

UNITED STATES PATENT OFFICE

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PAPER MAKING

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This invention relates to the art of paper-making and more particularly to the manufacture of papers whose fibrous composition is radically different from that of the ordinary printing or writing papers.

In making paper, it is the practice to beat the papermaking stock in water until the cellulose fiber constituting the stock has been hydrated to a condition compatible with the realization of the texture, uniformity, and other qualities desired in the paper to be made from the beaten stock. It has been found that when cellulose fiber is mercerized, it does not respond to hydration upon beating in water and, accordingly, that it does not lend itself to transformation into paper whose characteristics are comparable to those existing in paper producible from beaten, unmercerized fiber.

I have found that etherified cellulose fiber and more particularly the hydroxy-cellulose ethers can be hydrated by beating in the presence of water even when such fiber has been prepared by etherifying mercerized cellulose fiber or so-called alkali-cellulose and that the beaten etherified fiber can be transformed into paper whose texture, uniformity, and other characteristics compare favorably with those inhering in paper made from beaten unmercerized fiber. Indeed, a sheet of paper made from beaten or hydrated hydroxy-cellulose ethers in fibrous form undergoes shrinkage during drying much in the same way as does a sheet of paper made from beaten unmercerized fiber, despite the fact that such ethers have been derived from mercerized cellulose fiber which resists hydration and which, when transformed into a paper sheet, undergoes very little shrinkage during drying.

In accordance with the present invention, I produce papers from papermaking stocks into which cellulose ethers and more particularly hydroxy-cellulose ethers have entered as raw material. Inasmuch as the particular ways in which the ethers are prepared do not constitute part of the present invention, I shall indicate generally a preferred practice of arriving at only one of these ethers. According to such practice, suitable cellulose pulp, preferably in mercerized condition or in the form of so-called alkali-cellulose, is etherified under controlled temperature conditions with ethylene oxide vapor to produce the hydroxy ethyl ether of cellulose. It is preferable that etherification be performed in the presence of a suitable catalyst, such as pyridine, which may be distributed in small amount

throughout the pulp, and that the pulp be tumbled or mixed while it is absorbing and reacting with the ethylene oxide. It is the hydroxy ethyl ether of cellulose so prepared or prepared otherwise and the hydroxy-cellulose ethers in general containing such other alkyl radicals as methyle, propyl, butyl, etc., that I use in fibrous condition for the purpose of making paper in accordance with the present invention.

The etherified fiber, say the hydroxy-ethyl ether of cellulose, may be beaten in water as ordinarily until it has been hydrated to a degree satisfactory for transformation into paper. Thus, I have found that such an ether prepared from refined sulphite wood pulp of spruce origin when beaten for a period of about 30 minutes in a ball mill acquires a slowness exceeding greatly that of ordinary unmercerized sulphite wood pulp of spruce origin beaten under the same conditions and further that the resulting beaten or hydrated etherified fiber can be made into a sheet of paper whose texture, uniformity, and other characteristics are not unlike those of the ordinary papers. The fact is, as already indicated, that the wet sheet of hydrated etherified fiber exhibits a shrinkage upon drying that approximates the shrinkage of a wet paper sheet whose base consists of beaten unmercerized pulp, such as ordinary sulphite wood pulp.

The principles of the present invention are applicable no matter whether the etherified cellulose is made from mercerized pulp or so-called alkali-cellulose or from unmercerized cellulose pulp. However, when it is desirable to arrive at cellulose ethers and papers which are to be dissolved in caustic soda solution to form syrups or solutions of the ether, it is preferable to etherify mercerized pulp or so-called alkali-cellulose, as ethers prepared from unmercerized cellulose pulp are resistant to being gelled or dissolved in caustic soda solutions even when they are peptized by being frozen in the presence of strong caustic soda solution and are then thawed out. So, too, the principles of the present invention extend to papers made from a paper-making stock which includes both cellulose fiber which has not been etherified and etherified fiber, the mixture being beaten or its component fibrous portions being separately beaten and then mixed. If desired, however, only one of the fibrous portions of the stock may be beaten or hydrated. The portion of the papermaking stock which has not been etherified may be the preponderant or subordinate portion of the stock and be mercerized

and/or unmercerized cellulose fiber. In any event, however, the paper sheet of the present invention comprises a substantial portion, say, at least about 20%, of hydroxy-cellulose ether in fibrous and preferably beaten form. Paper consisting of such ether or containing such a substantial portion of such ether is characterized by the quality of opacity.

I claim:—

- 10 1. A paper sheet comprising alkali-solubilizable hydroxy-cellulose ether in fibrous condition.
2. A paper sheet comprising alkali-solubilizable hydroxy-cellulose ether in beaten fibrous condition.
- 15 3. An opaque sheet of alkali-solubilizable hydroxy-cellulose ether in fibrous condition.
4. An opaque sheet of alkali-solubilizable hydroxy-cellulose ether in beaten fibrous condition.
5. A paper made up of hydroxy-cellulose ether in fibrous condition, mercerized cellulose pulp, and unmercerized cellulose pulp.
- 20 6. A paper made up of alkali-solubilizable hydroxy-cellulose ether in fibrous condition and unmercerized cellulose pulp.
- 25 7. A paper made up of alkali-solubilizable hy-

droxy-cellulose ether in fibrous condition and unmercerized cellulose pulp in hydrated condition.

8. A paper made up of hydroxy-cellulose ether and mercerized cellulose pulp.

9. A paper made up of a mixture of alkali-solubilizable hydroxy-cellulose ether in fibrous condition and unmercerized cellulose pulp, both the ether and pulp being in beaten condition.

10. A process which comprises beating in water paper-making stock including alkali-solubilizable hydroxy-cellulose ether in fibrous condition, and forming the beaten stock into paper.

11. A paper sheet comprising hydroxy-ethyl ether of cellulose in fibrous condition.

12. A paper sheet comprising hydroxy-ethyl ether of cellulose in beaten and hydrated fibrous condition, said ether being solubilizable in caustic soda solution.

13. A paper sheet comprising at least about 20% of alkali-solubilizable hydroxy-cellulose ether in fibrous form.

14. A paper sheet comprising at least about 20% of hydroxy-ethyl ether of cellulose in fibrous form.

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