THE TATE BIFFUNCTIONAL ACCUMULATOR PLATE

By Harry H. Morrell.

This novel plate is termed "Bifunctional" because it embraces two functions, positive and negative, and constitutes within itself a complete element. All storage cells heretofore known in practice consist of not less than two plates, each possessing but one function, either positive or negative, and this type may therefore be designated as "unifunctional."

An assembled Tate Bifunctional plate or unit and its constituent parts are shown in the accompanying illustrations, Figs. 1 and 2. Fig. 3 illustrates the method of assembling multiples of these units for the purpose of constructing plates of any desired size and capacity. The constituent parts of a unit, eight in number, consist of:—

(a) An open insulating sectional frame made of celluloid, hard rubber or any suitable material. One end of this frame and the three lateral supports are milled to half their depth and the internal vertical edges are grooved to receive the lead conducting strip. When this strip is drawn into the frame five pockets are formed for the reception of the active materials. These are about one thirty-second of an inch in depth, representing the distance between the surface of the metallic conductor and the outside faces of the frame itself. On one side of the frame the pocket is continuous—on the other it is interrupted by the lateral supports which break the channel into four pockets, and it is provided with a hole at each end to receive the assembling rods.

(b) A lead conducting strip provided with a relatively heavy-holed end to correspond with the hole at the milled end of the insulating frame.

(c) Two perforated insulating and separating shields, one of which is equipped with a series of interrupted, staggered bearings along its internal vertical edges which hold the par about one thirty-second of an inch apart, provide openings for the admission of the electrolyte and form a continuous vertical channel from bottom to top for the free circulation of the fluid and the escape of nascent gases. These are also provided with end holes to receive the assembling rods.

(d) Two assembling rods on which the constituent parts are threaded top and bottom.

(e) Two side binders made of hard rubber, porcelain or any suitable material.

Assembling.

The heavy ends of the lead conducting strips project about one-half of an inch beyond the sectional frame. In assembling a unit these frames, carrying the conducting strips and applied oxide, are reversed alternately so that one series of projections appear at the top and the other at the bottom of the unit. A pair of perforated insulating shields (c) are threaded between the sectional frames, and the top and bottom metallic projections of the latter are turned down in contact and lead-burned after the assembling rods (d) have been headed on the outside of the binders (e). Thus one alternate series forms the positive and the other the negative sections of the plate. A unit may consist of two or more sections. The standard which has been adopted for all purposes other than work of a very light nature, is a unit consisting of fifty-seven sections—twenty-eight positive and twenty-nine negative (one split negative). The dimensions are: Height 8⅝ inches, width across the face 9¾ inches, thickness 9/16 inch, and the weight of the unit of four pounds. The capacity on 8-hour discharge rate is 36 ampere hours, and the average voltage for eight hours 1.94. The total watt hour efficiency is 70, watt hour efficiency per pound weight of unit 17½, and total weight efficiency 40 pounds per horse-power hour.

To explain the practical operation of a Tate Bifunctional plate it is necessary first to refer to certain features which characterize the operation of storage cells as heretofore constructed through the medium of unifunctional plates, which have a direct relation to the phenomenon termed "sulphating," which place a limitation upon periods of charge and discharge and through which the life of these cells is defined. These features involve equalization of current density, transmutation of active material, metallic density and mechanical structure, and after discussing them with relation to unifunctional plates their relation to the Tate Bifunctional plate will be shown.

Equalization of Current Density.

There can be no doubt that apart from mechanical structure the most vital feature associated with the efficient operation of an electric storage cell is that relating to the equal distribution of current density over exposed active surfaces. If the oxide surfaces undergoing transmutation are unevenly attacked the appearance of the phenomenon termed "sulphating" is inevitable. In the following discussion of this subject

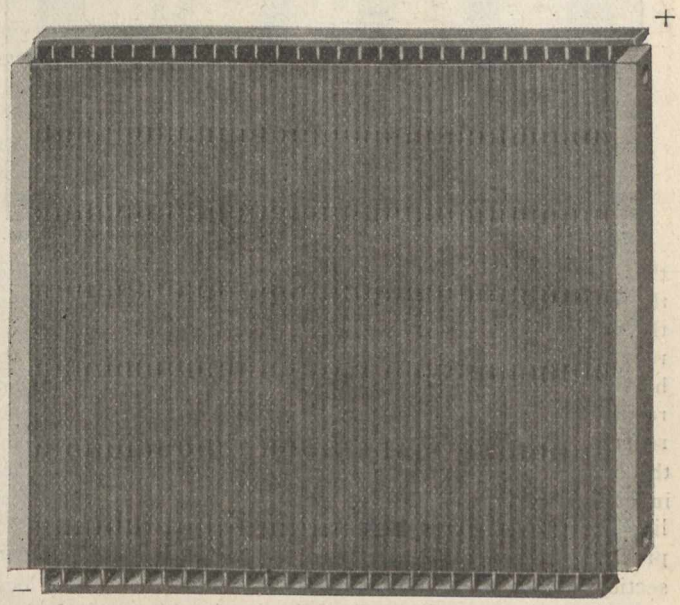

Fig. 1.—Tate Bifunctional Accumulator Plate.

an effort is made to set forth the reasons why equal current distribution can not be achieved through a conducting medium in the form of a plate or grid, more particularly those of relatively large superficial area.

When two unitunctional plates, a positive and negative provided only with upper terminals, are in electrical contact through the medium of the electrolyte the line of least resistance between them follows a path located above their horizontal centres and along their vertical and horizontal edge areas where so-called extraneous stream lines are given off. That is to say, the flow is heavier above than below the horizontal centres in all corresponding parts of the plates. As the vertical central regions are approached, the densities become relatively lighter through the whole length of the plates, for the reason that current flow, somewhat like magnetism, has a tendency to seek the more extreme or outermost sections of such conducting media, a manifestation well defined in the process of electro-plating.

The result of these conditions, encountered universally in the present practice of the art, is that with given current flow the superimposed or pocketed active masses are unevenly attacked and, emphasized with each increase of plate area, they probably represent the major cause of "sulphating" in unifunctional plate cells more especially those of large surface