capacity as employed for electric lighting and peak load regulation.

For the purpose of further elucidating this phenomenon we shall assume a metallic plate of relatively large area wherein the current enters along the upper horizontal edge and finds an exit along the lower horizontal edge. Under

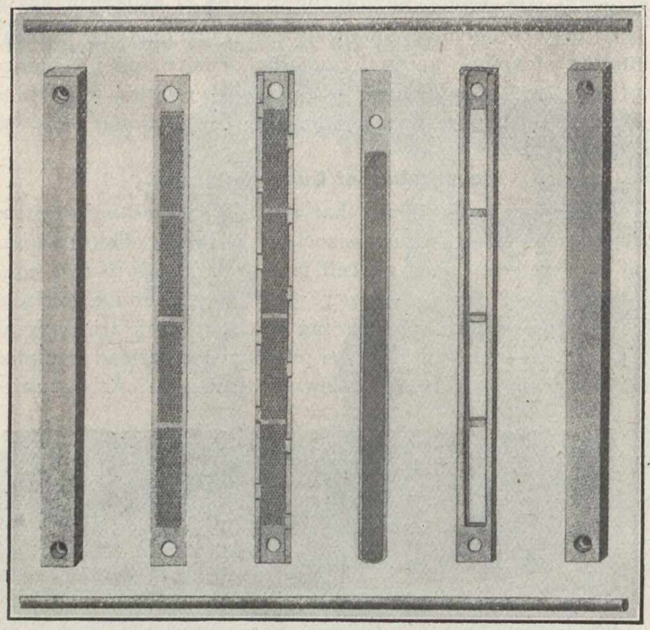

Fig. 2.—Component Parts of the Tate Bifunctional Accumulator Plate.

these conditions the line of potential equalization will follow the exact horizontal centre if metallic resistance throughout the whole of the plate is assumed to be constant; and if current density at one designated section located below the horizontal centre be represented by 10, the density of the corresponding section above the horizontal centre will also be represented by 10. This method of admitting and releasing the current provides for the equalization of current densities in corresponding sections of the plate located in a vertical line above and below the horizontal centre, but it does not provide for the equalization of current densities between plate sections which do not correspond with respect to relative location along the same line. Equalization in this vertical direction is more closely approximated as the distance between the top and bottom of the plate is shortened for the reason that as the horizontal line of equalization is approached potential and, consequently, current density must necessarily diminish to the extent of the progressive expenditure of energy required to overcome the resistance of the conducting medium, and this expenditure is in due proportion to the distance traversed. Thus the shortening of a plate or conductor tends to equalize current density in a vertical direction. Again, as previously stated, as the vertical central regions of the plate are approached these densities tend to become lighter through phenomena resembling somewhat the action of magnetism. Equalization in this horizontal direction is more closely approximated as the distance between the lateral edge areas of the plate is decreased, or in other words as the plate is narrowed. An experiment in the art of electro-plating demonstrating the conditions stated above is fully described and illustrated in the United States Patent No. 926710, June 29th, 1909.

Transmutation of Active Material.

In unifunctional plate cells of the Faure or applied oxide type, and more particularly those of relatively large capacity as employed in electric lighting and peak load service, the active material is applied to the plates or grids in relatively thick masses. Recent investigations appear to have demonstrated that these masses are inactive beyond a certain limitation of depth under ordinary or so-called normal working conditions. In "The Standard Handbook for Electrical Engineers," 1908, Edition Section 9, Page 14, paragraph 16, Messrs. Edward Lyndon and Otis Allen Kenyon, under the caption "Batteries" record the following statement:

"The electrolytic action seldom penetrates to a depth greater than one-sixteenth of an inch at ordinary discharge rates. So that where the thickness of the active material measured from the surface of the electrolyte to the conducting plate exceeds this amount the portion in excess of this thickness is practically useless."

Two results of this condition are obvious. First that the inactive material constitutes a dead resistance to current flow, thus curtailing the useful energy of the cell and second, that it is a constant menace with relation to the obstructive reaction termed "sulphating." In addition to this the depth of the active mass appears to bear a direct relation to the time periods required to effect its transmutation under the action of the current. This transmutation appears to be effected progressively in a direction extending outwardly from the area of contact between the active material and the metallic conductor, or inwardly from the active area in contact with the electrolyte, and current density and time in conjunction seem to be the essential factors in effecting transmutation, the latter being regulated by the depth or thickness of the mass. In other words in the operation of charging, when current flow is raised to the maximum limit of the cell, the element of time enters in and the duration of the charge is proportionate to the depth of the oxide mass. This deduction appears to receive ample confirmation in the process of charg-

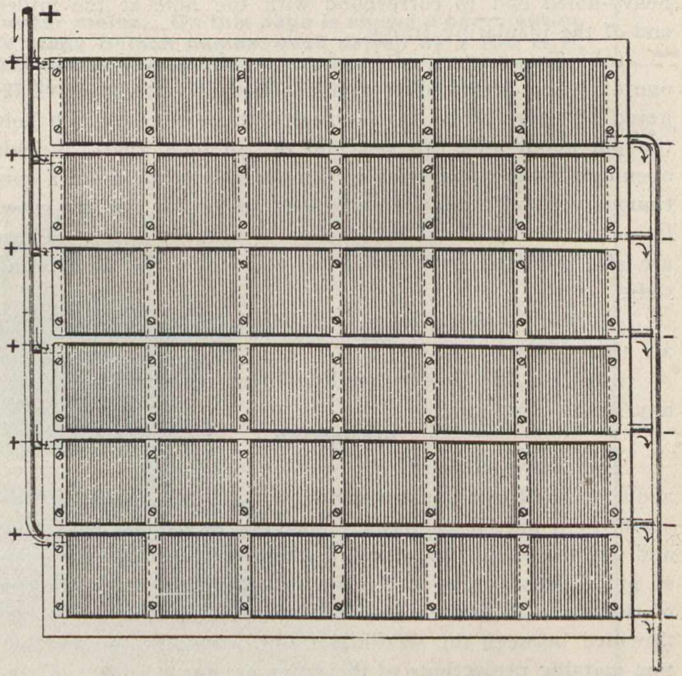

Fig. 3.—Multiple Unit Plate of the Tate Bifunctional Accumulator Showing Connections.

ing a Tate Bifunctional plate wherein the active columns are extremely short and narrow and approximately only one thirty-second of an inch in depth. The details of this process are fully set forth in the continuation of this discussion.

Metallic Density.

It is well understood that there is appreciable variation of density throughout any metallic mass and that when such a structure assumes the form of a plate or grid any increase of superficial area has a tendency to amplify such variation. These metallic irregularities present variations of resistance to current flow and corresponding variations in the density of current delivered to superimposed or pocket-