oil from overhead shafts and pulleys. If it is imperative that the dynamo should be placed in a position exposed to dropping oil, no time should be lost in protecting it. Oil, pure and simple, is not a good conductor of electricity, but dirt is. Oil gathers dirt, and holds it, and dirty oil becomes a dangerous element under such conditions; besides, a filthy dynamo, or any other machine, is always an assurance of one of three characteristics on the part of the party in charge: carelessness, which is akin to laziness; ignorance, for which there is no excuse; or downright, stubborn incompetency.

The engineer and dynamo man, as well as the fireman and the outside man, should ever bear in mind that there is no royal road to preferment in their calling, but that there is always room to spare upon the upper rounds of the electrical ladder. There is no success without effort. Do you ask what course he shall pursue to arrive at the topmost round? Read: not as he measures the water in the tank or boiler, but as he weighs the coal that goes into the fire. Let him learn to use the instruments which will tell him daily how high his line insulation is, that he may stop a small leak before it either breaks through or endangers the line by increasing the strain at some other weak point. Instruments which will tell him whether his armature or his field is in contact—crossed—with the frame of the dynamo. Instruments that will tell him whether the conducting wire is of proper resistance; or, if it shows a fault, will tell him where the obstruction is, and enable him to remove it, and thus restore his line to its best condition and the lights to their maximum steadiness and brilliancy. All this is in the direct line of economy, and economy in any proper mercantile enterprise is a guarantor of success; its twin at least, if not its synonym.—*Electrical Industries.*

THE ENGINEERING OF WARMING BUILDINGS BY MEANS OF HOT WATER.

For a number of years the Gurney Hot Water Heater Company of Boston, Mass., has conducted a series of very costly experiments in heating buildings by hot water. These have been conducted on such a liberal scale that those interested in the subject as one of applied science, as well as those engaged in the actual erection of heating apparatus, have been alike instructed and profited. The use of hot water for heating purposes is by no means a new thing, but looking at the devices and apparatus, and system in use many years ago, and comparing them with the present adaptations and improvements, there are evidences of wonderful progress and enterprise. Imperfect methods have been corrected; apparatus has been simplified without detraction in efficiency; and artistic designs have been introduced that are creditable to the designers, and appropriate for either places of public resort or private dwellings. Take for a simple instance the heating system of the new Auditorium in Chicago—a marvel of ingenuity, a wonderful display of mechanical skill. With its miles of pipes and elaborate radiators, proving beyond any doubt whatever, that the largest buildings, in even exposed situations, can be comfortably and economically warmed by either steam or hot water. But to return. The results of experiments conducted by the Gurney Hot Water Heater Company have been of a positive and advantageous character, giving a strong impetus to the adoption of hot water as a means of heating buildings, and proving beyond a doubt how the greatest efficiency and economy can be reached with absolute safety and cleanliness. It becomes, therefore, an interesting investigation to examine some of the engineering principles that have been recognized by the Gurney Hot Water Heater Company in the construction of their hot water heaters.

Fig. 1 is a vertical (sectional) representation of the ash-pit, grate, fire-pot and one corrugated section; fig. 2 is a sectional representation, showing general construction, circulation of water, and action of heat on surfaces. Reference being made to fig. 1, we remark that in this heater the initial point of circulation is in the ash-pit, the rays of heat from the bottom of the fire being sufficient to start the water in circulation at this point, which, while it economizes very greatly in fuel, takes up many units of heat which had hitherto been lost by radiation to the cellar. It will be observed that the return water being brought into the water base, is distributed over a larger area than could be done by any other process, the whole base being, properly speaking, a manifold for the reception of the return water of circulation, which being returned at the lowest point of the system, is freed absolutely from any of the repulsion which is inseparable from the introduction of water at a point opposite the heated surfaces of the fire-pot itself. It will thus be seen that in passing very hot surfaces the water does so on vertical lines, and the passage of the water being therefore very rapid, it is not possible to generate steam, and so cause imperfect circulation of the water.

Now, with this fact in mind, it will be noted that the water in the heater, as shown in the accompanying section, is coldest at the base, just above the line of the ash-pit; at this point bricks are introduced, which are dropped into wedge-like chambers, thus presenting a sufficient amount of water surface to the fire, taking away so much heat as may be done without causing the fire to be dull at the outside edge. By the use of this brick as perfect combustion at the edge of the fire as can be done in any stove is secured. Without this brick the heat taken from the fire by the water would be so great as to largely overcome combustion at the outside edges of the fire-pot; this has been the cause in the past of all the slowness that has been complained of in hot water heating. It will be observed in reference to this heater that the grate is made so as to roll on balls, and it is claimed that when loaded to its fullest extent the friction is in a large degree overcome, and by the use of the lever a child may shake the grate of the largest heater made.

We call attention to the fact that perfect combustion cannot be secured in a fire-pot in which water is passing rapidly over the outer surface, carrying away the heat from the outer surface of the fire. To meet this it has always been found necessary to either limit the surface over which the water travels, thus exposing part of the most valuable surface directly to the air of the cellar, or to interpose between the fire and water some kind of partial conductor like fire-brick. We call attention to the very simple method of construction by which is secured the useful effects of this non-conductor without the attendant danger of the efficiency of the fire-pot section being lost through the destruction of the fire-brick. On examination of the illustrations it will be seen that the brick is enclosed in a slot which is wedge-shaped, into which the brick is dropped from the top, and being so placed, is surrounded on three sides by water. By the use of this brick thorough combustion is secured on the outside edges of the fire, which would be impossible without it. The brick is rendered practically indestructible, it not being ever hot enough to fuse with the coal, and being free to move in this slot, expansion and contraction has no effect upon it, so that after four years of firing in the cold climate of Canada, the company