Electric Heating in the Home

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The question of electrically heating the home is one which is apparently being considered by many people in this Province, judging by the frequent questions asked the Hydro-engineer in the field. The usual layman, after asking when it will be feasible to heat the home electrically, continues by saying that he assumes that pretty soon power will be cheap enough to be used generally for house heating, dispensing with the use of coal altogether. He also assumes that new inventions and higher efficiency methods of using electric power will soon bring the cost within his reach.

It is for the purpose of explaining this matter in such a way that the layman can readily understand the situation and presenting some figures obtained from tests, that this article is prepared.

In considering the broad subject of electric heating basic facts must be considered and certain assumptions made. The fundamental fact is the relation of the kilowatt hour, or electric power unit, to the heat unit, or what is called the British Thermal Unit. (B. T. U.).

The primary power units used in the scientific and engineering world are the units of length, mass and time, or in English units—the foot, the pound, and the second. From these units by extensive and repeated experiment and analysis all other power units have been derived and the ratios between them are defined accurately. From fundamental units the kilowatt hour is equivalent to approximately 3,412 heat units. That is to say, if one kilowatt hour of electrical energy is all converted into heat, 3,412 heat units will result.

It should also be remembered that all forms of energy can be and are eventually dissipated in the form of heat, and it is possible even with the crudest electric heating elements to convert electrical energy into heat energy at practically 100 per cent efficiency.

This does not mean that all the heat from a kilowatt hour can be usefully employed for all purposes. Heat may be likened to a supply of water in that it will flow from a higher to a lower level only, without the application of external force.

"Heat Units" refers in no way to temperature. Temperature may be likened to head of water, or pressure.

The heat units available at a low temperature are for many purposes useless. A hot water radiator, no matter how much heat is circulated, will not give heat to the air in a room unless the temperature of the radiator is above that of the room. The same applies to any other form of heating apparatus owing to the fact that heat will not pass from a body of low temperature to one of higher temperature, the reverse operation only being feasible.

By careful analysis and experiment the number of heat units that can be obtained by burning various substances has been determined. Various grades of caol contain a certain number of heat units, depending upon the chemical composition of the coal. For the purposes of this article we will assume that first class high-grade anthracite coal will contain 14,500 heat units per lb. This means that if one lb. of coal is burned under ideal conditions in laboratory apparatus, a total of 14,500 heat units will be given off.

In actual practice coal is not burned under ideal conditions, and it is found that even in high grade steam boiler practice under test conditions only approximately 80 per cent of the available heat in the coal appears in the steam, the remaining 20 per cent being lost up the flue, through radiation and through incomplete combustion.

The ordinary hot water furnace, as used in the home, is far less efficient than the high grade steam boiler operated under ideal conditions, with skilled attendance, and it seems that if 45 per cent of the heat availabl in the coal is transmitted to the water and useful for house heating, it is about as good as can be expected. Many furnaces operate at even lower efficiency and probably few, if any, at a higher figure.

On mild days checks are opened and dampers closed, with a resultant lowering of furnace efficiency, due principally to incomplete combustion of the gases given off from the coal. We therefore believe that we are safe in assuming that not over 4 per cent of heat contents of the coal is useful for heating the house.

45 per cent of 14,500 heat units is 6,525 useful heat units obtained from a pound of coal. This compared with 3,412 heat units from one kilowatt hour used in an electric heater indicates that for house heating purposes one lb. of coal burned per hour is equivalent to 1.91 kilowatt hours, or one ton of coal burned in the house furnace equals 3,820 kilowatt hours.

That this ratio is not far from the actual figure obtained b tests will be shown by the eaxmple following.

Assuming this ratio to be correct within ordinary limits, it will be noticed that with current at one cent per kilowatt hour the heat equivalent of one ton of coal obtained from electric heaters would cost $38.20, and with current costing ¼c per kilowatt hour the heat equivalent of one ton of coal burned would cost $9.55, which would seem to indicate that for electric power to compete with coal at $8.00 electric energy would have to be procurable at less than ¼c per kilowatt hour.

It is undoubtedly true that houses built especially for electric heating can be so insulated as to reduce the heat loss through the walls and windows, with a corresponding decrease in the number of kilowatt hours necessary for heating. Anything of this kind done to reduce the heat losses from the house would also lessen the cost of heating by coal or any other method.

Kinds of Electric Heaters.

Electric heating at present is confined largely to auxiliary service in homes, offices, etc., that is to take the chill off during cool mornings and evenings, or to supplement the regular heating system during extremely severe weather.

The usual heaters for this purpose consist of resistance wire wound on suitable supports, either with or without reflection surfaces. These, being light, are portable and comparatively cheap. They are also practically 100 per cent efficient as far as converting electrical energy into heat is concerned. They may be operated at high temperature or at a glowing heat or at a low temperature, dependent upon design and the wishes of the builder. Such heaters require the use of power during the entire time that heat is desired.

For large installations, and where it is necessary to turn off the electric power during part of the time and yet keep a fairly uniform temperature in the room, some form of heat storage is necessary. Experience seems to indicate that for this purpose the best arrangement consists of the ordinary hot water house heating system with the furnace replaceld by a carefully insulated or lagged water tank, provided with one or more heating units of the bayonet type. In many cases a small motor is used to rapidly circulate the hot water in the system.

With such an installation it is customary to automatically cut off the electric power during the lighting peak, and to at least reduce it during the period of heavy station load. This can be accomplished by suitable time clocks.

The amount of energy fed into the heating system is also automatically regulated by means of thermostats, which vary the number of heating units in service, according to the temperature to be maintained in the building. This system, while fairly high in first cost, is flexible, self-contained, automatic, practically free from fire risk and free from dust and odors. It may be considered practically ideal. Another system which has been tried, and which seems to have a promising future for some cases, consists of a cast iron or pressed steel radiator filled with water or oil, for heat storage purposes, and individual bayonet type heaters, either hand or automatically regulated. These radiators may be either stationary or portable, and the scheme does away with expensive water piping throughout the house. It has the disadvantage of not having as large a heat storage capacity as the system above mentioned, and therefore is not as well adapted to keeping uniform temperature during off peak load periods. The first-named system may be used to store heat during the entire night and give it out during the entire day without supplying any electric power to the system during the day time.

Another system adapted for auxiliary heating, that is, to supplement an ordinary furnace during severe weather, consists of electric heating elements attached to the water piping system near the individual radiators for boosting the temperature when required.