DYNAMIC ELECTRICITY.

THE DEPOLARIZATION OF ELECTRODES.

BY GEO. M. HOPKINS.

Having explained the causes of the enfeeblement of currents in galvanic batteries in a former paper,* I will describe some of the methods in use for preventing the principal cause, viz., that of the polarization of the negative electrode. In all single fluid batteries this necessarily takes place to some extent, whatever precautions may be adopted for its prevention. The means of depolarizing single fluid batteries are mechanical, and consist in the agitation of the exciting fluid by gravity, as in the fountain battery, by air jets, as practiced by Grenet and Byrne, by stirring the fluid by mechanical means, by rotating or swinging the electrodes, and by roughening the electrode, as in the case of Smee's battery, in which the platinum plate is covered with a deposit of finely divided platinum.

In single fluid batteries the polarization of the negative plate may be greatly retarded by enlarging it so as to afford a great surface for the dissipation of the hydrogen. In two fluid batteries the depolarization is effected by chemical means, and perhaps more perfectly in the sulphate of copper batteries than any other.

In all single fluid batteries the oxidation of the zinc liberates hydrogen at the negative plate, and the hydrogen rapidly reduces the power of the battery in the manner explained in the former paper. In Smee's battery the microscopic points formed by the roughened platinum surface facilitate the escape of hydrogen, and in this way may tend to maintain the power of the element.

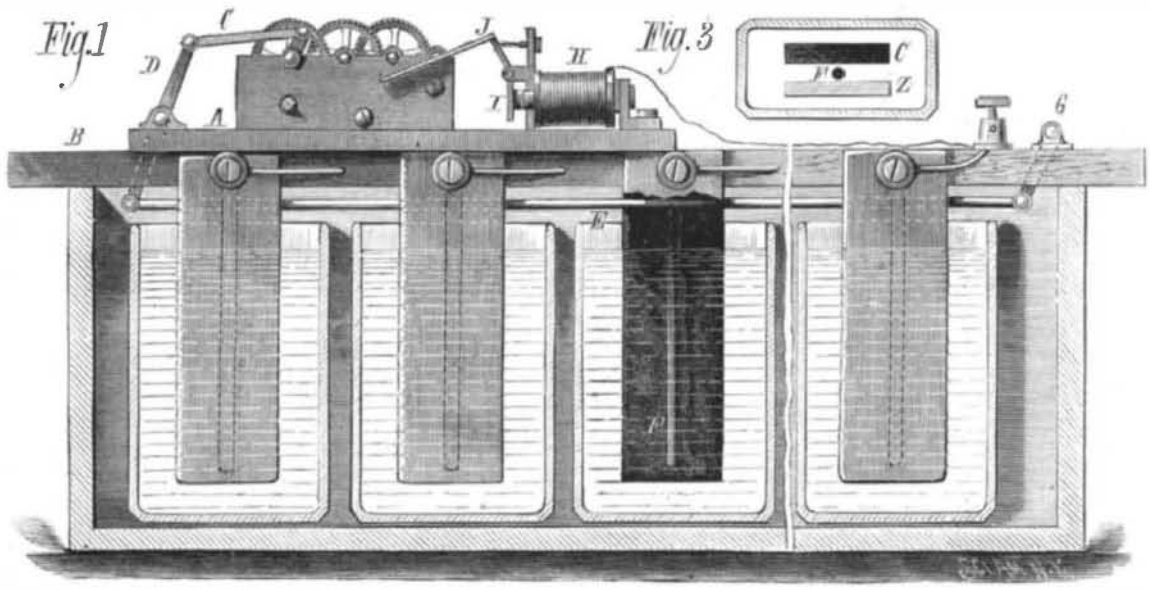
In the Grenet battery the negative plate quickly polarizes, rendering the battery unfit for uses of more than a few minutes' duration. However, the agitation of the exciting fluid by the withdrawal and replacement of the zinc restores the battery to its normal strength. Grenet agitated the exciting fluid by means of air blown in through glass tubes, as shown in Fig. 4. This prevents polarization to a great extent, and renders the battery very active. Dr. Byrne, of Brooklyn, adopted this plan of depolarization in his battery with remarkable results.

On page 182 of the current volume of the SCIENTIFIC AMERICAN is shown a zinc-carbon battery employing the bichromate of potash solution as an excitant, and arranged for the introduction of the solution to the cells by air pressure, which may also be made to agitate the solution. This is a very convenient form of battery for experimental purposes and for uses of short duration, as it can be made to yield a strong current while the exciting fluid lasts. The air in all these cases acts only as a mechanical agitator. The fountain battery, described and illustrated on page 150, exhibits another practical method of mechanical depolarization.

Figs. 1, 2, and 3 of the annexed engravings show a purely mechanical agitator, consisting of a system of spring-acted stirrers, controlled by an electro-magnet of high resistance in a derived circuit. This magnet absorbs but an exceedingly small proportion of the current, and has only sufficient power to move the lever controlling the spring motor.

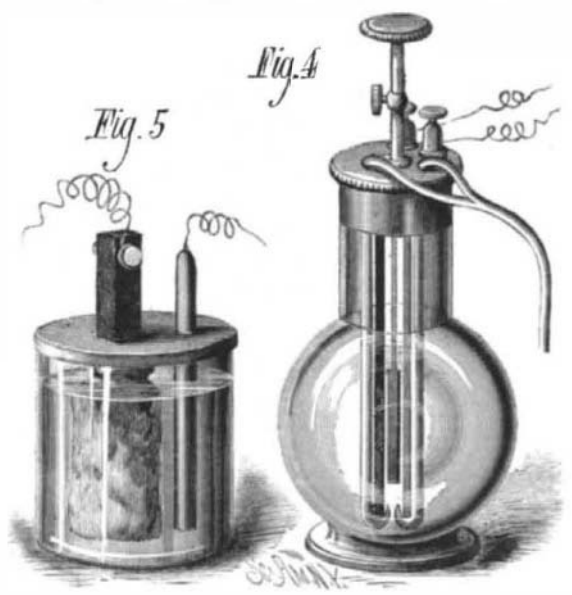
This motor, which may be of the cheaper class, is mounted on a base, A, secured to two parallel bars, B, carrying the zinc and carbon plates, *z c*, of the battery. These plates are placed flat against the bars, B, and secured by screws and washers. The zinc of one element is connected with the carbon of the next by a wire passing diagonally through the bar, and the first zinc and last carbon are connected with the binding posts at the ends of the bars, B.

The second shaft in the train of gearing is provided with a crank connected by a rod, C, with the lever, D, which is fastened to a rock shaft, and connected with the bar, E, extending the whole length of the battery between the zinc and carbon of each element, and carries a series of vertical rods, F, of vulcanite, one such rod being located between the zinc and carbon plates of each element. The zinc in one of the elements is broken away in the engraving to show this rod. A swinging arm, G, supports the extremity of the rod, E. A high resistance magnet, H, mounted on the base, A, is connected with the two binding posts of the battery, so as to receive a small portion of the current. The armature attached to the lever, I, when drawn against the poles of the magnet brings the lever, I, into engagement with the fan, J, which is the last element in the train of gearing composing the spring motor. A light retractile spring draws the lever, I, away from the fan, J, and removes the armature from the magnet when the power of the battery is reduced to a certain limit. The spring motor, being free to act, oscillates the rods, F, and by stirring the exciting liquid, disengages the hydrogen from the plates, and brings fresh liquid into contact with the zinc and carbon and restores the strength of the battery, when the armature of the magnet, H, will be acted upon, bringing the lever, I, into engagement with the fan, J, and stopping the action of the spring motor until the current is again weakened, when the operation just described will be repeated.



DEPOLARIZATION OF ELECTRODES BY MECHANICAL AGITATION.

In this way the strength of the battery will be maintained within certain limits, until the liquid is exhausted. Of course this system may be extended sidewise or lengthwise as much as may be desired.



GRENET BATTERY, WITH AIR TUBES.—CHLORIDE OF SODIUM BATTERY.

At least, all batteries employing mechanical means of depolarization, with, perhaps, the exception of Smee's, are only adapted to uses requiring a very strong current for a limited time.

The enlargement of the surface of the negative plate has great advantages, as it affords an increased surface for the accumulation or dissipation of the hydrogen.

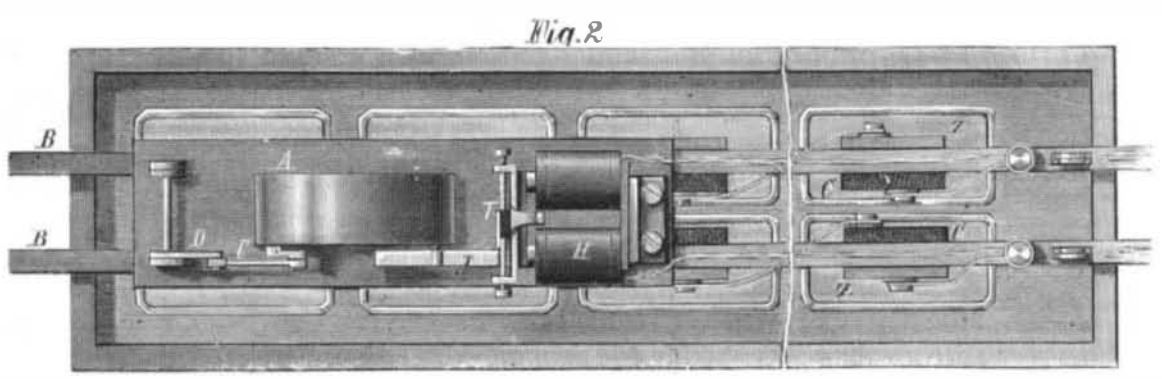
A very simple example of a battery with enlarged negative plate is shown in Fig. 5. A carbon rod is placed in a Canton flannel bag and surrounded with pieces of broken carbon about half inch square. The bag is tied around the carbon rod and placed in a jar partly filled with a strong solution of common salt. The zinc consists of a round rod about three-eighths of an inch in diameter, like that used in the Leclanche battery. The large carbon surface in this battery polarizes very slowly. One cell of the battery is sufficient to ring a bell on a short circuit.

The chemical method of disposing of the hydrogen in batteries is theoretically and practically the best, and the best example of the most perfect action of this character is found in the Daniell battery, in which the hydrogen resulting from the action of the dilute acid on the zinc is liberated on the surface of the copper plate, where it reduces the sulphate of copper, forming sulphuric acid and metallic copper, the latter being deposited on the surface of the copper plate. So long as sulphate of copper is present in the battery this action continues, and the current from the battery remains constant.

In the Grove battery the hydrogen at the platinum plate decomposes the nitric acid forming hyponitrous acid, which is either dissolved or disengaged as nitrous fumes. In the Bunsen battery the action is the same as in the Grove. When the bichromate of potassium solution is used in the Bunsen battery the hydrogen reduces the chromic acid to oxide of chromium, which remains in solution.

In the gravity battery the action is the same as that of the Daniell. The sulphate of zinc formed in the battery floats on the solution of sulphate of copper owing to its lower density. In the Leclanche battery the hydrogen of the decomposed water unites with the oxygen of the manganese.

The depolarization of batteries has been the subject of a great deal of thought and experiment, and, although the discoveries of Daniell, Grove, Bunsen, Leclanché, and other prominent investigators excite our admiration, the subject still affords a wide field for investigation.



PLAN OF DEPOLARIZING APPARATUS.

* Page 55, current volume, SCIENTIFIC AMERICAN.

Communicating with Wrecked Vessels.

Messrs. Low and Duff, engineers, Dundee, have just made an important improvement in connection with apparatus for communicating with wrecked vessels. It is a new gun which they tried at Monifieth recently, with marked success. The gun is 2 feet long, with a bore 2½ inches, and it is so constructed that the line which is to be fired from it passes through the back end of the gun. In the experiments made recently the line was shot 400 yards with two ounces of powder, which would have sent it further had the line used on the occasion been longer. The cord is coiled in the form of a cop and put inside of a steel canister. This canister is fired out of the gun, and leaves the line streaming behind it. The distance to be covered is simply a question of size of gun and canister. The gun was sent to Birmingham and tested in the most thorough manner in the proof-house there. The twine used in the experiment was made of flax, and carried 200 lb. dead weight with a length of 6 feet of twine.

The Citadel Park of Barcelona.

Marked indications of the growing revival of enterprise and industry of Spain are shown in the old seaport city of Barcelona, in the northeastern corner of the kingdom, on the Mediterranean. It is a city of abont 250,000 inhabitants, and a good bnsiness place; in fact it may be styled the New York of Spain. We recently chronicled the introduction there of the electric light for street illumination. A recent number of *La Ilustracion*, of Madrid, contains a large and beautiful picture representing different portions of a new park lately inaugurated in Barcelona. Its area is nearly a hundred acres, and was formerly occupied by the decaying walls and ruined ramparts of the old citadel. Here also was the old state prison. These ancient works, relics and mementos of barbarous times, have all given place to the new park of the citadel, filled with marble fountains, beautiful walks, grottoes, cascades, flowery arbors, shade trees, and other adornments. At the principal entrance the following inscription is set up:

"These parks and gardens being the property of all the citizens, they are all interested in their preservation; and they are accordingly placed under their especial care and vigilance. Signed: The Constitutional Alcalde of Barcelona."