

brushes through the leads from the winding to the bars on which the brushes are making contact. The direction of the lines of force in the field between the poles in each case is supposed to be horizontal. If the turns of the winding in the last case, starting at the lower brush, and is wound in a right-hand direction and advancing on the core in the opposite direction to that of its rotation, the upper or top brush will be positive. The E. M. F. generated in either half of the winding will be equal to the sum of the E. M. F. generated in each outside part of the winding; that is, all the turns on either side of the core between the brushes are connected in series. A winding of this kind is called a closed coil ring winding, and will also give a greater E. M. F. with the same speed and strength of field than a single open coil winding. A closed coil winding can also be placed on a drum core or on the outside of a ring core. Each conductor on the core will have a motion almost parallel with the lines of force for a considerable time twice in each revolution and will be practically inactive so far as the generating of an E. M. F. is concerned, but they are very necessary in a closed coil winding as a conductor to complete the circuits to the brushes. The drum with its winding and the commutator is called an armature. The iron frame or yoke through which the armature shaft extends on either side has two laminated projections fastened on the inside and extending very close to the face of the armature. On these projections or pole pieces are placed the field windings. These windings are connected in series and also in series with a resistance box or rheostat, to control the current flowing in them; the ends are then connected one to each of the brushes or terminal of the armature. A dynamo of this kind is called a shunt dynamo. If a piece of insulated wire large enough to carry the output of the dynamo is taken and a few turns made with it around each pole piece in addition to the shunt windings, so that it will help to strengthen the magnetic field and then connected in series with the external circuit, it would be a compound wound dynamo. The current should flow through each winding on each pole piece so that the face of one will be positive and the face of the other will be negative. If this is done the lines of force will flow in the iron yoke from the negative pole piece to the positive pole and across through the armature to the negative pole again, thus completing their circuit. The dynamo considered in this paper is a simple bipolar type, which requires only two sets of brushes.