THE DYNAMO, HOW MADE AND HOW USED

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HOW MADE AND HOW USED.

A Book for Amateurs.

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PREFACE.

THIS work was not written for the manufacturer of *large* Dynamos: it originally appeared in the pages of the *English Mechanic* in answer to the demands of many amateurs, who, desirous of constructing a small dynamo, capable of being worked by hand, and of giving a current sufficiently powerful for experimental purposes, were in need of such practical information, as to the correct proportion of the various parts, and the precautions necessary to ensure success, as they had been unable to gather elsewhere.

Encouraged by the flattering reception with which it has met, the author places it before the public in a separate form, trusting that it may lead many to taste the pleasures which can be extracted from even a slight acquaintance with the science of Electricity.

S. R. BOTTONE.

THE DYNAMO:

HOW MADE AND HOW USED.

THE interest awakened in machines for the generation of current electricity, consequent upon the demand for electric lighting and transmission of power, has induced many amateurs to turn their energies to the construction of small dynamos, such as might replace a battery of eight or ten cells, without the disagreeable concomitants of changing acids, cleaning plates, etc., provided such dynamos could be afterwards worked without the employment of power. Such efforts have not generally met with success, owing to the fact that no work of a practical nature has yet appeared in which the construction of the dynamo is fully explained. When the principles which control the manufacture of such machines is understood, dynamos can be constructed with as much ease and certainty as induction coils; and in the following pages these principles will be elucidated sufficiently to enable the amateur to carry out his work in an intelligent manner.

§ 1. *What a Dynamo is.*—As understood at present, the dynamo-electric machine may be defined as a machine whereby energy (motion) is converted into electricity by the aid of the residual magnetism present in certain iron portions: which electricity is caused to react on the iron and so heighten its magnetism; and this increased magnetism in its turn gives rise to more powerful electrical effects, and so on, until a limit is reached, depending partly on the velocity of the motion, partly upon the relative *apportionments* of the size and quantity of the wire and iron

employed in its construction, and partly on the resistance throughout the circuit. Although this principle was fully understood, and described by Soren Hjorth, of Copenhagen, in his patents, dated October, 1854, and April, 1855, yet the name 'dynamo' (from *dynamis*, Gr., *force*) does not appear to have been used in this connection until Dr. Werner Siemens employed it in a communication to the Berlin Academy, January 17, 1867.

§ 2. *Faraday's Discovery.*—The closeness of the relationship between the phenomena which we call *electricity* and *magnetism* had struck many philosophers of the eighteenth century. Oersted, of Copenhagen, in 1819, was the first to prove, by a series of masterly experiments, the magnetic properties of current electricity; Ampère, and Arago in France, and Sir Humphry Davy in England, then distinguished themselves by their zeal and activity in this research; but the keystone of the arch was laid when Faraday, in November, 1831, showed that it was possible to call forth electric currents by means of a magnet. In order that the reader should have an intelligent knowledge of the principles which underlie the construction of the dynamo, it would be well for him to repeat some of the experiments about to be described, more especially as they are easy of performance and trifling in cost.

The first thing required will be a *galvanometer*, an instrument for indicating the presence of current electricity (and in some cases to measure its quantity). To make this, a piece of crinoline steel, 2 inches long and $\frac{1}{3}$ of an inch in width, is 'softened' by heating the middle portion over a gas jet or other flame, until red hot, then allowed to cool *gradually*. By laying this across a knife blade the exact centre is found and *marked*. By means of a screw-drill a hole about $\frac{5}{32}$ of an inch diameter clear through the centre of this steel 'needle,' as it is called, is bored. By filing from the centre towards the side the needle is brought to the shape of a lozenge, as seen at Fig. 1, A. Holding this needle by means of a piece of copper wire passed through the hole, it is heated to dull redness over a flame and plunged into cold water to restore its temper. A piece of brass rod, $\frac{1}{8}$ of an inch in diameter, and about $\frac{1}{2}$ of an inch long, is now soldered centrally, just over the hole. This is easily done by cleaning the needle with a bit of sandpaper,

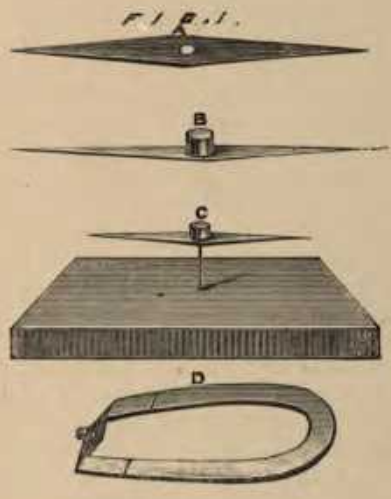
FIG. 1.
A
B
C
D

specially round the hole, cleaning also the little piece of brass rod, on its end, then putting a little piece (as big as a grain of mustard-seed) of plumbers' solder just over the hole bored in the needle. Holding the needle with a pair of forceps (a little rosin powder having been previously applied round about the hole) over the flame of a spirit-lamp or gas-burner, will cause the solder to melt and adhere to the steel. The piece of brass is now taken up with another pair of forceps, and laid (flat side downwards) as centrally as possible over the hole. Keeping the needle still over the flame, the solder will also flow round the brass and adhere to it, making a firm junction, when it may be removed from the flame, and placed *at once* on a cold metal or stone surface. It should now present the appearance shown at Fig 1, B. Any solder which may have exuded from between the brass and the steel should be filed away. Using the same bit in the screw-drill that was employed originally to bore the hole through the steel, a conical hole, reaching nearly but not quite to the opposite surface of the brass piece, is drilled from the hole in the steel. This serves as a pivot on which to poise the needle. A trial may now be made to find whether the needle is fairly centred; but no attempt need be made *yet* to balance it if not true. Having cut off the head of a fine-pointed pin, let us drive it, blunt end downwards, into the centre of a little slab of well-seasoned pine 3 inches by 3 inches by $\frac{1}{2}$ an inch, leaving not less than $\frac{3}{4}$ of an inch protruding. On the point we can poise the needle, and *mark* with a pencil the end which hangs (if either does). Fig 1, C, will show what is meant. The needle must now be *magnetized* by being allowed to remain for some time (twenty minutes or half an hour) across, and in contact with the poles of a horse-shoe magnet, care being taken that having once placed the needle in one position it should not be reversed, as its polarity would be reversed if this were done; and since in our latitude the *north-seeking pole of a freely suspended needle hangs downwards*, if the needle, when tried previous to magnetizing, had one end *heavier* than the other, *that* end must be placed against the north pole of the horse-shoe magnet, by which means it will acquire south-seeking polarity, and consequently neutralize to a certain extent the inclination of the poised needle. After magnetization