

UNITED STATES PATENT OFFICE

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PAPER SUITABLE FOR CAPACITORS AND PROCESS OF MAKING THE SAME

No Drawing.

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This invention relates broadly to a new and improved process of making paper from kraft pulp or sulphate wood pulp, and to the new product derived from such process.

5 A principal object of this invention is the production of a kraft paper which is materially less than one-half mil (0.0005 inch) in thickness.

10 Another object of this invention is the provision of a process for the production of such thin paper.

15 Still another object of this invention is to produce a condenser dielectric of paper which is very much cheaper than those at present in use, and which due to its nature, imparts useful properties to the condenser in which it is used.

20 Other and further objects of this invention will be more apparent as the description proceeds.

25 The importance of condensers in the electrical art is constantly increasing, and the need for cheaper as well as more efficient condensers is therefore apparent. One means of producing more efficient condensers is in the employment of the most suitable dielectric material. Paper has been used in the art as a dielectric material because of its dielectric properties and because it is comparatively cheap. However, in order to produce a compact and efficient condenser very thin paper has been necessary. It is known that the thinner the paper used as a dielectric the greater the capacity of the condenser will be. For
35 example, a decrease in thickness of the paper from, say, 0.0005 inch to, say, 0.0004 inch, which is a 20% decrease in thickness, will produce practically the same percentage increase in capacity of the condenser, assuming the same area of electrodes.

40 In order to obtain very thin paper it has been necessary heretofore to use linen stock or pulp, which can withstand the severe beating which has been relied upon in the past
45 to produce paper of the thinness necessary for a practical condenser dielectric. Paper suitable as an efficient dielectric condenser material should be materially less than 0.0005 inch in thickness. Wood sulphate
50 pulp, which is ordinarily known in the art

as kraft pulp, is materially less in cost than linen pulp, but as far as I am aware, no one has been able prior to the present invention to produce a paper from kraft pulp which is materially less than 0.0005 inch in thickness. 55 In fact, it has been common thought up to the present invention that such thin paper cannot be manufactured from kraft pulp by reason of the nature of the kraft pulp. The common belief has been that the kraft pulp 60 could not withstand the length of the beating operation, or the severeness of the beating operation for the length of time which would be necessary to produce such a thin paper, but would be so cut and shortened as to be unsuitable for the desired purpose. 65 Kraft pulp has therefore, as far as I am aware, never been beaten in excess of about 12 hours in making thin paper therefrom.

I have discovered that by properly controlling the conditions under which kraft pulp is beaten I can produce ultimately a kraft paper which is materially less than 0.0005 inch in thickness. This I have discovered I can do by controlling the beating action so that the severity of the beating is increased as the pulp hydrates. In other words, by beginning with a mild beating action and allowing the pulp to hydrate sufficiently, then increasing the severity of the beating action as the pulp is able to withstand it, I avoid cutting the fibres of the kraft pulp and can carry the beating action on for a period considerably in excess of that heretofore thought possible, and produce a pulp wherein the individual fibers are relatively fine and frayed out, and are suitable for making an extremely thin paper.

In order that my invention may be more fully understood and may conveniently be practiced by those skilled in the art to which it pertains, I shall describe the process I employ more in detail, and point out the salient features of the invention in the appended
95 claims.

In carrying my invention into practice I proceed as follows:

A suitable quantity of kraft pulp is washed for about six hours to remove any chemicals which may be left therein at the 100

pulp mill. The pulp is then beaten with a suitable amount of water for about thirty-six to forty hours at room temperature. The beating apparatus commonly used in paper making may be used for this purpose. During the beating the pulp heats up, due to frictional heat developed, to about 150° to 160° F. The beating operation according to the process of my invention is carried on as follows:

After the stock has been placed in the beater, the beater roll is adjusted so that the knives are just barely touching the bed plate. This can be ascertained conveniently by taking a stick and after placing it against the bed plate, lowering the beater roll until a brushing noise of the roll against the bed plate is heard when the ear is placed against the stick. Having so adjusted the beater roll, the beater is run for a definite interval, say, about four hours which is materially longer than has heretofore been the practice in beating kraft pulp. During this time the stock begins to hydrate and becomes finer and finer. At the end of this period the roll is adjusted a little closer to the bed plate, say, about 0.001 inch closer, and the beating is continued for another interval of time slightly longer than the first interval, say, about five hours. The stock thus hydrates further. At the end of this interval the beater roll is again adjusted slightly toward the bed plate, for example, another 0.001 inch, and the beating continued.

This operation of successive adjustments and beating operations is continued, each time slightly increasing the interval between adjustments, until the stock has been beaten about 36 hours. It will be seen that these operations permit the stock to gradually become more and more hydrated, and as the stock thus becomes more and more hydrated, and can better withstand the beating action, the beater roll is successively adjusted closer to the bed plate and successively imparts more of its weight to the pulp.

The degree of hydration can be observed by suitable test as the beating proceeds, for example, by employing what is known in the art as the Freeness test, and also by examining samples at various intervals under the microscope. When the Freeness test shows the proper value and the microscopic examination of a sample shows the fibers of pulp to be relatively fine and frayed out, the beating operation may be considered properly at an end.

At the end of the beating operation the process assumes the steps which are well known in the paper making art; that is, the beaten pulp is taken to a beater chest whence it goes to a Jordan beater or refiner, from which it goes to the machine chest. From the latter the pulp is taken to a riddle box where the foreign particles such as iron, sand,

etc., are removed. The next step is to send the material to the paper machine and from the paper machine to the super calenders.

If the above process is carried out, controlling the beating action as outlined above, a very fine thin kraft paper results. I have been able to obtain uniformly by means of the process of my invention a kraft paper 0.0004 inch in thickness. In certain cases I have obtained paper of 0.00034 inch in thickness. The product obtained is extremely fine and has the pores thereof closed so that a sheet 0.0004 inch in thickness when held up to the light is very uniform in texture or formation and is practically non-porous to the naked eye. In contra-distinction to this, a sheet of linen paper of the same thickness, when held up to the light, is not uniform in texture or formation to the naked eye.

Such extremely thin paper is suitable in many arts but is particularly useful in the electrical art as a dielectric material. While it possesses the desirable characteristics of linen paper in this connection its cost is slightly more than one-half that of linen paper of the same thickness. It also produces a compact and efficient condenser.

The unbleached kraft paper is light brown in color but when bleached is white and possesses a beautiful gloss or sheen. Obviously, both the bleached and unbleached kraft paper of my invention are capable of varied use in various arts where a thin tissue paper of its characteristics is desired. It may, for example, be used as cigarette paper, toilet tissue, etc.

In its application as a dielectric material the thin kraft paper may be used in connection with other solid or liquid dielectric substances. It may very successfully be used in capacitors wherein it is associated with dielectric material or materials comprising organic esters, such as tricresyl phosphate, which have been heat treated so that certain pyrogenic compounds are contained therein, or organic esters such as tricresyl phosphate, which have been heat treated in the presence of waxy materials all of which is more fully set forth in the copending applications of Frank M. Clark, Serial Nos. 425,357 and 425,359, filed Feb. 1, 1930, and assigned to the same assignee as the present invention.

While in accordance with the present process I have been able to produce thin kraft paper of the order of 0.0004 inch in thickness, it is entirely within the scope of my invention to produce even thinner paper than this by simply controlling the beating operation in the manner described above, but taking care to properly hydrate the pulp as it is beaten.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. A process for producing a thin kraft paper having a thickness materially less than

0.0005 inch which comprises controlling the beating action on the pulp by prolonging the intervals of time between successive adjustments of the beater roll with respect to the bed plate so that the pulp can hydrate sufficiently to withstand the necessary beating action, and increasing the severity of beating at each adjustment so as to produce ultimately fibers which will make a sheet of the thickness specified when subjected to paper making steps.

2. In a process for producing a thin kraft paper having a thickness materially less than 0.0005 inch, the steps which comprise controlling the beating action as follows: adjusting the beater roll so that it barely touches the bed plate of the beater, beating the pulp for an interval of time materially in excess of two hours with the beater roll in this position, successively decreasing by relatively small increments the distance between the beater roll and the bed plate at intervals approximately the same as the first interval until the pulp has been beaten sufficiently to produce ultimately such a thin paper.

3. A process for producing thin kraft paper having a thickness materially less than 0.0005 inch, which comprises controlling the beating action on the pulp by successively increasing the severity of the beating action as the pulp hydrates sufficiently to withstand such beating, and beating the pulp for a period of time sufficient to produce fibers which will make a sheet of the thickness specified when subjected to paper making steps.

4. A process for producing a thin kraft paper having a thickness materially less than 0.0005 inch which comprises washing the pulp as it is received from the mill, subjecting the washed pulp in the presence of a suitable quantity of water to a beating action for about 36 to 40 hours as follows: adjusting the beater roll so that it barely touches the bed plate of the beater, beating the pulp for about four hours with the beater roll in this position, successively decreasing by relatively small increments the distance between the beater roll and the bed plate at intervals approximately the same as or slightly greater than the first interval until the pulp has been beaten for the requisite time, then subjecting the beaten pulp to the usual paper making steps.

5. A process for producing thin kraft paper having a thickness materially less than 0.0005 inch, which comprises controlling the beating action on the pulp by successively increasing the severity of such beating action as the pulp hydrates sufficiently to withstand such beating, and beating the pulp by such controlled action until the individual fibers are relatively fine and frayed out.

6. A thin kraft paper having a thickness materially less than 0.0005 inch.

7. A thin kraft paper having a thickness of about 0.0004 inch.

8. A thin kraft paper having a thickness materially less than 0.0005 inch, the pores of which are substantially closed, and the fibers of which are relatively fine and frayed out.

9. A substantially non-porous kraft paper having a thickness of about 0.0004 inch.

10. In a process for making thin kraft paper the steps which comprise prolonging the beating in the individual stages of adjustment of the beater roll with respect to the bed plate and controlling the beating action in each stage so that the individual fibers can sufficiently hydrate to withstand further and more severe beating to ultimately produce fibers frayed out sufficiently to yield on being subjected to paper making steps a paper of the order of 0.0004 inch in thickness.

In witness whereof, I have hereunto set my hand this 23rd day of January, 1930.

AMOS L. ALLEN.

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