No. 729,502. Patented May 26, 1903.

UNITED STATES PATENT OFFICE.

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OXIDIZING ORGANIC COMPOUNDS.

SPECIFICATION forming part of Letters Patent No. 729,502, dated May 26, 1903.

Original application filed September 4, 1902, Serial No. 122,126. Divided and this application filed March 11, 1903. Serial No. 147,339. (No specimens.)

To all whom it may concern:

Be it known that I, MARTIN MOEST, Ph. D., a citizen of the Empire of Germany, residing at Höchst-on-the-Main, Germany, have invented certain new and useful Improvements in Oxidizing Organic Compounds, of which the following is a specification.

I have shown in my application of September 4, 1902, that under certain conditions cerium compounds are powerful oxidizing agents for organic substances. I have further found that in the presence of cerium compounds divers organic substances may be oxidized by means of the electric current even without diaphragm. The ceric compounds are hereby transformed into cerous compounds, but are at once reconverted by the current into ceric compounds. The oxidation may also be effected by starting from cerous compounds. Instead of pure cerium salts mixtures of salts containing other metals of the cerium group may also be used. Exceedingly-small quantities of cerous compounds need then only be used, so that in fact they merely act as carrier of the oxygen. In spite of this small quantity of cerium compounds the yield of the current is about quantitative in most cases. Besides, the same solution may serve for a theoretically unlimited number of experiments. As the electrolyte contains only a small portion of cerium compounds, the loss is thus also practically reduced to a minimum. As the cerium salts are not poisonous, all danger for workmen is avoided.

This new process has an essentially technical advantage over all other methods of oxidation known hitherto.

As regards the practical application of this process I operate in most cases without diaphragm, but some substances become resinous by a continual contact with metals. It is therefore advisable to surround the electrodes with some resisting material—such as filter-cloth, textures of asbestos, and the like—so that the electrolyte may reach the electrodes, but not the substance therein suspended which is to be oxidized.

The process may be illustrated as follows:

I. Oxidation of anthracene.—A vessel lined with lead serving as anode contains sulfuric acid of about twenty per cent. strength with any quantity of cerium sulfate being dissolved therein, yet it is preferable to use a solution of about two per cent. Any metal not attacked by the electrolyte may serve as cathode. The anthracene to be oxidized is introduced into the vessel while actively stirring and the mixture is heated to about 70° to 90° centigrade. Then the current is passed which is maintained at a density up to five amperes per square decimeter, a tension being required of from 2.9 to 3.5 volts. The current may vary within wide limits. Toward the end of the operation the temperature is raised to about 100° centigrade. The process is complete if while maintaining this temperature for some time the electrolyte keeps the yellow color of the not-reduced ceric sulfate. The quinone thus obtained is then filtered and the filtrate may be used for another operation. The yield of anthraquinone calculated to the current used is nearly quantitative and the product obtained is of excellent quality.

II. Oxidation of naphthalene.—As electrolyte is used sulfuric acid of twenty-per-cent. strength, containing dissolved in it about two per cent. of cerous sulfate, the whole being in a vessel lined with lead, which serves at the same time as anode. As cathode may be used any metal insoluble in the electrolyte, which metal may be arranged so as to serve as agitator. The finely-ground naphthalene is introduced and the current is closed. The temperature is maintained at 40° to 60° centigrade. The current density is about one to two amperes per square decimeter. As soon as the current quantity calculated to the quinone has passed the electrolyte the current is interrupted and the quinone thus formed containing still some unoxidized naphthalene is filtered. The electrolyte contains also some phthalic acid. If phthalic acid is chiefly to be obtained, the operation has to be continued in proportion.

III. Oxidation of phenanthrene.—In the manufacture of phenanthrenequinone the process is the same as in Example II. It is preferable to employ a somewhat more concentrated cerium sulfate solution. If the current quantity calculated to the quinone is employed and the temperature maintained at about 50° to 60° centigrade, then chiefly phenanthrenequinone is obtained. If the action of the current is continued, the oxidation leads, besides to other products, finally to benzoic acid.

The temperature, the proportions of quantity, and current in the above given examples may vary within wide limits.

Having now described my invention, what I claim is—

The herein-described process for oxidizing organic compounds, which consists in causing cerium compounds to act on organic compounds in an acid solution, while simultaneously introducing an electric current, substantially as set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

MARTIN MOEST.

Witnesses:

ALFRED BRISBOIS,

BERNHARD LEYDECKER.