three in number—viz. (*a*) mechanical energy, (*b*) chemical energy, and (*c*) thermal energy. All energy of either of these three forms may be potential or kinetic—potential when at rest, kinetic when in action. We will briefly call attention to some well-known illustrations of these forms of energy before proceeding to consider how they may be transformed into electrical energy.

Mechanical Energy.

(*a*) Mechanical energy. Every machine which possesses a handle and has to be driven involves the use of mechanical energy. If we take a sewing machine with a handle or treadle, and we turn that handle or treadle, we employ mechanical energy; the energy in the arm or leg of the operator is potential so long as the limb is at rest, but it becomes kinetic so soon as we exert the limb to set the machine in motion. In winding up a clock we employ mechanical energy, and store it in potential form in the raised weights or coiled spring, and it is given out again in kinetic form as the machine performs its work.

Chemical Energy.

(*b*) For illustration of chemical energy we need only point to an ordinary gas burner. Here we have the potential energy latent in the gas as it comes from the main, and the oxygen of the air becoming transformed by combustion into the kinetic energy manifested in the heat and light of the gas flame.

Thermal Energy.

(*c*) As regards thermal energy, we may refer to the steam-engine, where the potential energy of combustion is transformed into the kinetic energy of steam.

Transformation.

We may now consider more particularly the methods of transforming each of the above-named forms of energy into electrical energy. First, then (*a*), of *Mechanical Energy*. The simplest form of mechanical energy capable of being transformed into electrical energy is friction. If we take a rod of ebonite or sealing-wax, and rub it lightly on dry fur or silk, or even upon the coat sleeve, we shall find that some of the energy of the rubbing has been transformed into electrical energy; for, on presenting the freshly rubbed rod to some small cuttings of thin paper, we shall find that they are attracted to the rod, and jump through a perceptible air space to adhere to it, thus proving the presence of electricity. A better illustration is found in the old-fashioned electrical machine, where a disc or a cylinder of glass is made to revolve rapidly while a pad or pads rub against its surface. By means of this arrangement the utility of friction is much increased, and the mechanical energy required to turn the handle is partially transformed into electrical energy. This is apparent in the sparks which may be drawn from the machine. Another kind of machine, which we may here mention, but which will be more fully referred to in another lesson, is the dynamo. Mechanical energy is required to drive a dynamo, and electrical energy is obtained from it.

Re-Transformation.

We will now point out how this electrical energy may be re-transformed into energy of its original form. If we take a dynamo and set it in action by the use of mechanical energy we are able to get from it electrical energy, and this electrical energy may be used to actuate a machine called an electro-motor, which shall in its turn give out mechanical energy. We have thus mechanical energy producing electrical energy, and this same electrical energy reproducing mechanical energy. This we may term an energy cycle, and illustrate it by the following diagram.

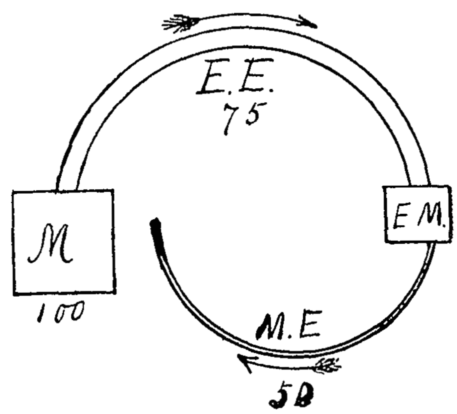

FIG. 1.

M is the mechanical generator; EE is the electrical energy; EM is the electro-motor; and ME is the mechanical energy.

We must be careful to note that in this transformation and re-transformation, much of the energy used to start with is lost in the process, and the diagram is intended to show this. Let 100 represent the value of the mechanical energy used in M; 75 may be taken as the value of the electrical energy of EE, supplied to the electro-motor EM, and 50 as the value of the mechanical energy of ME. We thus have only one-half the original energy available on re-transformation, and frequently in actual practice the proportion is still less.

Secondly (*b*), of *Chemical Energy*. Take a cylindrical glass vessel containing dilute sulphuric acid, and introduce therein a strip of