

UNITED STATES PATENT OFFICE

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SHEET MATERIAL AND METHOD OF MAKING

No Drawing.

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This invention relates to sheet materials having improved dielectric properties, adapted for use in condensers and the like, and provides a method of making the same.

In the art of making electrical condensers it has heretofore been regarded as essential to employ a paper made from rag fibres, which could be saturated with a suitable dielectric material such as wax or a cellulosic sheet impervious to oils and waxes and possessing in itself adequate dielectric strength. Rag or bast fibre, however, is relatively expensive for such use and other materials which have been tried either do not possess sufficiently good dielectric properties or other electrical characteristics and are therefore unsuitable.

Accordingly, it is an object of this invention to provide a method of making a condenser sheet which shall make use of inexpensive materials and yet produce a product of high dielectric strength. It is also an object of the invention to obtain a sheet which shall possess these properties and be relatively thin. Other objects will appear from the following disclosure.

It is found, as a part of this invention, that relatively pure alpha cellulose fibres (such as those obtained from coniferous woods by well known methods of treatment) are intrinsically characterized by a high dielectric strength. Furthermore, such fibres felt together under the usual treatment for manufacture into paper to produce a web or mat which possesses a marked degree of absorptive capacity. In the course of fabricating such fibres into paper, however, it is difficult to develop appreciable strength except in relatively thick layers or sheets while condenser sheets, as above mentioned, are preferably thin.

On the other hand, it is found that fibres such as those of a sulphate or kraft pulp (which yield a stronger sheet of paper and may, accordingly be made into much thinner sheets than alpha cellulose pulp), are less pervious or impervious to impregnating materials and do not themselves possess so good dielectric properties. Consequently, while they may be made into thin sheets such product are not per se wholly satisfactory and are not adapted to receive an impregnation

of dielectric material to improve them in this respect.

The method of the present invention includes the preliminary preparation of a high alpha cellulose pulp and of a sulphate or kraft pulp, followed by mixing the two pulps in suitable proportions, running the mixed pulp into the form of a sheet or web, and passing through rolls or calenders, in the usual manner, to produce a paper sheet of the desired thickness and density, in accordance with paper-making practices. The sheet produced may then be impregnated or saturated with a suitable dielectric substance in the customary manner.

The preparation of the alpha cellulose includes a mild but prolonged beating of the pulp (e. g., a pulp of over 93% alpha cellulose and approximately 6% concentration) to reduce the average size of the fibres, preferably with the rolls so set as to avoid cutting action on the fibres and without inducing appreciable hydration.

The sulphate or kraft pulp (which may also have a concentration of 6%, for example, and is preferably freshly prepared) is more resistant than the alpha cellulose and may be subjected to a more drastic beating action. This tends to brush out or fray the fibres and at the same time reduces them (preferably without cutting action) to finer form. The ultimate fibres, are nevertheless, stronger and tougher than the alpha cellulose fibers and while they may include a few shives the proportionate amount or number is reduced by the beating treatment. At the same time, the fibre undergoes an appreciable hydration, although the alpha cellulose content, upon determination is frequently found to be in the vicinity of 80 to 87%.

The beating treatment of both pulps is controlled by repeated examinations of the fibre under the microscope. The rolls are set wider apart, if necessary, to avoid any observed tendency to cut across the fibres, or closer together if the beating action is too slow. The indication in the alpha cellulose of a sufficient reduction in fibre size or fibrillation determines the completion of the treatment. In the kraft pulp the same criteria are observed as well as

the degree of hydration of the pulp which does not occur with the alpha pulp to any appreciable extent. About the same length of time is required in both cases to yield a satisfactorily beaten pulp, this period being usually in excess of twenty-four hours.

The furnish is then prepared from these two pulps by mixing them in appropriate quantities. The larger the proportion of high alpha cellulose pulp employed, the more open or porous the resulting paper will be. But it is not practicable to use an all alpha cellulose wood pulp since it does not produce a paper sufficiently strong to resist necessary handling. Moreover, since the alpha cellulose tends to make a more open sheet the resulting paper will absorb a high proportion of impregnant.

On the other hand, a paper sheet made entirely from kraft pulp, while strong, has poorer dielectric properties and is non-absorbent of impregnating material. It may also contain moisture, which is enclosed during manufacture and is not removable by drying and it is thought that such moisture may decrease its value as a dielectric when used alone.

By the addition of kraft pulp to alpha cellulose pulp, however, (in amounts up to 60%) it is found that the strength of the finished sheet is greatly increased without destroying the inherent properties of the alpha cellulose, and the resulting sheet may be more readily formed much thinner and without decreasing its dielectric properties.

For example 35% to 45% of kraft pulp may be added to 65 to 55% alpha pulp, the mixture being uniform and then run on a Fourdrinier machine in the usual way to produce a sheet of paper of the required thickness.

In the usual practice of making condensers, the paper sheet thus produced, in one or more thicknesses as may be required, with alternate sheets of metal foil, is rolled into cylindrical form upon a core. After removing the core, this cylinder is placed in a closed chamber which is evacuated and heated to a temperature of about 200° F., and held under these conditions for a number of hours to effectively dry the whole roll. Melted wax or paraffin (having a melting point below the temperature of the chamber, for example) is now admitted to the chamber and, (when the chamber is filled) subjected to pressure. The wax is finally allowed to drain off; the wax impregnated roll is removed, and the impregnated roll is subjected to hydraulic pressure which flattens it into the customary oval shape in which these condenser units are generally used.

The finished condenser thus obtained is characterized by improved dielectric prop-

erties, and also possesses uniformity of density and impregnation.

I claim:

1. Method of making dielectric sheet material for condensers and the like, comprising as steps preparing a high alpha cellulose wood pulp and a sulphate pulp, mixing said pulps, and forming the resulting mixture into a sheet of paper. 70

2. Method of making dielectric sheet material for condensers and the like, comprising as steps preparing an alpha cellulose pulp and a sulphate pulp, mixing said pulps, and forming the resulting mixture into a sheet of paper, evacuating and drying the same. 75

3. Method of making dielectric sheet material for condensers and the like, comprising as steps preparing an alpha cellulose pulp and a sulphate pulp, mixing the pulps, forming the resulting mixture into a sheet of paper, and impregnating with molten wax. 80

4. Method of making dielectric sheet material for condensers and the like, comprising as steps preparing an alpha cellulose pulp and a sulphate pulp, mixing the pulps, forming the resulting mixture into a sheet of paper, drying and evacuating the same and finally impregnating with a molten dielectric substance. 85

5. Method of making dielectric sheet material for condensers, comprising as steps preparing an alpha cellulose pulp and a sulphate pulp, subjecting the same to a beating operation, mixing the pulps in the proportion of 10% to 60% of the sulphate pulp, and forming the mixed pulp into a sheet of paper. 90

6. Method of making dielectric sheet material for condensers, comprising as steps preparing an alpha cellulose pulp and a sulphate pulp, subjecting the same to a heating operation, mixing the pulps in the proportion of 35% to 45% of the sulphate pulp, and forming the mixed pulp into a sheet of paper. 95

7. A sheet material for condensers and the like, comprising alpha cellulose fibres bonded together with sulphate fibres. 100

8. A sheet material for condensers and the like, comprising alpha cellulose fibres bonded together with sulphate fibres, and characterized by being absorbent and by having high dielectric properties. 105

9. Sheet material for condensers and the like comprising alpha cellulose fibre and 10% to 60% of sulphate fibre, in uniform distribution and admixture. 110

10. Sheet material for condensers and the like comprising alpha cellulose fibre and 35% to 45% of sulphate fibre, in uniform distribution and admixture. 115

11. Sheet material for condensers and the like comprising alpha cellulose fibre and 10% to 50% of sulphate fibre, in uniform distribution and admixture and impregnated with a solid dielectric. 120

12. Sheet material for condensers and the 125

like comprising alpha cellulose fibre and 35% to 45% of sulphate fibre, in uniform distribution and admixture and impregnated with a solid dielectric.

5 13. A pulp for the manufacture of sheet material for condensers and the like comprising 10% to 60% of a sulphate pulp, and a pulp of high alpha cellulose content.

10 14. A pulp for the manufacture of sheet material for condensers and the like comprising 35% to 45% of a sulphate pulp, and a pulp of high alpha cellulose content.

Signed by me at Boston, Massachusetts,
this 28th day of June, 1929.

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