This invention relates to primary cells and methods of making the same; and it comprises a new primary cell of the Lalande type having an alkaline electrolyte, a zinc pole and a copper oxide pole, the latter carrying a facing of reduced copper and being protected by a layer of preshrunk zincated paper or fabric; and it also comprises a method of making such cells wherein paper or fabric is preshrunk and impregnated with zinc by a treatment with sodium zinate, the preshrunk fabric being further treated with a solution of sodium and/or potassium silicate, dusted with a powdered metal electropositive to copper, such as metallic zinc, and wrapped around a copper oxide pole with the face carrying the zinc next the oxide, the whole then being assembled with the other elements of a Lalande cell; all as more fully hereinafter set forth and as claimed.

For closed circuit work, the type of cell employing copper oxide against zinc in a caustic soda electrolyte is practically the only one used. It is not well adapted for open-circuit work and shelf loss is apt to be considerable; both facts being largely due to the solubility of copper oxide in solutions of caustic soda or of caustic potash. While this solubility is very small, it is nevertheless sufficient to allow migration of copper by a diffusion and convection to the zinc in time. Copper reaching the zinc produces local action. On closed circuit the caustic soda solution is kept stripped of copper and this action does not occur. Solubility of copper in the caustic soda solution is aided by many organic impurities but, on the other hand, copper can be withdrawn from the solution by cellulose and some other substances. Alkali cellulose, which is a condition in which cellulose must occur in such a cell, is fairly active in withdrawing copper from the electrolyte. Cotton cloth, paper, etc., are often used in this type of cell for structural reasons and in so doing, they have the additional utility of withdrawing copper from the electrolyte. We have found, however, that paper and cloth treated with a sodium zinate solution possess this absorbing power for copper in a considerably increased degree and in our copending application, Serial No. 107765, we have described and claimed various cells utilizing this property. In the present invention, we also utilize paper or cloth so treated. In the Lalande type of cell, sometimes the copper oxide is employed as a granular mass supported in suitable ways and sometimes it is formed into a solid body by appropriate treatments. In either event, it is customary to metallize the outer surfaces by some sort of a reducing treatment; that is, the copper oxide is superficially converted into copper before assembling the cell. This is an item of some expense in the manufacture of these cells.

In the present invention, we utilize the copper stopping properties of zincated cellulose, using a sheet of this material for surrounding the copper oxide pole. And before assembling the sheet with the copper oxide, the sheet is surfaced with fine zinc dust. On assemblage of the zinc-trewn zincated paper with the copper oxide pole and wetting, the zinc superficially reduces the copper oxide and is itself converted into sodium zimate which passes into the paper. The paper is locally treated with a solution of sodium zinate of high concentration. In specific embodiments of the present invention, we take cheesecloth or paper and immerse it in a strong solution of zinc oxide in caustic soda or potash. Such a solution may be made directly by dissolving zinc or zinc oxide in caustic soda; but it is more economical to employ exhausted battery solutions. On complete exhaustion Lalande type cells, having the usual strength of caustic soda electrolyte, give sodium zinate solutions of about 40° Baume. These are suitable for our purpose. On immersion in the zinate solution at the ordinary temperature, that is a temperature of, say, 60° to 70° F., the paper swells, and shortens and shrinks laterally. The total shrinkage may amount to a loss of 40 to 50 per cent of the square area. The paper takes up and holds zinc oxide. Swelling and adsorption are complete in a short time. In practicing our invention, the shrunken paper is withdrawn, slightly dried and dipped in a solution of potassium or sodium silicate, this serving as an adhesive. The solution may be merely painted over one surface. On this painted surface is next dusted fine zinc powder. Aluminum powder may be used. With aluminum powder, sodium aluminate is formed in the cell and reacts with the sodium silicate to form a layer of artificial zeolite, which is useful in removing copper from solution.
In manufacturing the cells for use, the cell is assembled as shown in Figure 1, with the paper sleeves 11 in place having their zinc coated surfaces adjacent the copper oxid cathode. The inner sleeve has its exterior face surfaced with zinc dust while the outer sleeve has its interior face surfaced with zinc dust. The cells are shipped and stored in a dry condition. Upon addition of the electrolyte to the cell, this electrolyte consisting of about a 20 per cent solution of caustic soda in water, the presence of the zinc next to the copper oxid surface causes a superficial reduction of the copper oxid cathode surfaces. In this way, the usual manufacturing operation of superficially reducing the copper oxid is dispensed with and considerable time and expense in the manufacture of the cells are done away with.

What we claim is:—

1. In the process of manufacturing primary cells of the zinc-copper oxid type, the steps which comprise impregnating a paper sleeve with sodium zinicate solution, superficially coating the so-treated paper with a solution of alkali silicate, sprinkling a thin layer of zinc dust on the paper while it is still wet with silicate solution, and thereafter placing said paper in a copper oxid-zinc cell with the metallized surface of said paper in contact with the copper oxid.

2. A new material for use in copper oxid-zinc cells comprising paper impregnated with sodium zinicate solution and having a layer of zinc dust on one side of said surfaces.

3. A primary cell comprising inner and outer zinc anodes, a body of copper oxid disposed between said anodes, sheets of paper disposed between the copper oxid and the zinc anodes, said paper carrying zinc dust on its surface, and said metallized surface being in contact with the copper oxid.

4. In a cell of the Lalande type, a layer of paper impregnated with sodium zinicate solution and having a layer of metal dust on one surface of said paper.

5. In a cell of the Lalande type, a layer of paper impregnated with sodium zinicate solution and having a layer of metal dust on one surface of said paper, said metal being electropositive to copper.

6. In a cell of the Lalande type, a layer of paper impregnated with sodium zinicate solution and having a layer of zinc dust on one surface of said paper.

7. In a cell of the Lalande type, a layer of paper impregnated with sodium zinicate solution and having a layer of zinc and aluminum dust on one surface of said paper.

In witness whereof we have hereunto signed our names at Waterbury, Connecticut, this 31st day of December, 1926.

MARTIN L. MARTUS,
EDMUND H. BECKER.