

UNITED STATES PATENT OFFICE

RALPH H. MCKEE, OF JERSEY CITY, NEW JERSEY

PAPER AND PROCESS OF MANUFACTURING THE SAME

No Drawing.

Application filed March 14, 1929. Serial No. 347,189.

This invention relates to paper and to processes for the manufacture thereof, and more particularly to a strengthened pervious and non-waterproof paper of controlled porosity and to a process of manufacturing the same.

Heretofore papers of a diverse nature have been produced but, for the purposes of the present invention, the prior papers can be divided, generally speaking, into water-resistant papers and non-water resistant papers. A typical kind of paper belonging to the water-resistant class is one constituted of several kinds of pulp, sizing material and a loading or filling material. This type is exemplified, for instance, in a printing paper which is composed of a mixture of sulfite and soda cellulose, a rosin sizing and white kaolin or clay. The sizing, as well known in the art, performs a dual function of rendering the paper water or ink resistant and of increasing the strength of the paper by bonding the fibres thereof together. On the other hand, the non-water resistant class is typified in filter paper or blotting paper. In neither of these two papers, are sizing or loading materials used. Usually these two papers consist of a single kind of cellulose. As is well known, filter paper and blotting paper have very low tensile and bursting strength, particularly when they are wet, and have a tendency to permit fibres to be rubbed off their surfaces in the form of lint. These defects are objectionable especially under certain conditions.

Various proposals have been made for overcoming the aforesaid defects in non-water resistant papers. Many kinds of sizing and of modified sizing have been suggested for incorporation with pulp but this procedure has produced paper which in addition to being strengthened, was made water resistant. Among some of the expedients formerly employed to strengthen non-water resistant paper were the method of making the paper very thick, the method of densifying the paper, and the method of thickening and densifying the paper. These latter methods were utilized in making filter paper capable of retaining finely divided

precipitates like precipitated barium sulfate. Although the paper was maintained in a non-water resistant condition by these latter expedients, the strength of the paper could never be increased to any material extent. Prior attempts, as far as I am aware, have been unsatisfactory and unsuccessful for one reason or another and have been unable to provide the art with an unsized, strong paper.

I have discovered a new non-waterproof paper having a tensile and bursting strength of the order of sized paper and a process which enables me to manufacture my new paper in a simple, economic and efficient manner. My new paper, in addition to being strong, has a porosity which may be controlled and has a constitution of such a nature that fibres will not rub off easily to give lint. Other advantages and features of my new product and process will become apparent from the following description of a typical and illustrative embodiment of my invention.

Although the present discovery has wide application it will be explained hereinafter with particular reference to filter paper. Broadly stated, my new paper is constituted of a multiplicity of matted fibres which are bound together with a bonding agent which acts solely as a strengthening material without imparting water-resistant property to the bonded fibres. The preferred form of the new paper consists of fibres of one kind which are firmly and securely bonded together by a strengthening material having a cellulosic constitution. The strengthening material coacts with the fibres in such a manner that the porosity of the paper can be controlled.

In the manufacture of my new paper, pulp is treated and handled in the usual manner preparatory to paper making. It is not necessary to employ any special apparatus for carrying my process into practice but the usual paper-making machinery may be used with good efficiency in the production of my new paper. The bonding agent or strengthening material of cellulosic constitution, which is utilized in connection with the binding of the fibres, may be added to the pulp at any appropriate place in the paper

making system, such as in the beater or in the stuff chest or even in the head box. I prefer, however, to add a bonding agent to the pulp in the beater just before the beater is discharged. The pulp with the added bonding agent is then carried through the usual steps involved in the manufacture of filter paper. During the heating and calendering of the paper the viscose is precipitated by the action of heat on and around the fibres. The resultant product is for example a filter paper which is non-resistant to water but which is just as strong as papers hitherto made in the paper manufacturing art with sizing materials. The strength of the new filter paper is retained even when the paper is wet.

The bonding agent which I prefer to employ is a special type of sodium cellulose xanthate solution. I have found that a solution of sodium xanthate made with a minimum of caustic soda and carbon bisulfide content gives particularly advantageous results when used in accordance with my invention. As a preferred example of such a sodium cellulose xanthate solution, commonly known in the art as a viscose solution, the following is mentioned. The solution comprises, cellulose approximately 100 parts (by weight), caustic soda approximately 35 parts, carbon bisulfide approximately 38 parts, and water from about 2000 to about 5000 parts. In making up this preferred solution it is first prepared with about 1000 parts of water and then after it has ripened more water is added to give the dilution noted hereinabove, i. e., to give a viscose solution containing about 2000 to 5000 parts of water. In the preparation of the viscose solution I prefer to ripen the solution until it has a sodium chloride precipitation number of about 8% or less. Under many circumstances the ripening may with advantage be allowed to continue until it has a precipitation number corresponding to about 3 to 4% sodium chloride solution. Ripening of this order occurs while the solution still carries approximately 8 to 10% of cellulose content. As noted hereinabove, the solution is only diluted with the larger amount of water after the ripening is completed.

The special type of viscose solution described hereinabove is preferably added to the beater contents just before the beater is discharged, although the viscose solution may be added either in the stuff-chest or even in the head box of the paper machine. The amount of the viscose solution thus added to the paper pulp depends upon several factors including the desired strength to be obtained in the finished paper, the porosity of the final paper, and other features as the type of pulp, and the like.

In the present instance, the amount of viscose used is such as to give an amount of

cellulose precipitated on the cellulose pulp equivalent to one half of one percent to approximately three percent of the pulp used, all on a dry basis. The computed porosity is ordinarily in inverse proportion to the amount of cellulose furnished by the viscose solution, that is when 3% of the cellulose is furnished by the viscose solution and 97% of it is furnished by the pulp, then a filter paper is obtained which has very little porosity and which consequently is capable of filtering out very finely-divided precipitates such as barium sulfate. If, on the other hand a filter paper is used having the same minimum thickness, but with only sufficient viscose to give one half of one percent cellulose then such a paper, while removing precipitates of the ordinary size such as calcium sulfate (gypsum- $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) will permit the penetration through it of finely divided precipitates such as precipitated barium sulfate. Hitherto in order to make a filter paper capable of retaining a finely divided precipitate, as mentioned hereinabove, it has been necessary either to make a filter paper very thick or to densify it or both to thicken and densify it.

Viscose solutions commonly used in the rayon, cellophane, and similar industries require treatment with ammonium sulfate and sulfuric acid or similar acid or acid salt solutions in order to precipitate the cellulose. In my improved process, however, this is not an essential step. Ordinarily, in the present process, the heating of the paper on the drying rolls is sufficient to cause precipitation of the cellulose on the fibres of the pulp. With some waters, it may be desirable to add either a small amount of an acid or of an acid salt, such as aluminium sulfate to make the precipitation complete. In general, however, this will not be required.

During my process a part of the sulfur derived from the carbon bisulfide of the viscose solution is evolved as hydrogen sulfide along with the steam while the paper is passing over the steam heated drying cylinders. A small part of the sulfur, however, will tend to remain as elemental sulfur and will give a yellow tone to the paper. This separation of sulfur can be overcome by the addition of sulfur dioxide or sodium sulfite to the diluted pulp fed to the paper machine. The sulfur dioxide reacts with the alkali in the sodium cellulose xanthate solution to produce sodium sulfite and, sodium sulfite, whether produced in this way or added by itself, will combine with the sulfur to form colorless sodium thiosulfate. The amount required is extremely small and will depend upon the percentage of viscose solution applied to the pulp from which paper is made, as one skilled in the art will readily understand.

In most cases the presence of the small amount of precipitated sulfur in the filter

paper will be without objectionable effect as far as its use is concerned. In many other cases the presence of the small amount of water soluble sodium thiosulfate will also be without undesirable effect as far as the use of the filter paper is concerned. In still other cases it may be desirable to have both of these entirely removed and this may be accomplished by changing the sulfur to sodium thiosulfate and then removing the sodium thiosulfate by passing the paper through a bath of water. The apparatus to be used for the removal of sodium thiosulfate is the same as that used in the paper industry for continuously surface sizing with animal sizing except that the bath is filled with running water instead of with a glue solution, as will be readily understood.

My improved process permits the art, for the first time, to make a filter paper which carries a binding material to give it increased strength both when dry and when wet and yet at the same time is not sized in the ordinary sense, i. e., the paper is not made water resistant. My improved filter paper is much stronger than filter paper of the same weight now in commercial production and is also capable of having its porosity varied and controlled. In other words, my improved paper can be made to retain different sized particles by varying the amount of cellulose precipitated on the fibre, and, thus the porosity of the paper is controlled. Accordingly, with the use of the present invention it will not be necessary to use a heavy and thereby necessarily more expensive filter paper in order to accomplish the removal of finely divided particles from a liquid, but instead it will be possible to use thinner and hence cheaper filter paper which has the porosity thereof decreased. In other words, my invention provides a paper in which the retentivity is increased by the precipitation of more cellulose from viscose upon the fibres.

The present invention may be applied to the manufacture of non-water-resistant cigarette paper of controlled or regulated porosity. Paper of this character ordinarily contains sizing material but my new paper is free from sizing material which might tend to interfere with the burning qualities of the paper. The matted fibres of my new paper, as explained hereinabove, are bonded together by pure cellulose which has been precipitated from a viscose solution. The amount of this solution is such as to give the desired porosity in the finished cigarette paper. Inorganic filling material, such as precipitated calcium carbonate, is added to the paper in sufficient amount, say 18%, to regulate the rate of burning to approximately that of the tobacco used in the cigarettes.

It will be noted that my process provides a convenient procedure which can be carried

out with present systems of paper making machinery without necessitating any alterations. In other words, the viscose solution or equivalent agent capable of precipitating a binding and strengthening material of cellulosic composition on the fibres of the pulp can be added or incorporated in the paper-making pulp of fibrous material at any appropriate and suitable stage prior to the formation of the web or sheet of matted fibres which is subsequently converted into a sheet of paper by operations well known to one skilled in the art. In the event that the water acting as the vehicle for the pulp does not contain CO_2 enough to facilitate precipitation of the viscose solution on to the fibres of the pulp any suitable substance noted hereinbefore may be used to cause precipitation of the cellulosic binding and strengthening material from the viscose solution in the body of pulp at or during any stage of operations prior to the paper making. The novel paper produced by my new process is porous and non-waterproof but nevertheless is strong and has approximately the strength of a corresponding paper which has been sized. By establishing the proper ratio or relation between the cellulose fibres and the cellulosic strengthening and binding material precipitated from the viscose solution or the like, the porosity of my new paper can be controlled.

Although the aforesaid description was given with particular reference to filter paper, it is to be noted that my improved process can be utilized without change in the manufacture of blotting papers, such as desk blotters. These blotters in addition to being strong will not easily rub off cellulose fibres. In other words, I can manufacture a blotting paper of good character in a simple, efficient and economic manner and of such a nature that it will not give lint upon being rubbed.

While I have given a specific example of my improved paper and process of manufacturing the same merely by way of illustration, it is to be understood that I am not to be confined to the exact constituents nor the proportions given as they are to be regarded only as illustrative and typical. Various modifications may be made without departing from the nature of my invention as defined in the appended claims.

I claim:

1. A pervious and non-water-resistant paper comprising a thin sheet of fibrous material, and less than 3% of a strengthening and binding material precipitated during the process of making the paper from a viscose solution having a low caustic soda and carbon bisulfide content on the fibres constituting the said fibrous material to give the latter a strength approximating corresponding to sized paper of same weight without rendering it water resistant.

2. A pervious and non-water-resistant paper comprising a thin sheet of matted fibrous material, and a cellulosic strengthening and binding material precipitated from a well-ripened viscose solution of 8% or less salt number on to the fibres of said sheet of fibrous material to give the latter a strength approximating corresponding to sized paper of same weight without rendering it water resistant, said binding material being present in less than three per cent of weight of the paper.

3. A strong, pervious, non-waterproof paper comprising a thin sheet of matted fibrous material constituting approximately 97% of the weight of the paper on a dry basis and a cellulosic product precipitated on the fibres of said sheet of fibrous material from a viscose solution during the process of producing the paper, said cellulosic material precipitated from said viscose solution being present in quantity not greater than approximately 3% of the weight of the paper on a dry basis, whereby a paper of controlled porosity is obtained.

4. A strong, pervious, non-water-resistant filter paper, substantially free from sizing material, comprising a thin sheet of fibrous material, constituting approximately 97% of the weight of the paper on a dry basis and a cellulosic product precipitated on the fibres of said sheet of fibrous material from a well-ripened viscose solution, having a sodium chloride precipitation number of about 8% or less by heat during the process of producing the paper, said cellulosic product being present in quantities not greater than 3% of the weight of the paper of same weight on a dry basis whereby a sheet of fibrous material is obtained having a strength approximating sized paper of same weight and having a porous and pervious structure of controlled porosity.

5. In the art of making strong, porous, non-waterproof paper, that improvement which comprises incorporating less than 3% of cellulose in the form of a viscose solution in the paper pulp prior to the formation of a web or sheet of paper and causing the precipitation of a cellulosic product from said viscose solution to the fibres of the web or sheet of paper by the application of heat and without the addition of chemicals.

6. The process of making strong, porous, non-waterproof paper which comprises preparing a pulp of fibrous material, incorporating in said pulp less than 3% of cellulose in the form of a viscose solution, forming a web or sheet of fibrous material and causing precipitation by the application of heat to the viscose solution of a cellulosic product on to the fibres of said fibrous material to strengthen the fibres of said web, whereby the finished paper made from said treated pulp will have a strength of the order of sized

paper of same weight without being water-resistant and will have a pervious structure of controlled porosity.

7. The process of making strong, porous, non-waterproof paper, substantially free from sizing material, which comprises establishing a supply of pulp of fibrous paper making material, adding to said pulp prior to the formation into a sheet of matted fibres a well-ripened viscose solution having a sodium chloride precipitation number not greater than 8% in such amount that the amount of precipitated cellulose will be less than 3% and then forming a web of matted fibrous material, precipitating the cellulosic product from the viscose solution by the application of heat and finally making a sheet of paper having the strength of the order of sized paper of same weight without being water-resistant.

8. The process of making strong, porous, non-waterproof paper, substantially free from sizing material, which comprises preparing a mass of paper making pulp, adding a well-ripened viscose solution, having a low caustic soda and carbon bisulfide content to said pulp in limited amounts not greater than approximately 3% on the dry basis, forming a web of matted fibres from said pulp, effecting a precipitation of cellulosic material from said viscose solution on to said fibres of said web by the application of heat.

9. A process such as set forth in claim 8, where n sodium sulfite is added to the pulp to convert sulfur precipitated from the viscose solution into sodium thiosulfate.

In testimony whereof I have hereunto set my hand.

RALPH H. McKEE.