A NEW OXIDE OF COPPER BATTERY.

By MM. F. DE LALANDE and G. CHAPERON.

WE have succeeded in forming a new battery with a single liquid and with a solid depolarizing element by associating oxide of copper, caustic potash, and zinc.

This battery possesses remarkable properties. Depolarizing electrodes are easily formed of oxide of copper. It is enough to keep it in contact with a plate or a cell of iron or copper constituting the positive pole of the element.

Fig. 1 represents a very simple arrangement. At the bottom of a glass jar, V, we place a box of sheet iron, A, containing oxide of copper, B. To this box is attached a copper wire insulated from the zinc by a piece of India rubber tube. The zinc is formed of a thick wire of this metal coiled in the form of a flat spiral, D, and suspended from a cover, E, which carries a terminal, F, connected with the zinc; an India-rubber tube, G, covers the zinc at the place where it dips into the liquid, to prevent its being eaten away at this level.

The jar is filled with a solution containing 30 or 40 per cent. of potash. This arrangement is similar to that of a Callaud element, with this difference—that the depolarizing element is solid and insoluble.

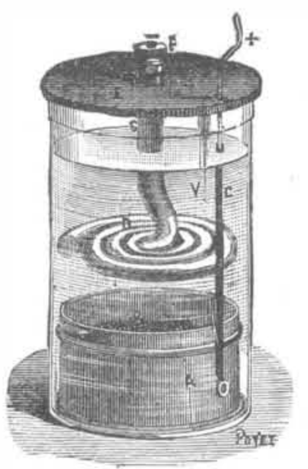

FIG. 1.

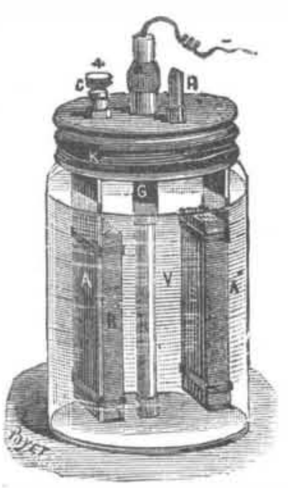

FIG. 2.

To prevent the inconveniences of the manipulation of the potash, we inclose a quantity of this substance in the solid state necessary for an element in the box which receives the oxide of copper, and furnish it with a cover supported by a ring of caoutchouc. It suffices then for working the battery to open the box of potash, to place it at the bottom of the jar, and to add water to dissolve the potash; we then pour in the copper oxide inclosed in a bag.

We also form the oxide of copper very conveniently into blocks. Among the various means which might be employed, we prefer the following:

We mix with the oxide of copper oxychloride of magnesium in the form of paste so as to convert the whole into a thick mass, which we introduce into metal boxes.

The mass sets in a short time, or very rapidly by the action of heat, and gives porous blocks of a solidity increasing with the quantity of cement employed (5 to 10 per cent.).

Fig. 2 represents an arrangement with blocks. The jar V, is provided with a cover of copper, E, screwing into the glass. This cover carries two vertical plates of sheet-iron, A, A', against which are fixed the prismatic blocks, B, B, by means of India rubber bands. The terminal, C, carried by the cover constitutes the positive pole. The zinc is formed of a single pencil, D, passing into a tube fixed to the center of the cover. The India rubber, G, is folded back upon this tube so as to make an air-tight joint.

The cover carries, besides, another tube, H, covered by a split India-rubber tube, which forms a safety valve.

The closing is made hermetical by means of an India rubber tube, K, which presses against the glass and the cover. The potash to charge the element is in pieces, and is contained either in the glass jar itself or in a separate box of sheet-iron.

Applying the same arrangement, we form hermetically sealed elements with a single plate of a very small size.

The employment of cells of iron, cast-iron, or copper, which are not attacked by the exciting liquid, allows us to easily construct elements exposing a large surface (Fig. 3).

The cell, A, forming the positive pole of the battery is of

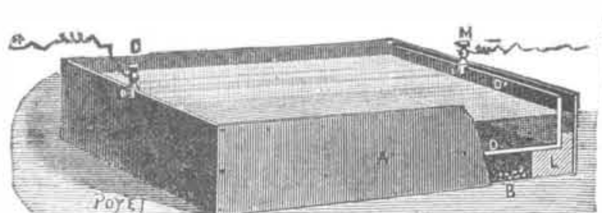

FIG. 3.

iron plate brazed upon vertical supports; it is 40 centimeters long by 20 centimeters wide, and about 10 centimeters high

We cover the bottom with a layer of oxide of copper, and place in the four corners porcelain insulators, L, which support a horizontal plate of zinc, D, D', raised at one end and kept at a distance from the oxide of copper and from the metal walls of the cell; three-quarters of this is filled with a solution of potash. The terminals, C and M, fixed respectively to the iron cell and to the zinc, serve to attach the leading wires. To avoid the too rapid absorption of the carbonic acid of the air by the large exposed surface, we cover it with a thin layer of heavy petroleum (a substance uninflammable and without smell), or better still, we furnish the battery with a cover. These elements are easily packed so as to occupy little space.

We shall not discuss further the arrangements which may be varied infinitely, but point out the principal properties of the oxide of copper, zinc, and potash battery. As a battery with a solid depolarizing element, the new battery presents the advantage of only consuming its element, in proportion to its working; amalgamated zinc and copper are, in fact, not attacked by the alkaline solution, it is, therefore, durable.

Its electromotive force is very nearly one volt. Its internal resistance is very low. We may estimate it at 1/6 or 1/4 of an ohm for polar surfaces one decimeter square, separated by a distance of five centimeters.

The rendering of these couples is considerable; the small cells shown in Figs. 1 and 2 give about two amperes in short circuit; the large one gives 16 to 20 amperes. Two of these elements can replace a large Bunsen cell. They are remarkably constant. We may say that with a depolarizing surface double that of the zinc the battery will work without notable polarization, and almost until completely exhausted, even under the most unfavorable conditions. The transformation of the products, the change of the alkali into an alkaline salt of zinc, does not perceptibly vary the internal resistance. This great constancy is chiefly due to the progressive reduction of the depolarizing electrode to the state of very conductive metal, which augments its conductivity and its depolarizing power.

The peroxide of manganese, which forms the base of an excellent battery for giving a small rendering, possesses at first better conductivity than oxide of copper, but this property is lost by reduction and transformation into lower oxides. It follows that the copper battery will give a very large quantity of electricity working through low resistances, while under these conditions manganese batteries are rapidly polarized.

The energy contained in an oxide of copper and potash battery is very great, and far superior to that stored by an accumulator of the same weight, but the rendering is much less rapid. Potash may be employed in concentrated solution at 30, 40, 60 per cent.; solid potash can dissolve the oxide of zinc furnished by a weight of zinc more than one-third of its own weight. The quantity of oxide of copper to be employed exceeds by nearly one-quarter the weight of zinc which enters into action. These data allow of the reduction of the necessary substances to a very small relative weight.

The oxide of copper batteries have given interesting results in their application to telephones. For theatrical purposes the same battery may be employed during the whole performance, instead of four or five batteries. Their durability is considerable; three elements will work continuously, night and day, Edison's carbon microphones for more than four months without sensible loss of power.

Our elements will work for a hundred hours through low resistances, and can be worked at any moment, after several months, for example. It is only necessary to protect them by a cover from the action of the carbonic acid of the atmosphere.

We prefer potash to soda for ordinary batteries, notwithstanding its price and its higher equivalent, because it does not produce, like soda, creeping salts. Various modes of regeneration render this battery very economical. The deposited copper absorbs oxygen pretty readily by simple exposure to damp air, and can be used again. An oxidizing flame produces the same result very rapidly.

Lastly, by treating the exhausted battery as an accumulator, that is to say, by passing a current through it in the opposite direction, we restore the various products to their original condition; the copper absorbs oxygen, and the alkali is restored, while the zinc is deposited; but the spongy state of the deposited zinc necessitates its being submitted to a process, or to its being received upon a mercury support. Again, the oxide of copper which we employ, being a waste product of brazing and plate works, unless it be reduced, loses nothing of its value by its reduction in the battery; the depolarization may therefore be considered as costing scarcely anything. The oxide of copper battery is a durable and valuable battery, which by its special properties seems likely to replace advantageously in a great number of applications the batteries at present in use.

FARCOT'S SIX HORSE POWER STEAM ENGINE.

THIS horizontal steam engine, recently constructed by Mr. E. D. Farcot for actuating a Cance dynamo-electric machine, consists of a cast iron bed frame, A, upon which are mounted all the parts. The two jacketed, cylinders, B and C, of different diameters, each contains a simple-acting piston. The two pistons are connected by one rod in common, which is fixed at its extremity to a cross-head, D, running in slides, E and F, and is connected with the connecting rod, G. The head of the latter is provided with a bearing of large diameter which embraces the journal of the driving shaft, H.

The steam enters the valve-box through the orifice, J, which is provided with a throttle-valve, L, that is connected

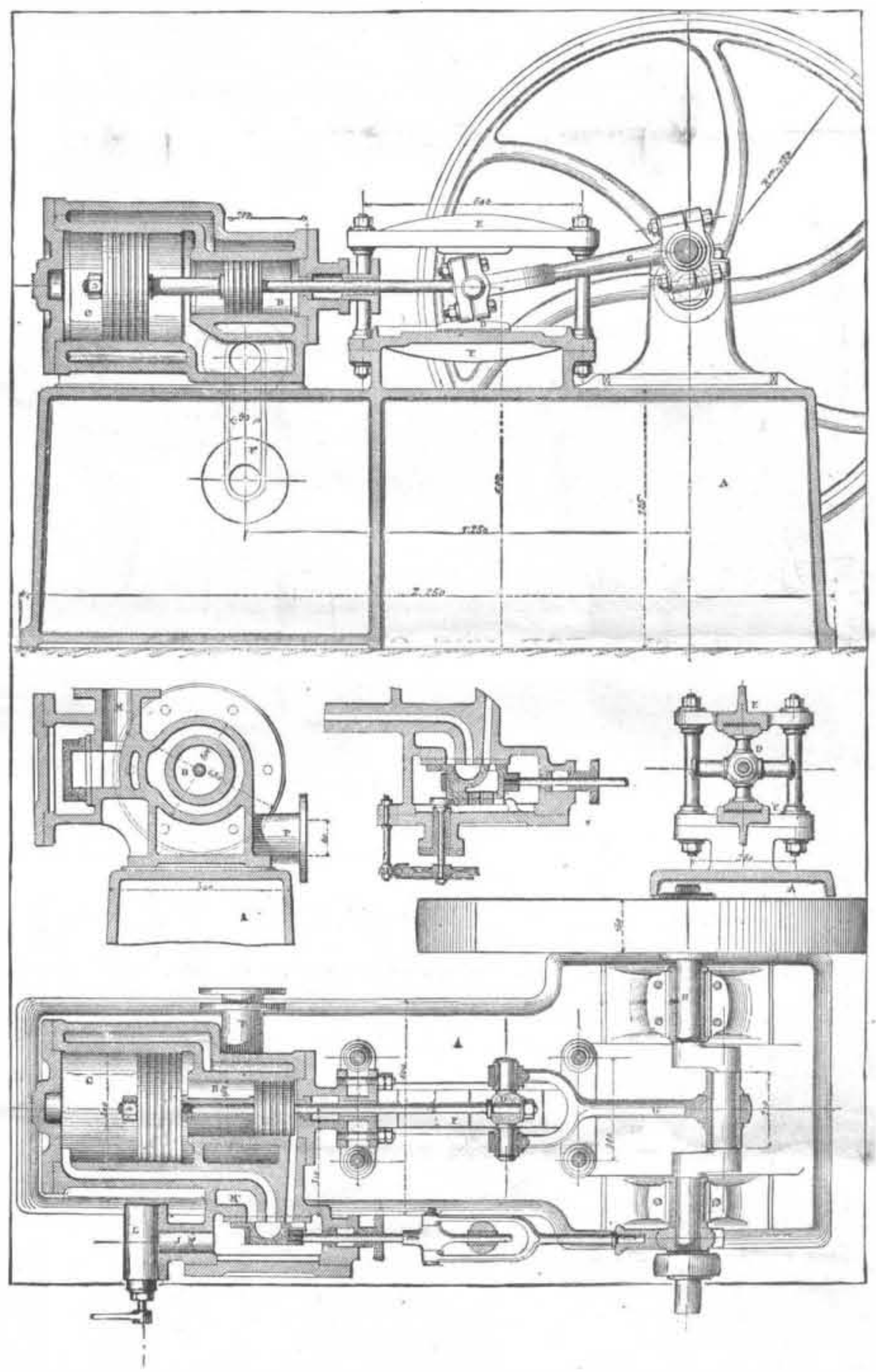

FIG. 1.—Longitudinal Section (Scale of 0·10 to 1). FIG. 2.—Horizontal Section (Scale of 0·10 to 1). FIG. 3.—Section across the Small Cylinder (Scale of 0·10 to 1). FIG. 4.—Section through the Cross Head (Scale of 0.10 to 1. FIG. 5.—Application for a Variable Expansion (Scale of 0.10 to 1).

FARCOT'S SIX H. P. STEAM ENGINE.

with a governor placed upon the large cylinder. The steam, as shown in Fig. 2 (which represents the piston at one end of its travel), is first admitted against the right surface of the small piston, which it causes to effect an entire stroke corresponding to a half-revolution of the fly-wheel. The stroke completed, the slide-valve, actuated by an eccentric keyed to the driving shaft, returns backward and puts the cylinders, B and C, in communication. The steam then expands and drives the large piston to the right, so as to effect the second half of the fly-wheel's revolution. The exhaust occurs through the valve chamber, which, at each stroke, puts the large cylinder in connection with the eduction port, M.

The volume of air included between the two pistons is displaced at every stroke, so that, according to the position occupied by the pistons, it is held either by the large or small cylinder. The necessary result of this is that a compression of the air, and consequently a resistance, is brought about. In order to obviate this inconvenience, the constructor has connected the space between the two pistons at the part, A', of the frame by a bent pipe. The air, being alternately driven into and sucked out of this chamber, A', of relatively large dimensions, no longer produces but an insignificant resistance.

As shown in Fig. 5, there may be applied to this engine a variable expansion of the Farcot type. The motor being a