UNITED STATES PATENT OFFICE.

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ENVELOP FOR STORAGE BATTERIES.

SPECIFICATION forming part of Letters Patent No. 649,003, dated May 8, 1900.

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To all whom it may concern:

Be it known that I, ELMER A. SPERRY, a citizen of the United States, residing at Cleveland, in the county of Cuyahoga and State of Ohio, have invented certain new and useful Improvements in Cellulose Nitrate-Cellulose Envelops for Elements of Storage Batteries, of which the following is a specification.

My invention relates to separators or envelops for elements of batteries; and it consists in an improved material of which such separators or envelops may be constructed, the characteristics of which are fully described in the following specification, the novelty being pointed out in the claims hereto annexed. It has been found that in battery elements, especially storage-battery elements, the active material more or less readily disintegrates and tends to fall from the plate, accumulating in the bottom of the cell. It has furthermore been found that with an envelop, if properly constructed from substance permeable to the electrolyte and such as not to interfere with the traverse of the ions, this material or substance may be retained mechanically in position, and while on the one hand the action is entirely unimpeded on the other the active material is retained and the capacity of the battery does not deteriorate, as in the case where the active material is allowed to fall away from the plate or electrode. For this purpose I have used cellulose of special form and of such a material and structure as will retain its rigidity and inflexibility to a considerable degree. This I have found is best attained by using pure cellulose and in treating fiber in which the non-cellulosic constituents belong to the class of aldehydes and which I remove by the action of sulfurous acid, yielding thereby a fiber in which the ordinary strength is entirely preserved and one that can be used for the purpose and in the manner described. I have found that fibers treated with alkaline processes are short, brittle, and not suitable for battery purposes, especially when used in connection with a sulfuric-acid electrolyte. It has also been found that the individual fibers are rendered to a considerable extent more inert by being subjected to the action of sulfurous acid a second time with an intervening washing. To distinguish this product from the ordinary and less inert forms of sulfite fiber, I call it "double sulfite fiber." In this way the aldehydes are more thoroughly eliminated and the fiber is found to be almost perfectly inert in the liquid electrolyte described and unaffected by the nascent oxygen and hydrogen developed at the poles, while this fiber is found to yield excellent results, especially when corrugated or ribbed and treated and utilized as described in my application for United States patent, Serial No. 689,057, filed August 19, 1898. I have found, however, that the stiffness and general durability of the envelop may be still further improved by the addition of pyroxylin. This I prefer to make of the longer and smaller fibered grade of cotton—as, for instance, sea-island cotton—which is prepared in a peculiar manner in regard to three features.

First. The nitrogenizing process is carried on to a point where just the right amount of nitrogen is present, giving the fiber a maximum tenacity, as is well known in the art.

Second. The flexibility of the pyroxylin fiber I find to be somewhat improved by adding a trifle of vaseline; but with some processes of pulping and mixture with the cellulose this is found to be objectionable. In some instances, however, the pyroxylin fiber so treated may be used with success.

Third. During the latter part of the process, or, in fact, in any part of the process of nitrogenizing or in the washing, the fiber is treated with just sufficient nitrobenzol or equivalent to render the same not spontaneously explosive; but this is not necessary to the invention, and some of the special processes and treatment described in connection with the preparation of pyroxylin fiber may be eliminated and others used, and the invention extends to such use. Pyroxylin in the fiber form is then mechanically mixed or interspersed throughout the mass of cellulose, distributed as equally as possibly, so that the cellulose when used in sheet form will be found to have an almost unbroken network, web, or felting of the pyroxylin fiber. This I find increases the rigidity and indestructibility of a sheet to a very marked degree and increases the life of the envelop in a proportion considerably in excess of the increase in cost. I do not care to limit myself to any

exact percentage or proportion of the mixture of pyroxylin and cellulose, as for different purposes and different electrolytes and different constructions and materials employed in batteries this may be varied through wide limits.

It is sometimes found desirable to increase the rigidity or inflexibility of the sheet or envelop in one line more than another within the sheet. This I have been enabled to accomplish by a unilinear disposition of the fibers within the sheet—accomplished, preferably, by a flowing or so directing the water upon the pulping or matrix blanket that the majority of the fibers will take up a single unilinear direction within such matrix and eventually within the sheet. This does not mean that all the fibers in the sheet are parallel; but there is a direction easily discernible which indicates the direction of more fibers than any other line within the sheet, and the sheet is found to be more rigid to a bending moment applied at right angles to this line. When the matrix so constructed is prepared for use in sheet form, I prefer to subject it to a considerable pressure, which may be done in any well-known way, either by passing it through rollers or between plates at any point in the process of manufacture, and I find that the density and stability of the sheet after submersion in the electrolyte are improved if the sheet is subjected to the combined action of heat and pressure. For some special purposes it is found desirable to increase its rigidity or inflexibility in one line more than another. This I accomplish by (in addition to the above-named processes touching this point) corrugating the sheet in any of the well-known manners. This may be done by using a ribbed blanket on the pulping-machine or by corrugated rollers in the rolling process above referred to. I do not care to limit myself to any particular process of corrugation or style or configuration of the irregularity of surface constituting the corrugation.

I have employed the term "pyroxylin" as indicating the various forms of cellulose nitrates or nitrogen cellulose. The hexanitrates and others in the series may be employed. The only point as to the exact constituents of the compound is that which taken with the particular fiber originally employed will give a nitrogen cellulose of the maximum strength, durability, and tenactity. The reason why I prefer to use the word "pyroxylin" in this case as a generic term is that in its preferred form, not being spontaneously explosive and considering its mechanical uses only, the term "guncotton" would be misleading, and again using the generic term "nitrogen cellulose" it brings throughout the specification and claims in juxtaposition two expressions containing the word "cellulose," which might lead to confusion.

It will be readily understood that while it is designed to use the above parts in the relation shown, yet some may be used without the others, and the invention extends to such use. It will, furthermore, be readily understood that while the detailed construction has been described with more or less minuteness, yet the invention should be in no wise restricted to the exact methods and details described, but rather should be limited only in scope, as indicated in the claims.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. An envelop or separator for elements of batteries, consisting of an agglomeration of pyroxylin fiber and cellulose fiber in sheet form.

2. An envelop or separator for elements of batteries, consisting of a desiccated agglomeration of moistened pyroxylin fiber and cellulose fiber in sheet form.

3. An envelop or separator for elements of batteries, consisting of a compressed agglomeration of pyroxylin fiber and cellulose fiber in sheet form.

4. An envelop or separator for elements of batteries, consisting of a mixture of pyroxylin fiber and sulfite fiber in sheet form.

5. An envelop or separator for elements of batteries, consisting of a mixture of pyroxylin fiber and cellulose in sheet form, having one or more surfaces ribbed or corrugated.

6. An envelop or separator for elements of batteries, consisting of a mechanical mixture of pyroxylin fiber and cellulose fiber, the fibers of the cellulosic element being parallelly disposed within the mass.

7. An envelop or separator for elements of batteries, consisting of a mechanical mixture of pyroxylin fiber and cellulose fiber, both of the aforesaid fibers being parallelly disposed within the mass.

8. As an article of manufacture, a separator or envelop for elements of batteries, consisting of a network or matted mass of cellulose-nitrate fiber impermeable to the electrolyte, interspersed with cellulose fiber, permeable to the electrolyte, substantially as specified.

ELMER A. SPERRY.

Witnesses:
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