Company is recently bringing to bear its many years of experience in the construction of fuel stoves and ranges, in the manufacture of electric ranges. Three standard types have thus far been placed on the market. The ranges are of substantial construction, resembling the standard gas ranges in appearance. The cast iron parts are treated with a coat of ebonite, and the sheet metal parts are made of rust resisting steel. The oven doors and broiler pans are of white enamel, as are the splasher backs in the cabinet type ranges.

The cooking surface elements are of the enclosed type, consisting of nichrome wire, wound around mica

discs, and clamped between iron plates. These plates are connected by means of plugs which fit into receptacles and may be removed or connected as easily as any ordinary socket plug. The heating elements in the ovens are also of the iron clad type with the



No. 84 Estate Range (with Cookers Attached).

exception of the broiling elements, which are of the radiant type.

The ovens are of ample capacity for ordinary baking and roasting, and are heavily insulated. The doors, which open to the side, are strongly latched and fitted with thermometers. Broiling operations are performed in the ovens, except in the No. 84 cabinet range, which is provided with a separate broiling compartment mounted below the oven.

The cylindrical fireless cookers, which may be hinged to the legs of the cabinet type ranges and swung out of the way when not in use, are a special feature. These cookers are heavily insulated, have interior dimensions of 8 inches depth by 10 inches diameter, and consume 500 watts each.

ESTATE RANGES.

No.	Type. Style	Oven Wattage.	Oven Dimensions.	Cooking Surface. No. of Elements.	Wattage (of Each)	Total Wattage of Range.
83	Low oven	1030) 1370)	18x12x12	2-6½ in. 1-8 in.	650 1200	4900
84	Cabinet	1500) 2000)	18x18x12	3-6½ in. 1-8 in.	650 1200	
		1500	Broiler			8150
88	Cabinet	1500) 2000)	18x18x12	3-6½ in. 1-8 in.	650 1200	6650

Rutenber Ranges.—After several years experience in the manufacture of electric ranges the Rutenber Electric Company has adopted three standard low oven types which are made up in either plain or nickel finish.

No. 115 Rutenber Range.

The frames of the ranges are made of cast iron and the sheet metal parts of blue polished steel.

The heating elements are of the radiant type, consisting of coils of wire laid in grooves of a special

moulded clay compound. Each range is provided with two such elements.

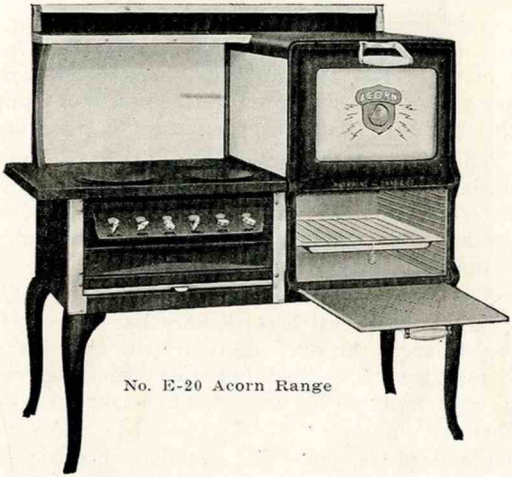
The ovens are heavily insulated with rock wool and the interior walls are made of a special alloy.

RUTENBER RANGES.

No.	Type. Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage. (of Each)	Total Wattage of Range.
105	Low	2-1000	18x18x14	4	1000	6000
110	Low	2-800	18x18x14	3	1000	4600
115	Low	2-800	18x12x14	2	1000	3600

The doors open to the side, are heavily latched to prevent the loss of heat, and are fitted with standard oven thermometers.

Acorn Ranges.—Rathbone Sard & Company, which has been the maker of the well-known Acorn fuel ranges for many years, has recently taken up the man-



No. E-20 Acorn Range

ufacture of electric ranges. It now has a line of these new ranges, consisting of two low oven types and five cabinet types. It will be noted that the low oven types are the same except that one has three surface elements, whereas the other has four. The cabinet type ranges have the same number of surface elements,

ACORN RANGES.

No.	Type. Style.	Oven— Wattage.	Oven— Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
E1	Low	1-1500 1-1000	18x14x18	3-10½ in.	1000	5500
E5	Low	1-1500 1-1000	18x14x18	4-10½ in.	1000	6500
E10	Cabinet	1-1500 1-1000	18x14x18	4-10½ in.	1000	
	Plate	warmer	18x10x18			6500
E20	Cabinet	1-1500 1-1000 1-1500	18x14x18 18x10x18	4-10½ in.	1000	8000
E30	Cabinet	1-1500 1-1000 1-1500	18x14x18 18x10x18	4-10½ in.	1000	
	Plate	warmer	18x10x18			8000
E40	Cabinet	1-1500 1-1000	18x14x18			
	Plate	warmer	18x10x18	4-10½ in.	1000	6500
E50	Cabinet	1-1500 1-1000	18x14x18	4-10½ in.	1000	
		Warmer	18x10x18			
	Plate	shelf	18x10x18			6500

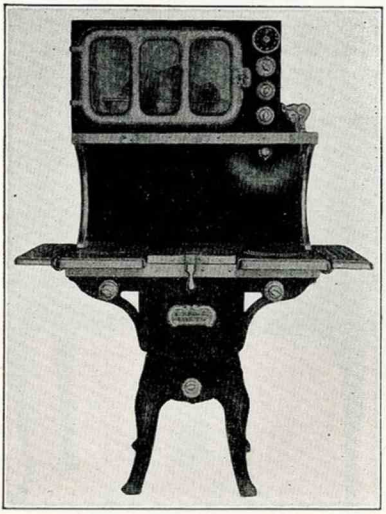
the same dimension and capacity baking and warming ovens, and occupy the same floor areas. The frames are made of cast iron and the sheet metal parts of heavy gauge iron. They are finished plain or equipped with white enameled splashers and nickel trimmings.

The ovens are lined with a special heat insulating material known as "duro-therm." They are provided with white enameled doors and broiler pans. The doors are also equipped with thermometers and positive tight closing latches.

The heating elements of the cooking surfaces are the standard General Electric sheathed wire enclosed types, whereas the oven units are the sheathed wire radiant types. Two hundred watt vegetable cookers may be substituted for any one of the surface cooking elements.

Standard Ranges.—The Standard Electric Stove Company, successors to the Detroit Fireless Stove Company, has developed a line of electric ranges which is different from other makes in several particulars. The ranges are made of Armco iron, finished in blue enamel, and nickel trimmed. The ovens and cooker pots are thoroughly insulated with rock wool, and lined with aluminum.

The compartments are mounted with the covers even with the cooking surface. These covers are hinged at the back and provided with locking devices. The compartments and surface heating elements are



Standard No. 500 Range.

mounted side by side in a line parallel with the front of the stove. The ovens are mounted above the cooking surface and fitted with plate glass doors.

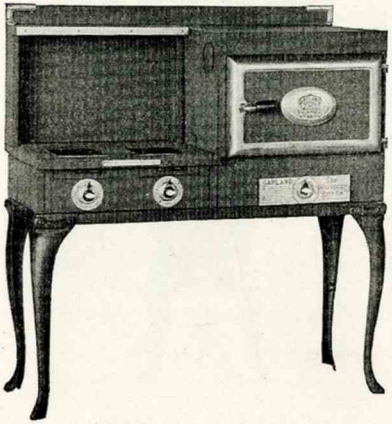
The oven elements are of the radiant type. The compartment and surface heating elements are of the

STANDARD RANGES.

No.	Type Style.	Oven Wattage.	Oven Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
300	Low cooker	1-660	cooker	2	1000	2660
400	Low cooker	2-660	cooker	2	1000	3320
500	High oven	2-800	11x12x16½	2	1000	
	Low cooker	1-660	cooker			4260
501	High oven	2-1000	11x12x19	2	1000	
	Low cooker	1-660	cooker			4660
600	High oven	2-800	11x12x16½	2	1000	
	Low cookers	2-660	cookers			4920
601	High oven	2-1000	11x12x19	2	1000	
	Low cookers	2-660	cookers			5320

enclosed type, consisting of resistance wires, baked in a special cement composition which is backed up with an iron shell.

The high oven types are provided with an automatic device which may be set to turn the current off after the food has cooked a certain length of time. Control switches and pilot lamps, mounted on the frame of the ranges, are also desirable features.



Garland No. 26 Range.

Garland Ranges.—The Michigan Stove Company, one of the larger manufacturers of fuel stoves has recently placed a new line of electric ranges on the market which are somewhat different from other makes of electric stoves. They are made up by various combinations of interchangeable parts in much the same way as sectional book cases. The cast iron frame and sheet steel parts are coated with black enamel, and the bright parts are nickeled. Doors, broiler pans, and splashers are also white enameled.

The heating elements consist of resistance ribbons, wound on mica cores, and incased in sheet steel covers, forming flat strips or bars ⅞ in. in width. Six of these strips, each of 200 watts capacity, are mounted

side by side to form a heating unit. These units or grids are separately fused and located on top of hinged plates. The cooking tops are built with either two or three grids. The special indicator switches which are mounted on the grids are very desirable as their positions may be determined at a glance.

The oven is of a single standard size and may be used alone, or made a part of several combinations with the grid tops. The aluminized steel inner wall is surrounded with an inch air space, which is in turn insulated with an inch of special material. The dou-

GARLAND RANGES.

No.	Type. Style.	Oven— Wattage.	Oven— Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
21	Low	2-1200	18x12x12	2	1200	4800
23	Low	2-1200	18x12x12	4	1200	7200
25	2-Low	4-1200	18x12x12	6	1200	12000
26	Cabinet	2-1200	18x12x12	2	1200	4800
27	High	2-1200	18x12x12	2	1200	4800
28	Low	2-1200	18x12x12	4	1200	7200
31	Low	2-1200	18x12x12	3	1200	6000
33	Low	2-1200	18x12x12	6	1200	9600
36	Cabinet	2-1200	18x12x12	3	1200	6066

ble door is made up in much the same way as the oven walls and is provided with a tight latch. Broiling is performed in the oven by placing the meat on adjustable pans, which press it against wire bars below the grids.

Hotpoint Ranges.—After many years successful experience in the production and marketing of lamp socket heating devices the Hotpoint Electric Heating Company has extended its efforts to the construction of electric ranges. The five types of ranges now manufactured are made of cast iron and sheet steel. They are attractively designed and trimmed in nickel and white enamel.

The ovens are heavily insulated with mineral wool. The doors latch tightly and may be fitted with glass if desired. The lining of the ovens is made of aluminized steel.

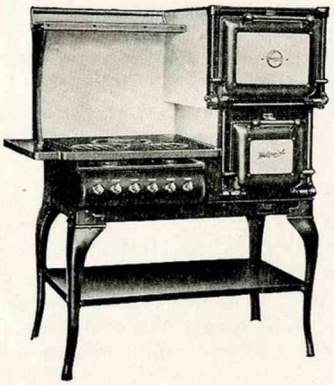
The cooking surfaces are hinged at the back, thus permitting easy access for inspection or repairs. The

heating elements are of the open coil radiant type, mounted above polished concave reflectors which collect the heat rays passing downward and direct them backward against the utensils. The reflectors are mounted on the crumb trays below the cooking surfaces, and may be easily removed for cleaning.

HOTPOINT RANGES.

No.	Type. Style.	Oven— Wattage.	Oven— Dimensions.	Cooking No. of Elements.	Surface. Wattage (of Each)	Total Wattage of Range.
D	Cabinet	2-1200	18½x18½x12	1	1500	
			*18½x18x10	1	1200	
				2	800	6,700
E	Cabinet	2-1000	16½x16½x11½	1	1500	
			*12½x12½x10½	1	1200	
				1	800	5,500
F	High oven	2-1000	18½x16½x11½	1	1500	
				1	1200	
				1	800	5,500
G	Low oven	2-1000	18½x16x11½	1	1500	
				1	1200	
				1	800	5,500
H	Low oven	2-1000	16x14x12	1	1500	
				1	800	4,300

*Warming closets.



No. E Hot Point Range.

Other Types of Ranges.—The recent rapid development of the electric range market has served to arouse latent interest in their production. A number of manufacturers of electric heating devices and fuel

ranges have signified their intention of designing and marketing electric ranges in the near future. The effort that is being put forth by the central stations and manufacturers to popularize and create a market for electric ranges must result in improved apparatus, standardization of design and eventual lowering of production costs.

CHAPTER VI

COMMERCIAL COOKING.

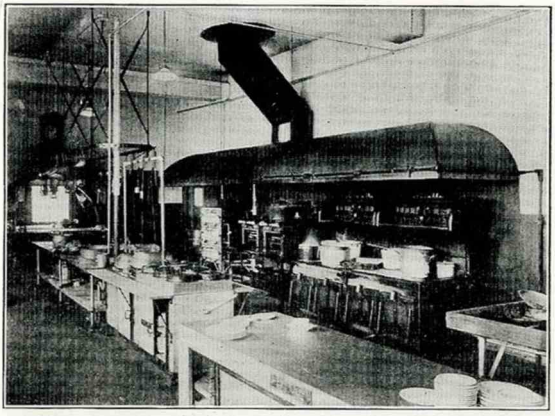
Opportunities in Hotels and Restaurants.—The substitution of electric for fuel heating apparatus in hotels, restaurants and institutions presents enormous commercial possibilities. Consideration of the opportunities afforded the central station companies, and the manufacturers of heating devices, however, have only recently been given favorable attention. The savings and other advantages accruing to the customer, the tremendous possibilities for building up attractive central station loads, and the ever widening market for the various kinds of electric heating devices in the modern hotels and restaurants, make the subject one of mutual interest worthy of serious consideration.

Advantages of Electric Cooking.—Most of the advantages already cited in favor of electric ranges in the home, apply to the use of electric cooking equipment in commercial enterprises to an even greater extent. The absence of dirt, smoke, excessive heat, and poisonous fumes, the advertising value of the clean sanitary kitchen, the improvement of food, and the saving in floor space, fuel storage capacity, and meat shrinkage, are all points of superiority that create keen interest.

Careful Planning Essential.—In spite of the advantages of electric cooking service in the modern hotel and restaurant kitchen, many failures have occurred. These have frequently been due to unwise selection of apparatus, lack of appreciation of the users' requirements, or the adverse attitude of a cook or chef. A careful preliminary study of each individual condition is of extreme importance if success is to be achieved.

It is first necessary to know the approximate maximum amount and kinds of food that will be served, how long a period will be allowed in which to serve them, how long they must be kept warm, etc. It is always necessary to consider maximum conditions. Unlike fuel apparatus electric equipment cannot be forced under conditions of stress.

The attitude, intelligence, and often the nationality of the cooks who actually operate the apparatus is worthy of serious consideration. The care and skill with which electric devices are manipulated, have



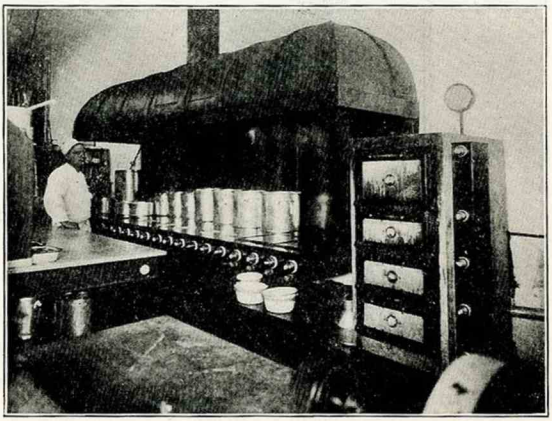
General Electric Ranges and Broilers in Bethlehem (Pa.) Steel Company's Kitchen.

much to do with their successful operation. Many cooks trained by long experience in the actual preparation of food, dislike to take up new methods. Others are intellectually unfitted or flatly refuse to learn.

Choice of Apparatus.—In laying out an installation it must be remembered that the equipment will be subjected to extremely rough usage. Only the best and most substantial apparatus available should be installed. It should be designed for easy control. The cooking surface of the range should be of adequate capacity because much top cooking is done in the

average hotel or restaurant. A few extra capacity units for rapid work are usually required. Preliminary advice, as to the kind of utensils that will give the quickest and most efficient results, will also be helpful to the user.

Shrinkage in Meats.—The tendency to minimize the importance of meat shrinkage by the management of hotels and restaurants is very general, but nevertheless such losses are worthy of serious consideration. The enormous waste resulting from the ordinary fuel methods of preparing meats, coupled with its high



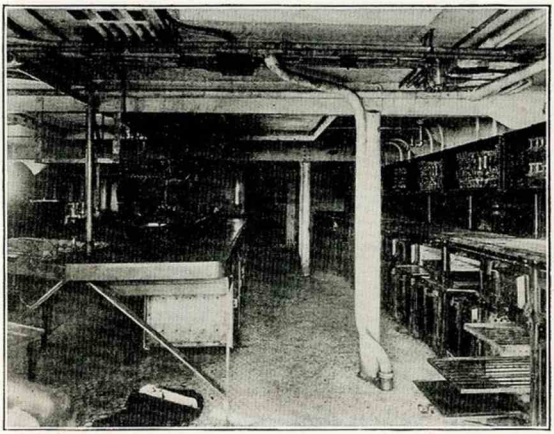
Special Hughes Cooking Surface and Standard Meat Roasting Oven in Cafeteria, Sacramento, Cal.

cost and serving value, make the savings effected by the application of electrical methods of real importance, especially where large quantities of meat are cooked daily.

To those who have actually observed meats prepared by both fuel and electric means the saving is obvious. A great many actual tests have been made, and universally the results have shown a marked saving in favor of electricity. The following table is a

compilation of experiments made by Mr. K. B. Matthews of England in the preparation of beef and mutton with coal, gas, and electricity:

	Weight before cooking.		Weight after cooking.		Type of Oven	Loss of weight.		Loss per cent.
	lb.	oz.	lb.	oz.		lb.	oz.	
Ribs of beef.....	5	7	3	12	Coal	1	11	31.0
Leg of mutton.....	8	8	5	13	Coal	2	11	31.7
Shoulder of mutton...	6	13	5	1	Coal	1	12	25.7
Leg of mutton.....	8	4	6	0	Gas	2	4	28.1
Leg of mutton.....	9	0	7	12	Elec.	1	4	13.1
Shoulder of mutton...	4	12	4	2	Elec.	0	10	13.1
Ribs of beef.....	9	1	7	6	Elec.	1	11	18.6
Leg of mutton.....	9	1	7	10	Elec.	1	7	15.8
Shoulder of mutton...	5	10	5	0	Elec.	0	10	11.1

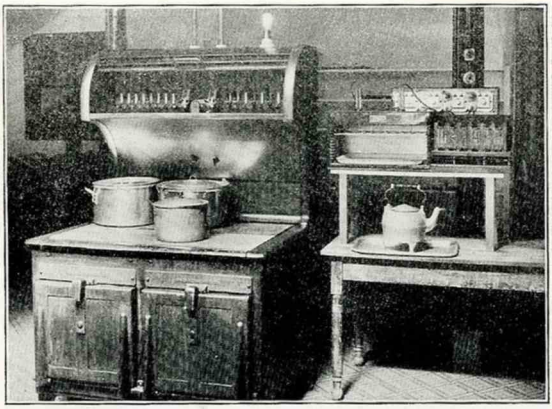


General Electric Ranges in Galley of U. S. S. Texas.

Apparatus Available.—Only a few manufacturers of electric heating devices in this country have undertaken the extensive production of commercial cooking apparatus. There are several reasons for this condition. Development work is expensive and the market for the equipment has, until recently been limited. Only such apparatus as will "stand up" under the severest kind of operating conditions ever proves satisfactory. The rather sad experience, which some concerns have had in attempting to utilize the less rugged

types of domestic cooking devices for hotel and restaurant service, has exerted a somewhat discouraging effect on further development.

There is no doubt, however, but that the experience gained thus far, has been valuable. The types of apparatus that have stood the test have been extremely satisfactory to the users, and now that so many improvements have been made in the design of heating apparatus, there is no question but the market will develop rapidly and result in quantity production and further price reduction.



General Electric Type D-54 Range in Dietary Kitchen in Pennsylvania State Hospital, Philadelphia, Pa.

As quite a few types of apparatus designed exclusively for commercial cooking service are now available, some of the features of those best known will be described.

Hotel Ranges.—No other piece of kitchen equipment is subject to such severe treatment as the hotel or restaurant range, especially the top cooking surface. Earlier installations were either too frail, too small, or too slow in heating to give satisfaction. The modern types, however, are heavily constructed,

available in adequate capacities, and generally provided with sufficient wattage in the heating units to perform work quickly.

General Electric Hotel Range.—This type of range is constructed of heavy cast iron, and steel sheet metal. The oven walls are well insulated with navy firefelt. The cooking surfaces are composed of eight oblong 9¼ by 12 in. enclosed type cast iron heating units, placed side by side, arranged with four 1600 watt units in front for high temperature cooking, and with four 800 watt units in back for lower temperature work.

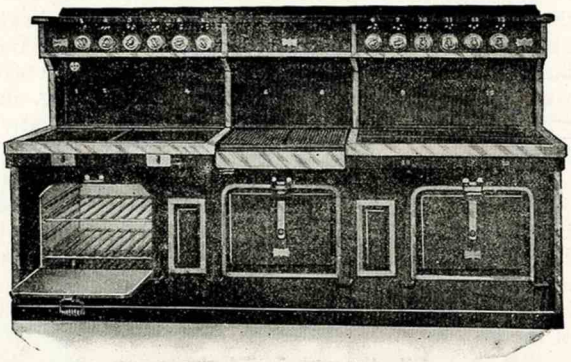
There are two ovens, each having a capacity of 4800 watts, and inside dimensions of 18 in. width, 28 in. depth and 16 in. height. The doors are heavily constructed and are of the drop type. All the heating units are fused and controlled by knife switches located in a sheet metal compartment above and at the rear of the cooking surface.

The overall dimensions of the range are width 44 in., depth 38 in. and height to top of switch box 68 in. The maximum rated capacity is 19.2 kilowatts. An equipment sufficiently large to take care of any requirements can be provided by placing as many of these ranges side by side as are necessary.

Simplex Hotel Ranges.—The high duty ranges manufactured for hotel and restaurant service are made of much heavier materials than those designed for domestic use. The parts are constructed of heavy gauge steel and cast iron. The general appearance is much the same as that of the more elaborate hotel fuel ranges. They are ordinarily made up in complete sections consisting of a cooking surface 7 ft. 6 in. long by 2 ft. 9 in. wide, with two ovens mounted beneath. For very large installations, two or more of these sections are placed, end to end, or back to back.

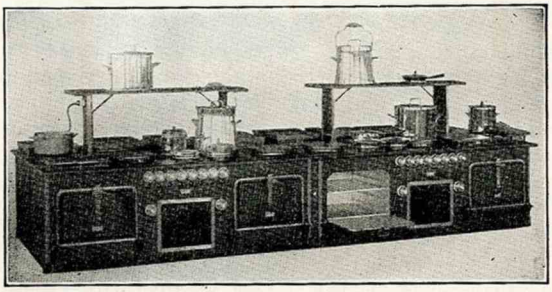
The cooking surface is usually made up to suit the customer's requirements. The units may consist of any suitable arrangement of the following heating elements in various capacities:

Rim or flat griddles, 9 in. by 12 in., 12 in. by 18 in. or 18 in. by 24 in. sizes.
Hotel broilers, 9 in. by 12 in., or 12 in. by 18 in. sizes.
Disc stoves 4½ in. diameters to 20 in. diameters together with special heavy copper kettles and other utensils of similar dimensions.
Deep fat frying kettles—12 in. diameter, 5 in. deep.
Hotel toasters—10 in. by 12 in., or 12 in. by 18 in. sizes.
Waffle irons—two or three section (for 4½ in. waffles.)



Simplex 3-Oven Range, Welfare Dining Hall, Edison Electric Illuminating Company, Boston.

The ovens are of heavy construction, well insulated and provided with massive drop doors. The

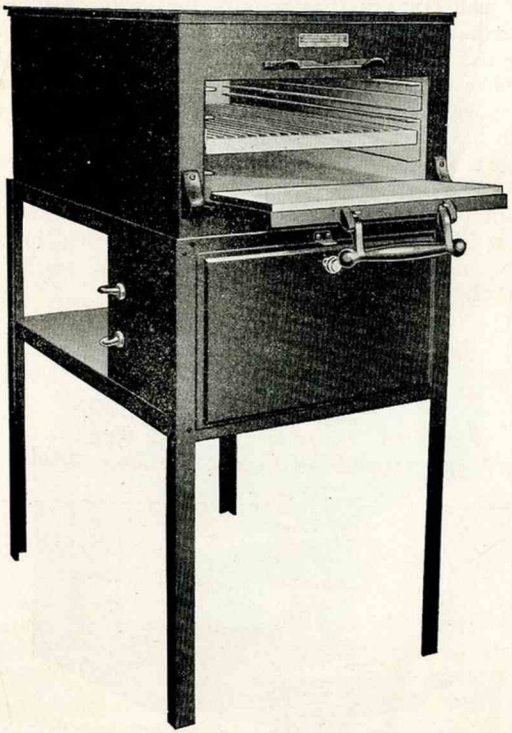


Four-Section Simplex Range, Montana State Hospital, Billings.

interior dimensions are 24 in. wide, 27 in. deep, and 16 in. high. The oven heaters are located in both the top and bottom.

Each range section is supplied with a distributing panel, located between the ovens and accessible from the front. The circuits are separately fused, and each device has its own control switch, and pilot light.

Meat Broilers.—Two types of broilers are made —the open type and the enclosed type. It is safe to



Hughes Meat Broiler.

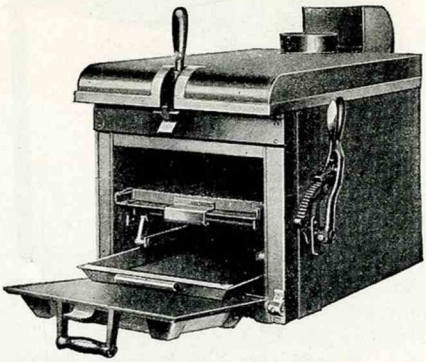
say that better results can be secured with either of these types than are attainable with any kind of fuel broiler.

The Simplex open type apparatus consists of a corrugated cast iron surface slanting slightly towards

a grooved end. The meat rests on the hot surface and the juices are collected at the mouth of the groove and poured over the meat before serving. The heating is done by means of a sealed-in unit under the corrugated surface. The standard hotel size is 12 in. by 18 in. and has a capacity of 2200 watts.

The Hughes Broiler is of the enclosed type and is manufactured in three standard sizes. The smaller size has interior dimensions of 18 in. by 30 in. by 8 in. and has a capacity of 4.5 kilowatts. The medium size is composed of two compartments placed side by side, each having the same dimensions and capacity. The large size is 32 in. by 30 in. by 8 in. and has a capacity of 10 kilowatts. The walls of these broilers are heavily insulated. The units are of the open type and give off radiant heat. The exteriors are finished in black iron, and the bodies are supported on angle iron frames.

The General Electric broiler is of the enclosed type and equipped with radiant heating elements. The



General Electric Meat Broiler.

broiling area is 14 in. by 20 in. The rated capacity is 5 kilowatts, of which 4.5 kilowatts is used during actual operation and 500 watts for maintaining the temperature when the device is not in service. It is

made of heavy sheet steel and angle iron construction and the walls are thoroughly insulated. It is mounted on angle iron supports.

Hot Closets.—Hot closets are required in almost every hotel and restaurant kitchen for keeping food and dishes warm. They generally consist of double walled or well-insulated ovens with oue or more shelves, doors opening to the side, and equipped with

Cutler-Hammer Hot Closet.

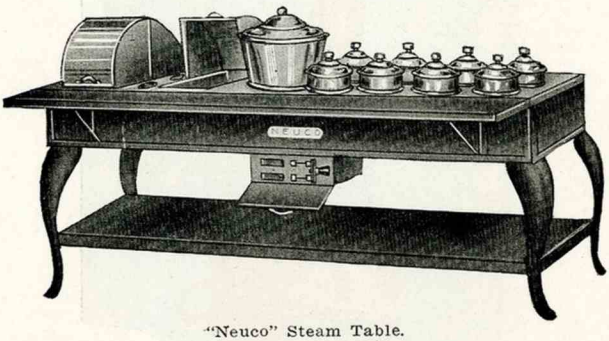
relatively small heating units mounted in the bottom. They are usually provided with three-heat control switches. The Hughes and Simplex warming ovens are made up in several standard sizes but may be designed in any special size or capacity.

Steam Tables.—When food must be kept warm for any length of time for serving, a steam table is usually considered a necessity. Either immersion or circulation heaters may be used for this purpose.

Immersion heaters may be inserted through the top or in the side of the steam table. They must be

kept covered with water constantly, or the elements will burn out.

Circulation heaters of various types may be utilized in heating a steam table by connecting them with pipes to the bottom of the tank and placing the heaters at an angle of about 10° to 15° with the horizontal. The colder water reaching the lower end of the heater will rise in temperature and gradually pass up through the heater into the tank, thus creating a constant circulation and gradual heating of water as long as the current is applied.



"Neuco" Steam Table.

It is essential that steam tables be well insulated against heat losses. If the circulation method of heating is employed, the pipes leading to and away from the heater should be well lagged.

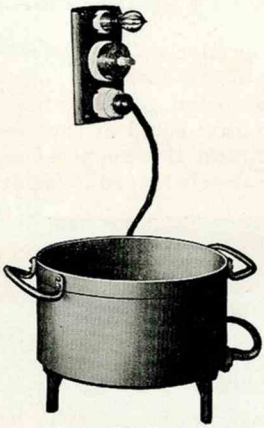
In making calculations of the heater capacity required for a steam table, area of radiating surface, kind and thickness of lagging, nature of top surface, amount of water in reservoir, hours of use, and the maximum quantity of food warmed, should be taken into consideration.

Water Heaters.—A supply of hot water for cooking, dish washing and various other purposes must always be provided in the hotel or restaurant kitchen. The subject of heating water electrically is taken up

more fully in another chapter, but it is well to keep in mind that the demand for hot water is usually much in excess of most chefs' or cooks' preliminary estimates.

Frying Kettles.—Fat, oil, or lard is often required to be heated to a high temperature for preparing French fried potatoes, doughnuts, croquettes, and other foods.

The Simplex frying kettle designed for heavy service has standard dimensions of 12-inch diameter and 5-inch depth. It has a maximum rated capacity

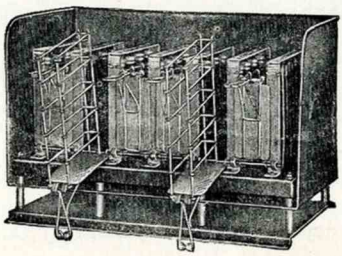


Simplex Frying Kettle.

of 2400 watts and is provided with a three-heat control switch. Larger sizes are sometimes manufactured for special work.

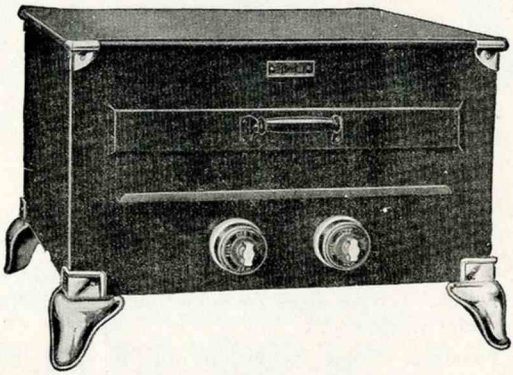
Toasters.—Some provision for toasting bread evenly and quickly is required in all hotel and restaurant kitchens. A high heat is required and the device must do the work rapidly, or the toast will be dry and hard.

The General Electric radiant type toaster has a capacity of two, three, or six slices of toast, during the preparation of which 1350 watts, 1800 watts, and



General Electric Hotel Toaster.

3150 watts, respectively are connected. The sides, base, and back of the device are of sheet iron. The top and front are open. The heating coils, of which there are seven, are placed at each end and between the hinged wire racks that support the slices of bread. Each rack is separately hinged to facilitate the removel



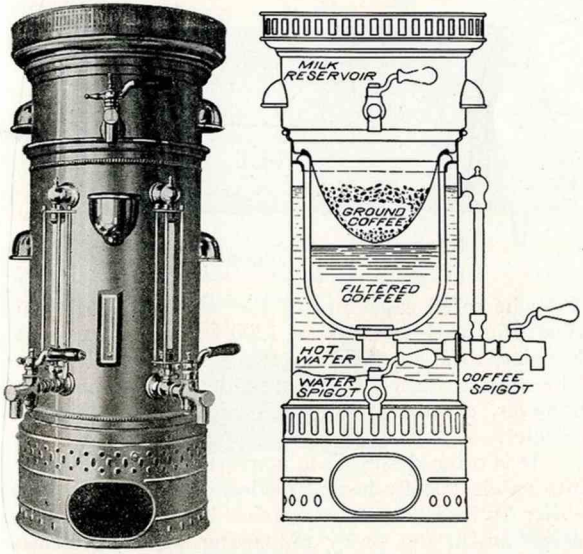
Hughes Hotel Toaster.

or examination of individual slices.

The Hughes toaster is of the oven type. The toast is placed on a rack measuring 8 inches by 18½ inches and inserted within the sheet iron casing between radiant type heating elements. The rated

capacity is 2 kilowatts. The outside dimensions of the device are 9¼ inches wide, 19 inches deep, and 9 inches high. Sixteen slices of bread may be toasted at one time. As the operation is performed within the casing the heat is conserved to a marked extent.

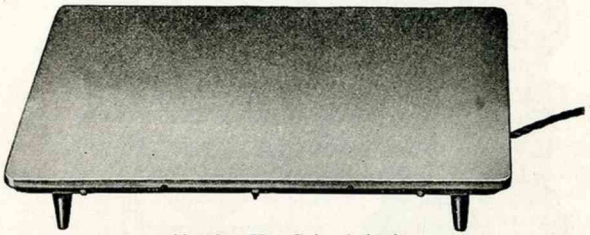
The Simplex toaster consists of an oblong flat top griddle on which the bread is placed and provided with either one or two grids, hinged at the back, which are folded down upon the upper surface of the bread,



Cutler-Hammer Coffee Urn.

thereby toasting both sides of the slices simultaneously. The device is made in two sizes. The smaller one is 10 inches by 12 inches and has a rated capacity of 1000 watts. The larger one is 12 inches by 18 inches and is rated at 1700 watts. Both sizes are equipped with three-heat switches and so connected that the bottom griddle may be heated separately for baking hot cakes and similar operations. The heating elements are of the enclosed sealed-in type.

Coffee Urns.—Either immersion type or disc type elements may be used for heating coffee urns in a hotel or restaurant. Electrically heated urns of ten gallons capacity or larger, provided with heating units of either the immersion or disc type, are available. Some of these urns are of the single shell type, whereas others are double walled and thoroughly insulated. Some are of the spray type and others are equipped with stoneware crocks for holding the coffee.



Simplex Hot Cake Griddle.

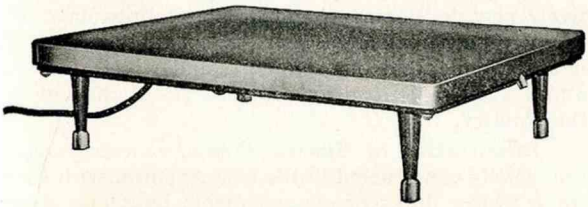
The rated capacities of the standard single shell type urns vary from about 1200 watts for a two gallon size, to about 4500 watts for the ten gallon size. The double walled types are much to be preferred, however, on account of their higher operating efficiencies.

It is often desirable to convert a fuel burning urn into an electrically heated device. This may be done, either by inserting an immersion heater of the proper design in the top, or by supporting a heating element against the bottom of the urn.

Hot Cake and Frying Gridldes.—Flat top griddles for making hot cakes are available in many sizes and makes. The 18 inch by 24 inch Simplex flat top griddle has a rated capacity of 2800 watts, whereas the frying griddle of the same make has a rated capacity of 3300 watts.

Frying griddles are a necessary adjunct to the modern hotel and restaurant kitchen. They are usually provided with raised edges. For quick frying

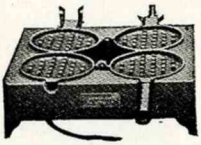
of eggs, steaks, and fish orders they are convenient. Operated on medium heat, the frying griddles may be used for making hot cakes.



Simplex Frying Griddle.

Waffle Irons.—For making waffles the electrically heated device is much superior to those heated by fuel. Little grease is required. The waffles are evenly browned and very attractive and palatable.

The Simplex waffle irons are made in two sizes, adaptable for making either two or three 4½ in. waffles at a time, and of rated capacities of 770 watts and 1150 watts respectively. They are so designed



Simplex Two-Section Waffle Iron.

that the sections are connected in series when heating up and in parallel when the waffles are baking. This arrangement makes it possible to keep the elements moderately hot between operations, and very hot while the waffles are cooking. The elements are of the sealed-in type imbedded in the iron. The frame of the device is of heavy cast iron.

Electric Bake Ovens.

Extent of Use.—The electric bake oven is being used extensively and with marked success in a number of western cities and towns as well as in some

parts of the east. It combines efficiency, speed, economy, and durability. It has found widest application in small bakeries, hotels, restaurants, and various institutions. The electric bake oven is a comparatively new development, and its possibilities have but recently been realized. There is no doubt, but what it has a wide field of usefulness, and will eventually afford a desirable load for central stations throughout the country.

Construction of Electric Ovens.—Electric ovens are usually constructed in the cabinet form, with from three to five decks or compartments built one above the other. This design is unlike the brick baker's oven which has only one deck but is somewhat similar to the ordinary portable gas oven. The exterior walls are generally made up of galvanized sheet iron and the space between the exterior and interior walls filled with a thick layer of mineral wool or some other heat resisting material.

The capacities of ovens now in use vary from 30 to 500 one-pound loaves, with baking surfaces of from 10 to 160 square feet, and with heater capacities of from 4 to 65 kilowatts. The weights of these ovens vary from 700 to 10,000 pounds. They may usually be heated to the proper temperature for bread baking in from 40 to 60 minutes.

There are two common methods of heating electric ovens, both of which have certain advantages. In the styles first placed on the market, the heating elements were mounted below the lower deck, and the heat circulated upwards along the sides and interior walls which were so arranged as to properly distribute the heat at each deck. The General Electric and Simplex ovens are made in this way. The Hughes bake oven, however, is heated by coils of resistance wire mounted between each deck, above the top deck, and below the bottom deck. Each element is controlled by a three-heat switch. The wattage of each element is a little greater than the one above it, and likewise, the front part of each deck is made somewhat hotter than the back. These provisions are

necessary on account of the gradual rise of heat to the top, and because of the heat losses around the deck doors.

Features of Electric Ovens.—The decks are accessible through hinged drop doors. The standard height of deck is about eight inches but they may be made higher if necessary. Tile decks may be used for continuous or heavy baking. Ovens so equipped will require more time to heat up but will maintain the temperature to better advantage when they are finally heated. Ovens not provided with tile decks are usually furnished with drip pans.

An accurate pyrometer for indicating the temperature should always be made a part of the oven equipment. This instrument will be an aid to economy of operation and a great convenience for the baker.

Table I.—Simplex Bake Ovens.

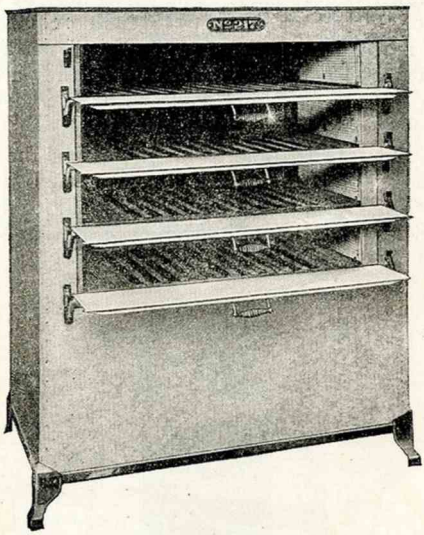
No.	No. 1-lb. Loaves.	No. of Decks.	Sq. ft. of Baking Surface.	Height of Decks in Inches.	Maximum kw. Demand.
152	36	3	12	8	6
154	56	4	18	8	8
156	70	5	23	8	9
158	90	5	26	8	10

Simplex No. 156 Bake Oven.

Simplex Ovens.—Four standard sized ovens, as shown in Table I, are made by the Simplex Company. The temperatures in the ovens are controlled by single

three-heat switches, which are usually fastened to the wall. The heating elements are of the cast grid type mounted in the base.

General Electric Ovens.—Three standard ovens, as shown in Table II, are manufactured by the General Electric Company. They are of the Blodgett type,



General Electric Type D-46 Bake Oven.

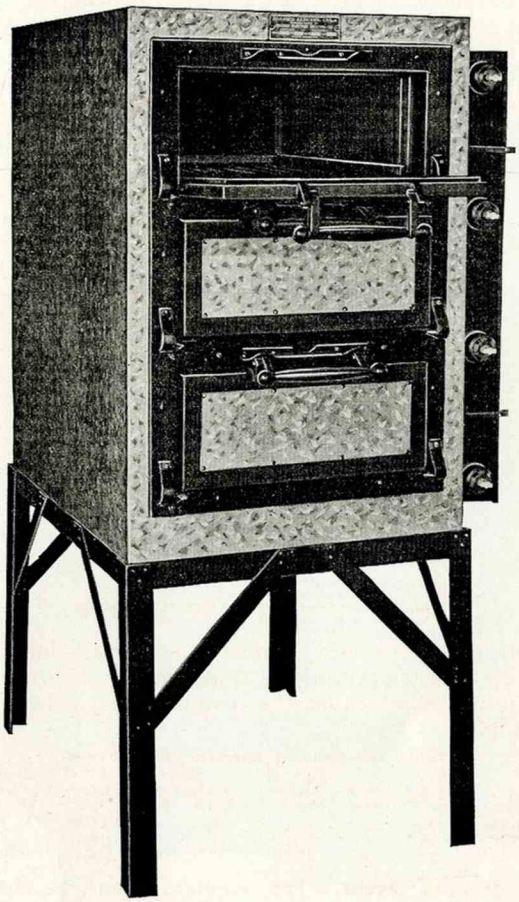
with grid resistance heating units fitted into the base. The temperature is controlled by a three-heat knife switch, which may be mounted in any convenient position.

Table II.—General Electric Bake Ovens.

Type.	No. 1½-lb. Loaves.	No. of Decks.	Sq. ft of Baking Surface.	Dimensions of Baking Comp. in Inches. Width.	Depth.	Height.	Maximum kw. Demand.
D-44	30	3	11.74	28	20	6.75	6
D-46	56	4	21.11	38	20	6.75	9
D-47	84	4	31.66	38	30	6.75	13

Hughes Ovens.—Ten standard ovens, as shown in Table III, are made by the Hughes Company. The heating units are mounted between the decks, and each

set is controlled by a separate three-heat switch. These ovens may be manufactured for use with tile decks when desired.

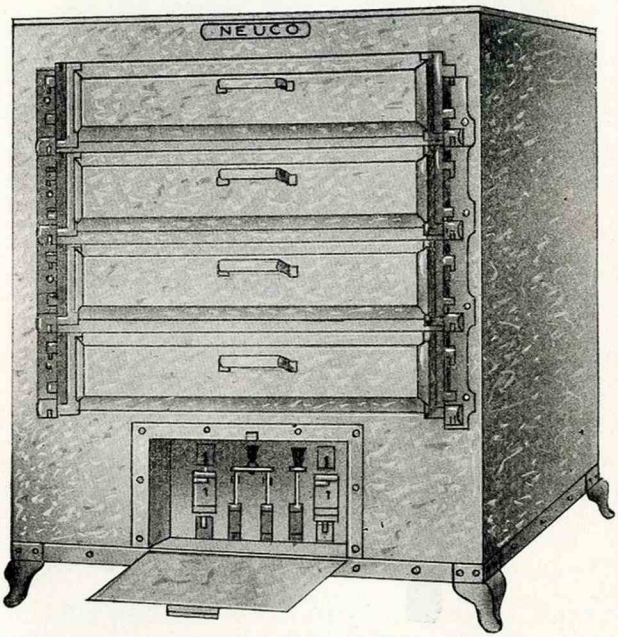


Hughes No. 200 Bake Oven.

Table III.—Hughes Bake Ovens.

Cat. No.	No. 1-lb. Loaves.	No. of Depth.	Sq. ft of Baking Surface.	Dimensions of Baking Comp. in Inches. Width.	Depth.	Height.	Maximum kw. Demand.
150	30	3	10	18	27	8	4
175	40	4	13.5	18	27	8	5
200	63	3	20.75	37	27	8	7.3
215	84	4	27.75	37	27	8	10
220	126	3	41	37	53	8	15
250	168	4	54.5	37	53	8	20
300	192	3	61.5	37	80	8	23.5
315	252	4	82	37	80	8	31
400	378	3	121	73	80	8	47
415	504	4	161	73	80	8	62

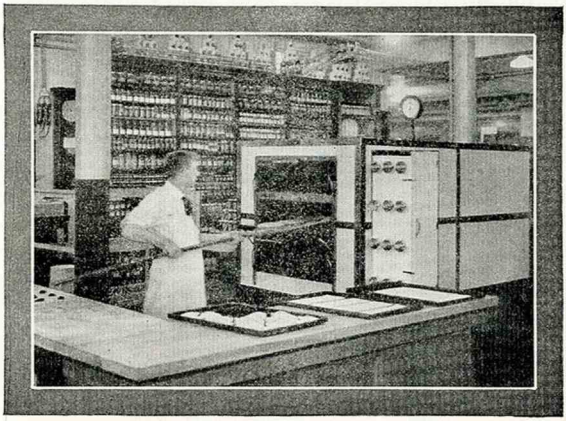
Advantages of Electric Ovens.—The many features of superiority of electric heat over fuel heat which apply in the use of electric ranges obviously attend its use in connection with electric baking ovens. A baker's shop is ordinarily a hot, stuffy place because



"Neuco" No. 107 Bake Oven (Capacity 48 2-lb. Loaves).

of the intense heat. Very little radiation of heat, however, is noticeable from the electric oven on account of its heavy insulation. The hand may be held against the outside with no discomfort after the oven has been in service several hours.

Heat Regulation.—The heat regulation in an electric oven is nearly perfect. It is an obvious advantage

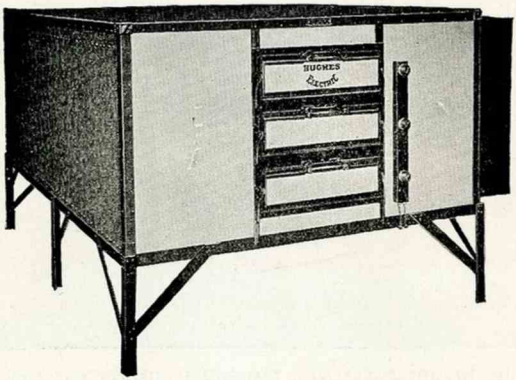


Hughes No. 300 Bake Oven, Installed in Bakery and Grocery, Norfolk, Va.

to be able to obtain the desired temperature in an oven in a short period of time. This feature alone goes a long way toward insuring satisfactory results.

With coal ovens it is necessary to have a continuous fire in order that they may be put in operation without delay. Sometimes only one or two batches of bread are baked during the night but the fire must be kept up to take care of the next day's business. The electric oven overcomes this objection as it can be heated quickly. If the oven is not used continuously it may be maintained at baking temperature on the low heat with one-quarter the maximum current consumption.

Saving in Floor Space.—Only a fraction of the floor space is required for an electric oven that is necessary for a brick oven. The user of a brick oven, furthermore, must have a large space in front of his oven in which to manipulate his peel for inserting and removing material. Very small space for this purpose is required by the user of an electric oven. The use of coal ovens, moreover, makes it necessary to provide storage space for a large supply of fuel. Coal must also be paid for in advance and a considerable



Hughes 500-Loaf Oven (Special Design).

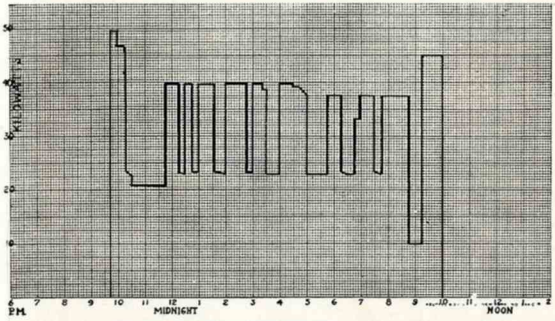
amount of money is tied up. No storage space, however, is required for electric energy, and it is not paid for until used.

When a new bakery is constructed it may be made of lighter material, because electric ovens weigh only a fraction as much as brick ovens.

Sanitary Features of Electric Ovens.—Electric ovens are absolutely sanitary. The heat is derived from resistances operating at comparatively low temperatures. There are no fumes or objectionable odors such as are produced by gas ovens, to contend with. The dirt and dust always encountered with brick ovens are entirely obviated. The electric ovens may also be easily and quickly cleaned.

The fact that an electric oven is used in a place of business is an advertisement for the establishment. It carries an appeal to the public generally.

Diversity of Baking.—All classes and kinds of bread, cake, cookies, pies, pie shells, patty shells, and rolls may be baked in the electric oven with the greatest satisfaction and ease, and at a very reasonable cost. Patty shells will attain the beautiful brown and flaky appearance in an electric oven without the use of egg



Typical Load Curve Hughes Special 500-Loaf Oven, Turning Out 560 14½-oz. Loaves Every 45 Minutes.

and butter mixtures that are usually required in other ovens. Bread, cake and pies will always have just the right shape and color. They will likewise remain fresh longer, as less moisture is removed from the product.

A larger, better colored, finer textured, and thinner crusted loaf of bread can be produced in the electric, than in the fuel oven. The light golden brown color of bread baked electrically will always increase the demand for the product.

Cakes, cookies, etc., which require lower temperatures than bread, can be baked after the bread is taken from the oven without using additional current, or they may be baked while the oven is heating up.

Economy in Roasting Meats.—The great variety of food that may be prepared in an electric oven, makes

it of considerable value for cafe, cafeteria, hotel, and restaurant use. All kinds of meats, including fish and fowl, may be roasted in an electric oven with less shrinkage than in any type of fuel oven. The shrinkage loss in fuel ovens varies from 30 to 40 per cent, whereas it is only from 15 to 20 per cent in the electric oven. The meats will always be juicy, wholesome, clean, attractive, and delicious in flavor. No oxygen being consumed or poisonous gases being given off in the electric oven, the meats do not take on the hard, bitter tasting crust often apparent where fuel is used.

In roasting chickens in the electric oven it is not necessary to spread a greased cloth over them to prevent the formation of hard crusts. They will be juicy and palatable if cooked in an open pan.

Utilizing Stored Heat.—After the day's cooking is done, cereal, baked apples, baked pork and beans, spiced ham, etc., can be prepared in electric ovens without using any additional current. Simply place the materials in the oven. They will cook on the stored heat and be ready to serve for breakfast.