THESIS

ACCUMULATORS

OR

SECONDARY

BATTERIES

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'03

ACCUMULATORS or SECONDARY BATTERIES.

A storage battery is a cell or a series of cells capable of storing up electric energy and giving it off at a required time. A storage battery acts upon the same principle as a galvanic cell in giving forth electric current as the equivalent of chemical energy, but it differs from the galvanic cell in that once it is exhausted, it is not worthless but can be recharged by current from a dynamo. The passing of a current from a dynamo, through the storage cell, has the tendency to produce an oxide of lead on one plate, and spongy or metallic lead on the other. If the plates are properly prepared, and the current passed through the battery repeatedly, first in one direction, then the other, the cell will finally be completed or formed.

HISTORY.-The first storage cell was probably built in I8I2 by Ritter. This device consisted of alternate discs of copper and moistened card and was capable of receiving a charge from a voltaic pile and of producing the physical, chemical, and physiological effects obtained from the ordinary pile. The first battery of importance was built in I860 by Gaston Plante'. This battery consisted of lead plates in a I0% solution of sulphuric acid. The most important development next made was by Camille A. Faure in I88I. This was the first cell where the lead oxides were used with the lead. Many minor improvements were made since then, but nothing proved of importance until the last year, when Edison's new cell was developed. This is better by far than any cell up to this time.

The storage battery finds many useful applications. It is used for equalizing loads in large lighting plants. It is also used to keep up the pressure at the ends of long trans-

mission lines; for telegraphing purposes; for isolated electric lighting; for boat propulsion, for automobiles; in fact it is used in all cases where a portable source of electric energy would find application.

A Design for a High Capacity Storage Cell.

This battery is composed of lead peroxide, sulphuric acid, and a composition of lead and antimony, and of the form in which the active material or material which is to become active, is mechanically applied to a metallic, supporting and conducting grid. This cell is designed to have a large output per unit of weight of complete cell. This has been accomplished in such a manner that the durability of the whole is not seriously affected. The negative and positive grids differ slightly in construction and form.

The positive grid consists of light rectangular frames, having a T-shaped sectional outline. This open frame is strengthened by means of a vertical and horizontal cross rib, intersecting at the centre of the grid. This frame gives a definite form and thickness to the grid and to the active material in it. This frame contains four square, vertical conductors, which carry the current to and from the active material. On account of a great electrolytic action in the positive grid, these conductors must be made large in order to prevent buckling. For this reason these conductors are placed farther apart in order to reduce the amount of lead, without diminishing the cross-section. The active material of this grid consists of minium, or red lead, together with a small mixture of litharge. This mixture of lead oxide is moistened with a solution of ammonium sulphate, and while still soft is placed in the grid, and the whole is pressed until dry.

All negative grids are cast from the same material as the

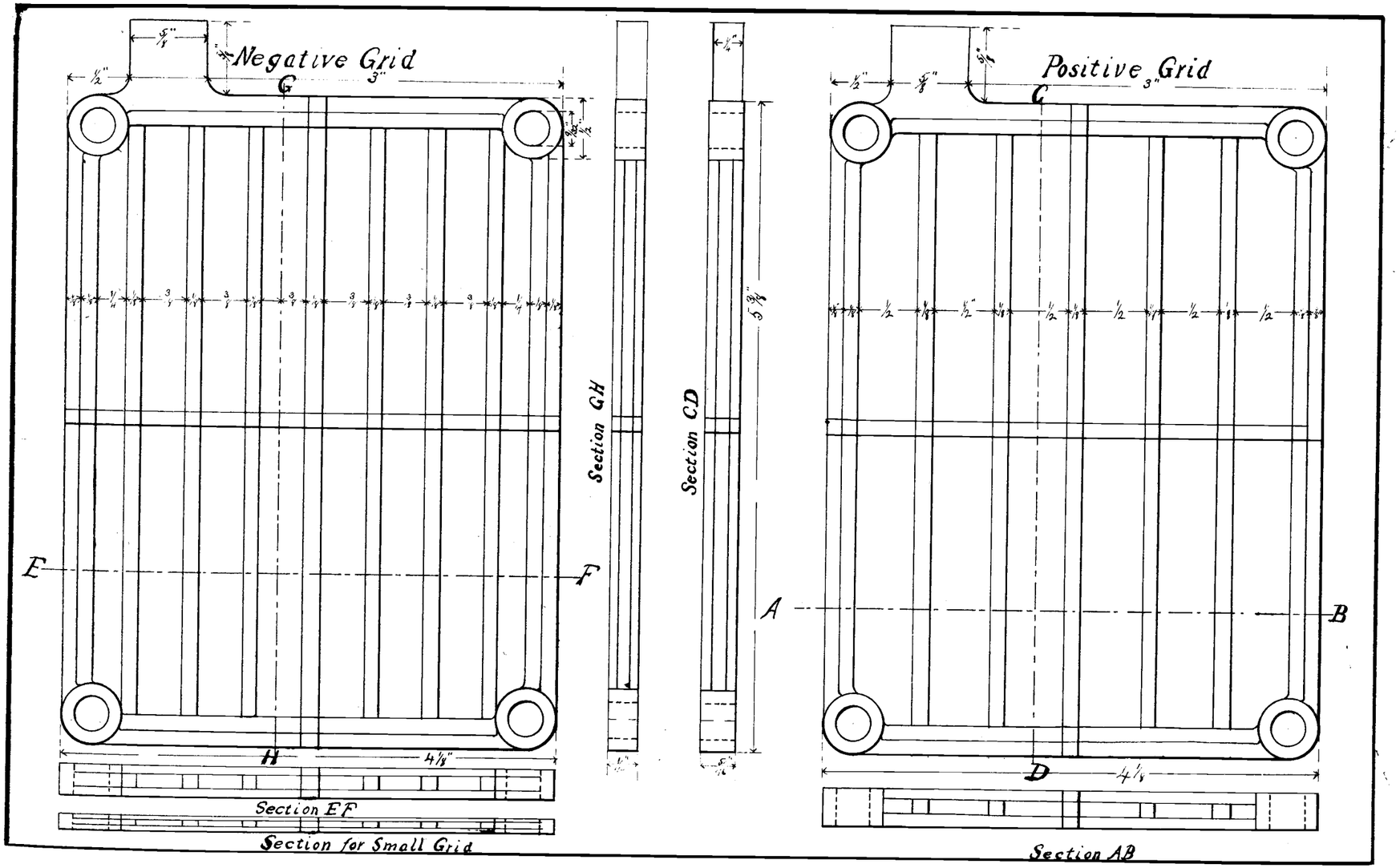
positive grids, that is, an alloy of lead with 10% antimony. They have the same shape and dimensions as the positive grids. But these grids are not nearly as thick as the positive grids, yet they have more bars to support the lead oxide. These grids are not subjected to any electrolytic deterioration, and for this reason the bars are made much thinner and closer together, thus giving a better distribution of current over the surface of the plate. The two end negatives are made only one-half as thick as the other negatives, because only one face will be in action. The material used for filling the negatives is composed of litharge and a small amount of minium. This is moistened with a very dilute solution of sulphuric acid, it being impracticable to use ammonium sulphate because of the rapidity with which the reaction takes place in the latter case. The grid is filled with the mixture in the same manner as the positives, and the plate is then laid aside to harden until dry.

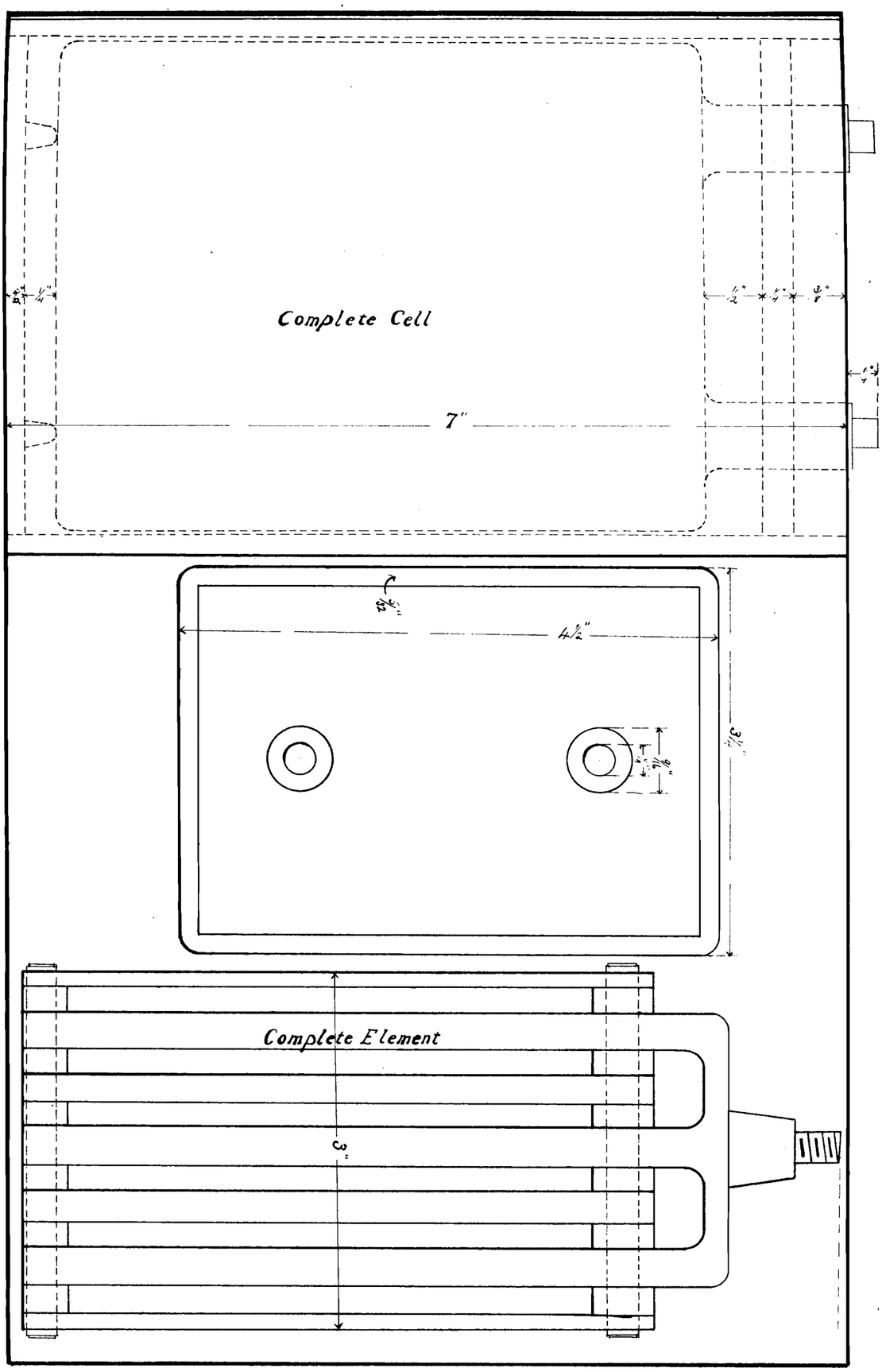
A complete cell is composed of seven plates, three of which are positive plates or grids, the remaining four being negative. The positive and negative plates being alternately disposed. The negative plates can be easily distinguished by the fact that they are very much thinner. These plates are separated by means of leather washers and a thin perforated fiber sheet. The plates are connected by hard rubber rods, that extend through each of the plates, and act as an insulator. These rods have nuts on the ends, by which means the plates are assembled, the positive plates are connected to each other, and also the negatives in the same manner. This is done by burning pieces of the lead alloy to the lugs provided for this purpose.

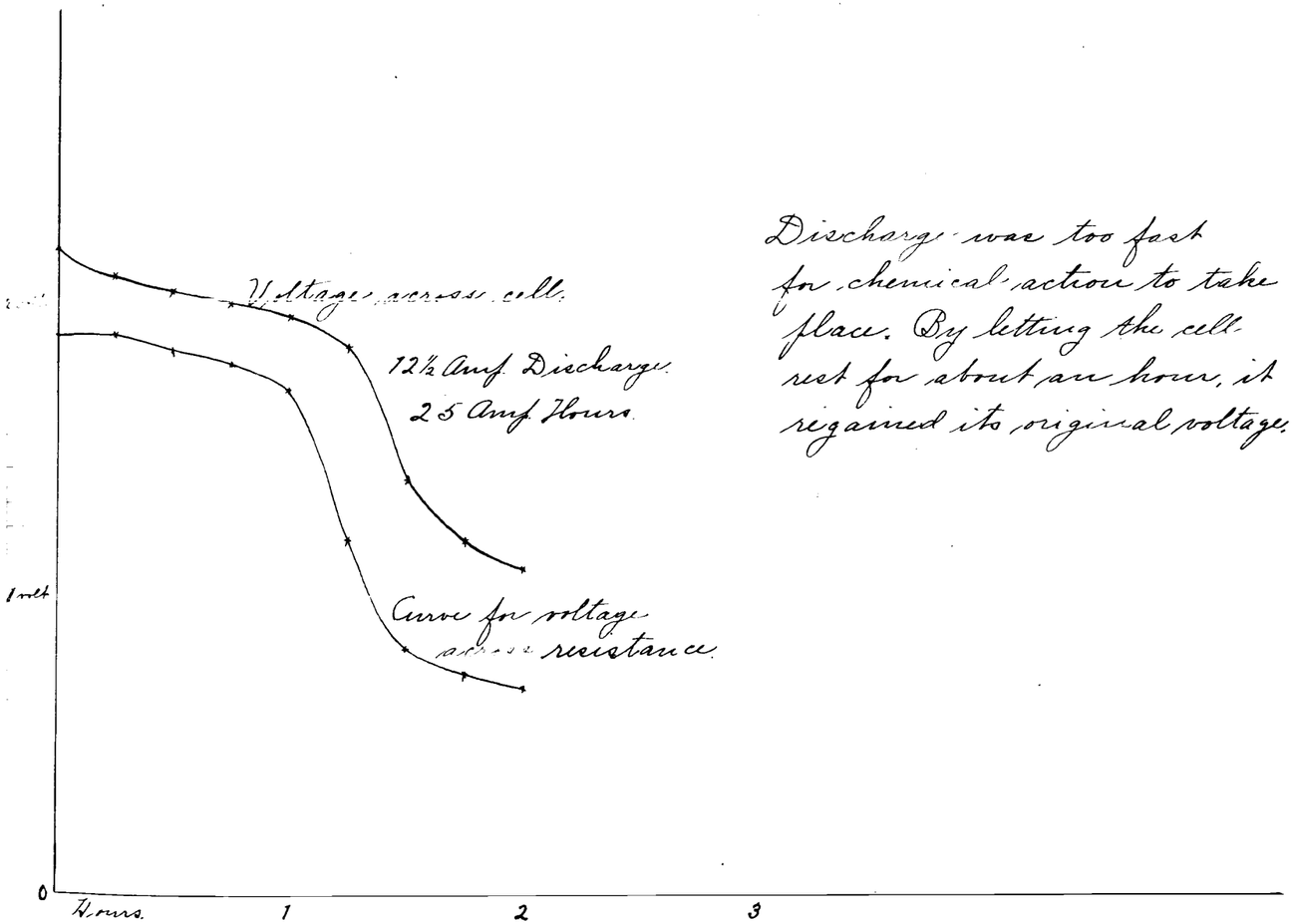
During the process of "forming", the cells are placed in

a very dilute solution of sulphuric acid, after which a very smallcurrent is passed through the cells from the positive to the negative plates. This current may be increased as the cell becomes formed. The amount of current that is allowable can be easily determined by the evolution of gases from the cell. To form the cell properly, it will require from I50 to 200 ampere-hours, provided no energy is lost by allowing the cell to liberate gas.

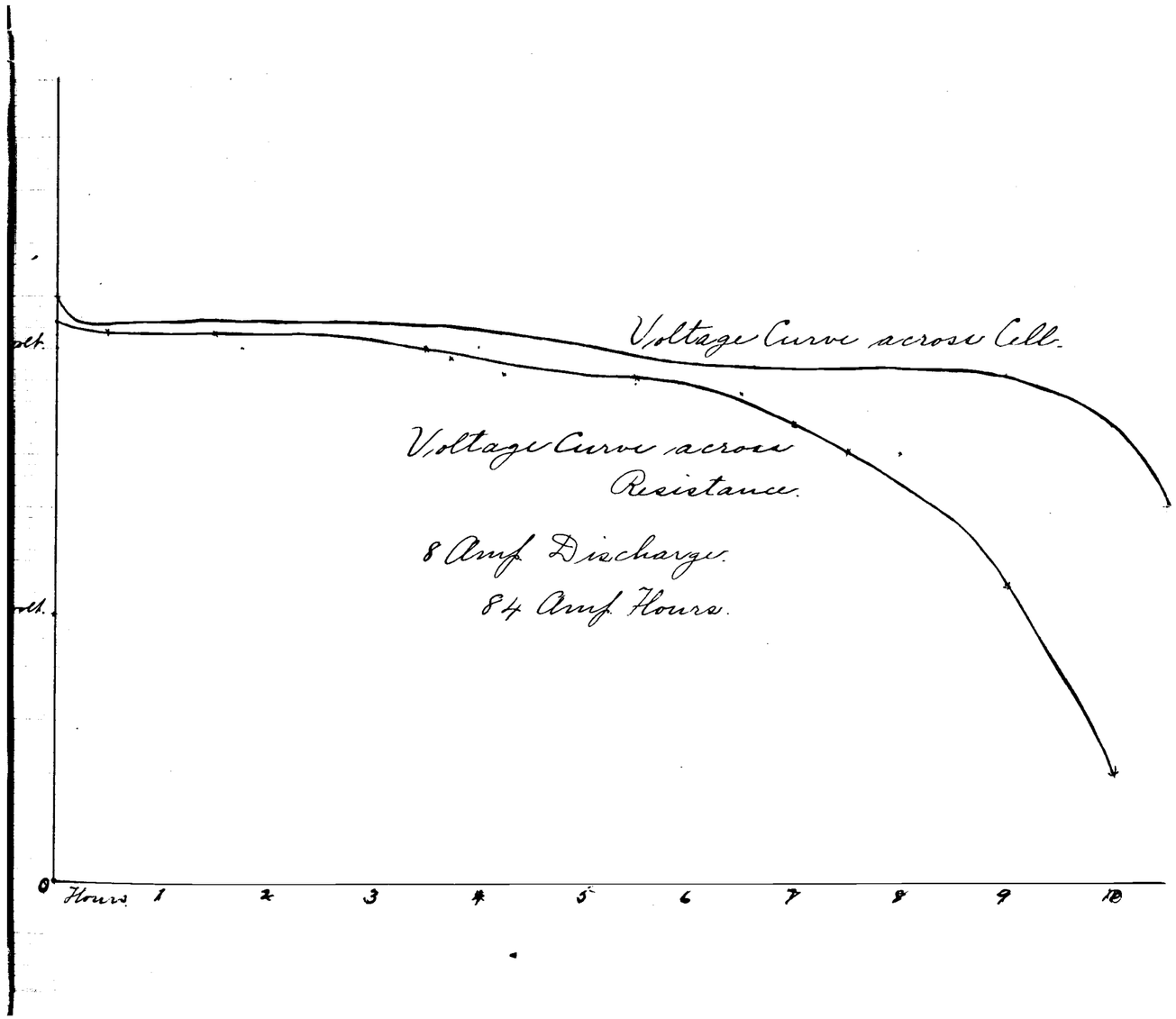
After the cell is properly formed, the forming solution is removed and the cell is placed into the regular electrolytic, consisting of sulphuric acid, and water, mixed to a specific gravity of from I.25 to I.275. This electrolyte must be cold before it is placed in the cell.


Negative Grid
G
3"
H
4⅛"
E
F
Section GH
Section CD
A
Section EF
Section for Small Grid
Positive Grid
G
3"
D
4⅛
B
Section AB


Complete Cell
7"
4½"
Complete Element



Discharge was too fast for chemical action to take place. By letting the cell rest for about an hour, it regained its original voltage.


Volt.
Volt.
0
Hours 1 2 3 4 5 6 7 8 9 10
Voltage Curve across Cell.
Voltage Curve across Resistance.
8 Amp Discharge.
84 Amp Hours.

Voltage Curve across Cell.
44 Amp. Discharge.
74.8 Amp. Hours.