R. M. LOCKWOOD.

Galvanic Batteries.

No. 137,556. Patented April 8, 1873.

FIG: 1.

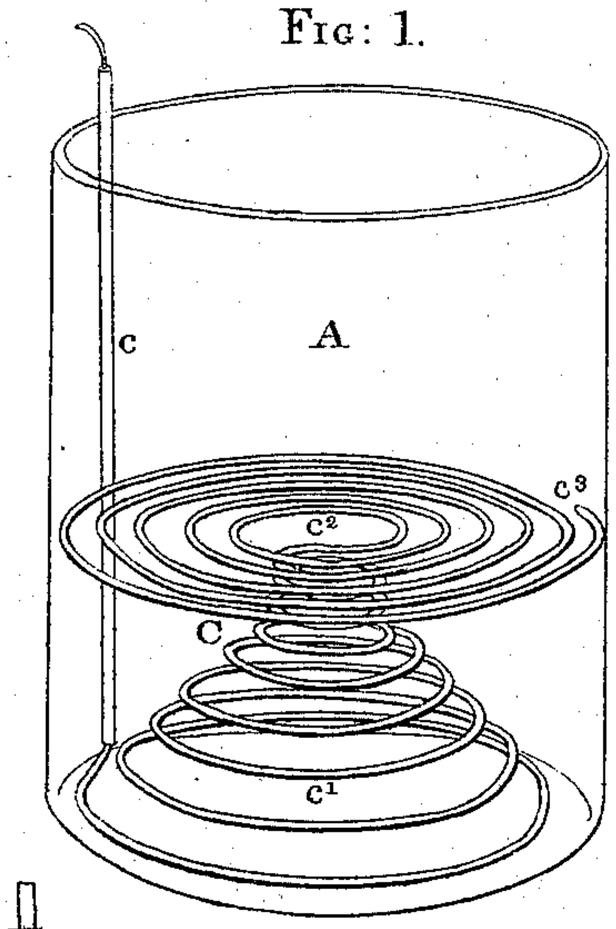


FIG: 2.

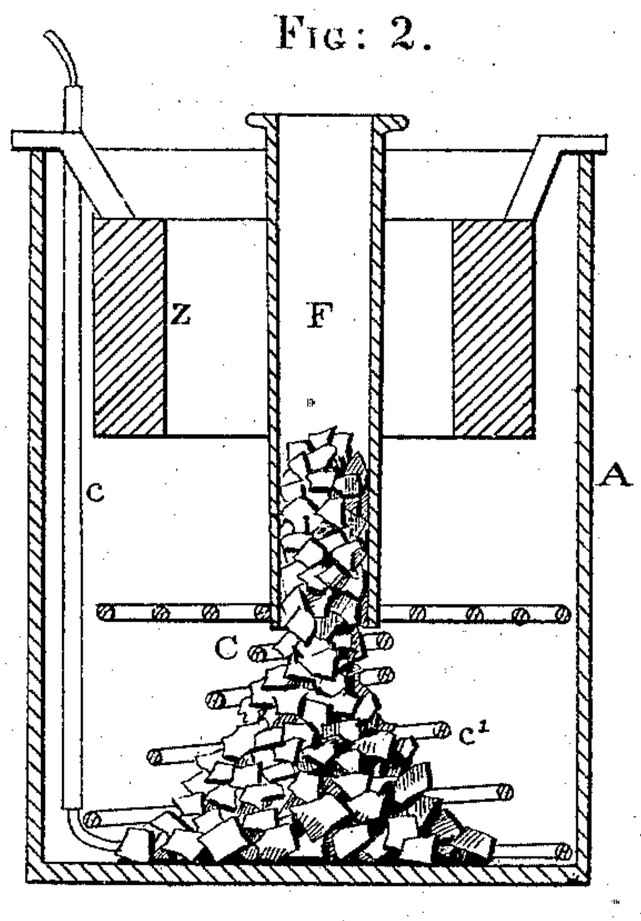


FIG: 3.

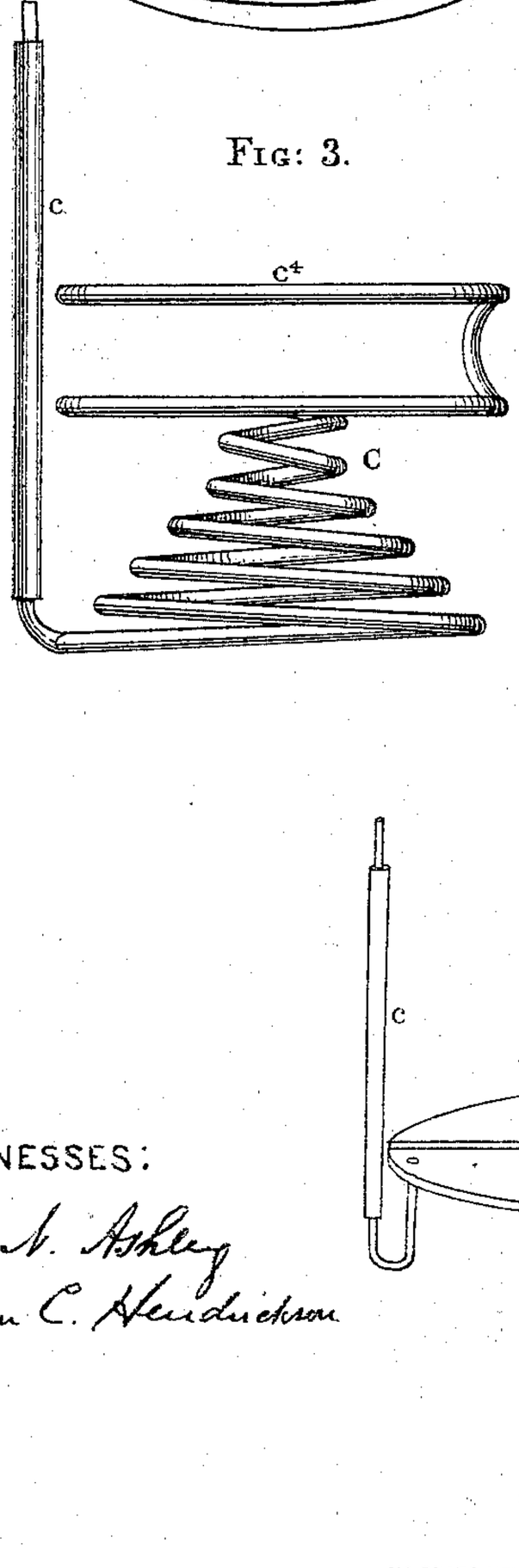


FIG: 4.

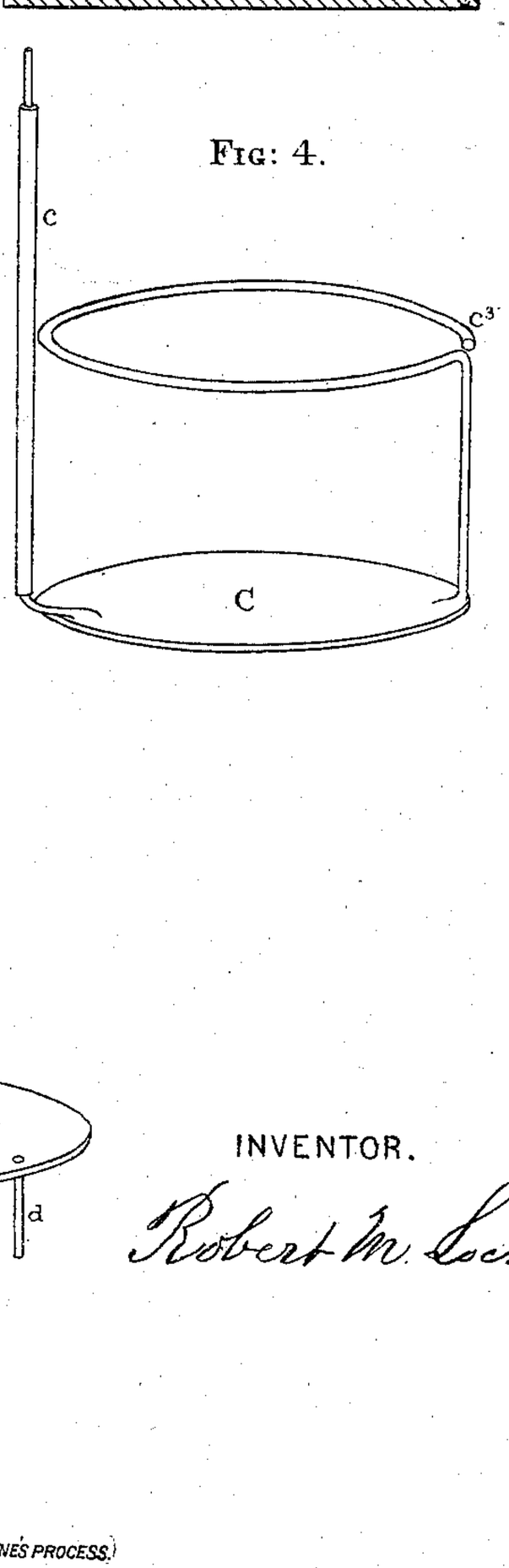
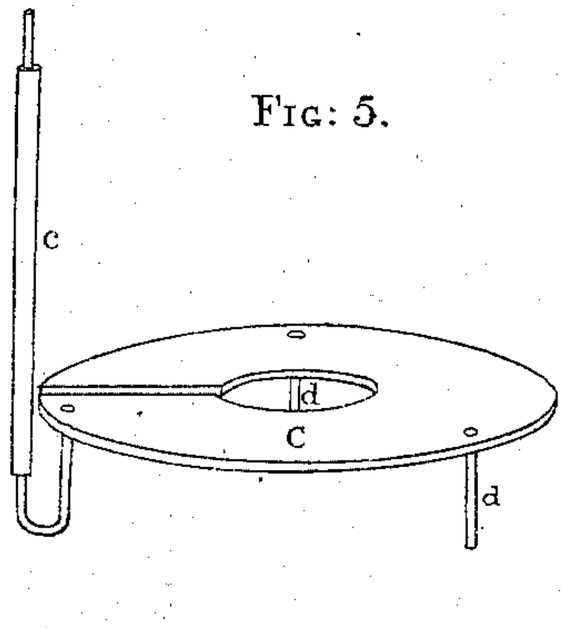


FIG: 5.



WITNESSES:

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ROBERT M. LOCKWOOD, OF NEW YORK, N. Y., ASSIGNOR TO WILLIAM H. SAWYER, OF SAME PLACE, AND FRANK L. POPE, OF ELIZABETH, N. J.

IMPROVEMENT IN GALVANIC BATTERIES.

Specification forming part of Letters Patent No. **137,556,** dated April 8, 1873; application filed December 6, 1872.

To all whom it may concern:

Be it known that I, ROBERT M. LOCKWOOD, of the city of New York and the State of New York, have invented an Improvement in Galvanic Batteries, of which the following is a specification:

My invention relates to an improved method of effecting and maintaining a separation between the two liquids in which the positive and negative elements of a galvanic battery are, respectively, immersed. My improvement consists in so constructing and arranging the copper or negative element that the effect upon the solutions of the electric current flowing through the said element is such as to effectually prevent them from any intermixture with each other.

In the drawing, Figure 1 is a perspective view of a battery-cell and its copper or negative element. Fig. 2 is a vertical transverse section of a cell showing the arrangement of the zinc element in relation to the copper. Figs. 3, 4, and 5 are modifications in the form of the copper element.

The separation of the two liquids in a galvanic battery has heretofore been effected either by the use of a porous diaphragm of unglazed earthenware, leather, or some similar material, or else by so arranging the elements of the battery and their respective solutions that the same result is accomplished by the action of gravity—that is to say, the copper solution, being the heaviest, would remain at the bottom of the cell, while the lighter zinc solution would rise above it. It has been found in practice that neither of these devices effectually prevents the deposit of some portion of the negative metal upon the positive element—an effect which involves a considerable waste of material. This deposit also materially diminishes the permanency of the action in the battery.

I have discovered that the influence of an electric current which traverses a conductor immersed in the solution surrounding the negative element may be made to effect a more perfect separation of the two liquids than is possible by means of any device hitherto in use.

In order to accomplish this result I construct the negative element preferably in the form of a metallic wire coiled into a helix or spiral, as at C, Figs. 1 and 2. The upright portion of the wire at *c* is coated with some non-conducting substance, in a well-known manner, and forms a connection with the next cell of the series. Beginning at the bottom of the containing jar or cell A, this wire is coiled into a conical spiral, c^1, leaving a small opening, c^2, at its summit. The wire is then coiled (still in the same direction) in the form of a horizontal flat spiral, c^3. Crystals of any suitable metallic salt may be introduced, by means of the tube F, into the interior of the cone c^1, for the purpose of keeping the solution saturated, as shown in Fig. 2. Z is the zinc or positive element, suspended in the upper portion of the cell in the usual manner. When the circuit of the battery is completed an electric current circulates through the whole length of the spiral wire between *c* and c^3, and exerts an influence (which I believe to be of a diamagnetic nature) upon the particles of metallic salt suspended in the solution, which acts in conjunction with gravity to effectually prevent them from rising above the level of the flat spiral c^2 c^3. When, for example, the respective solutions are of sulphate of copper and sulphate of zinc, the copper solution can never rise above the plane of the upper spiral as long as an electric current is circulating through the wire of which the spiral is composed.

I will here remark that I do not desire to confine myself to the exact form of the negative element shown in the figures and hereinbefore described. The essence of my invention consists in making use of the influence of the electric current to effect a separation of the two liquids, and I sometimes construct the negative element, as shown in Fig. 3, with an additional flat spiral, c^4; or, as in Fig. 4, with a flat metallic disk at the bottom of the cell, and a wire bent to form a single turn instead of many; or, as in Fig. 5, where the plate is in the form of an annular disk, cut at one side in a radial direction and supported upon legs *d d*. I have, however, obtained the most per-

fect results by means of the arrangement shown in Figs. 1, 2, and 3.

I also remark that where two or more cells are connected together in series it is preferable that the direction in which the spiral is wound should be the same in each cell of the series, as a much more perfect action of the apparatus is attained thereby.

I am aware that it is not new to construct the negative element of a galvanic battery in the form of a flat metallic ribbon, coiled into a concentric spiral, and made to rest upon the bottom of the cell. This arrangement is employed in the battery invented by J. A. Calland, (United States Patent No. 96,199, dated October 26, 1869,) and I therefore make no claim to it.

I claim as my invention—

1. The method of effecting or maintaining a separation between two dissimilar liquids in a galvanic battery, by means of the influence of an electric current traversing the negative element of said battery, substantially as herein specified.

2. The continuous spiral wire $c\,c^1\,c^2\,c^3$, forming the negative element of a galvanic battery, and placed within the liquid, substantially as and for the purpose herein specified.

Signed by me this 3d day of December, 1872.

ROBERT M. LOCKWOOD.

Witnesses:

JAMES N. ASHLEY,

STEPHEN C. HENDRICKSON.