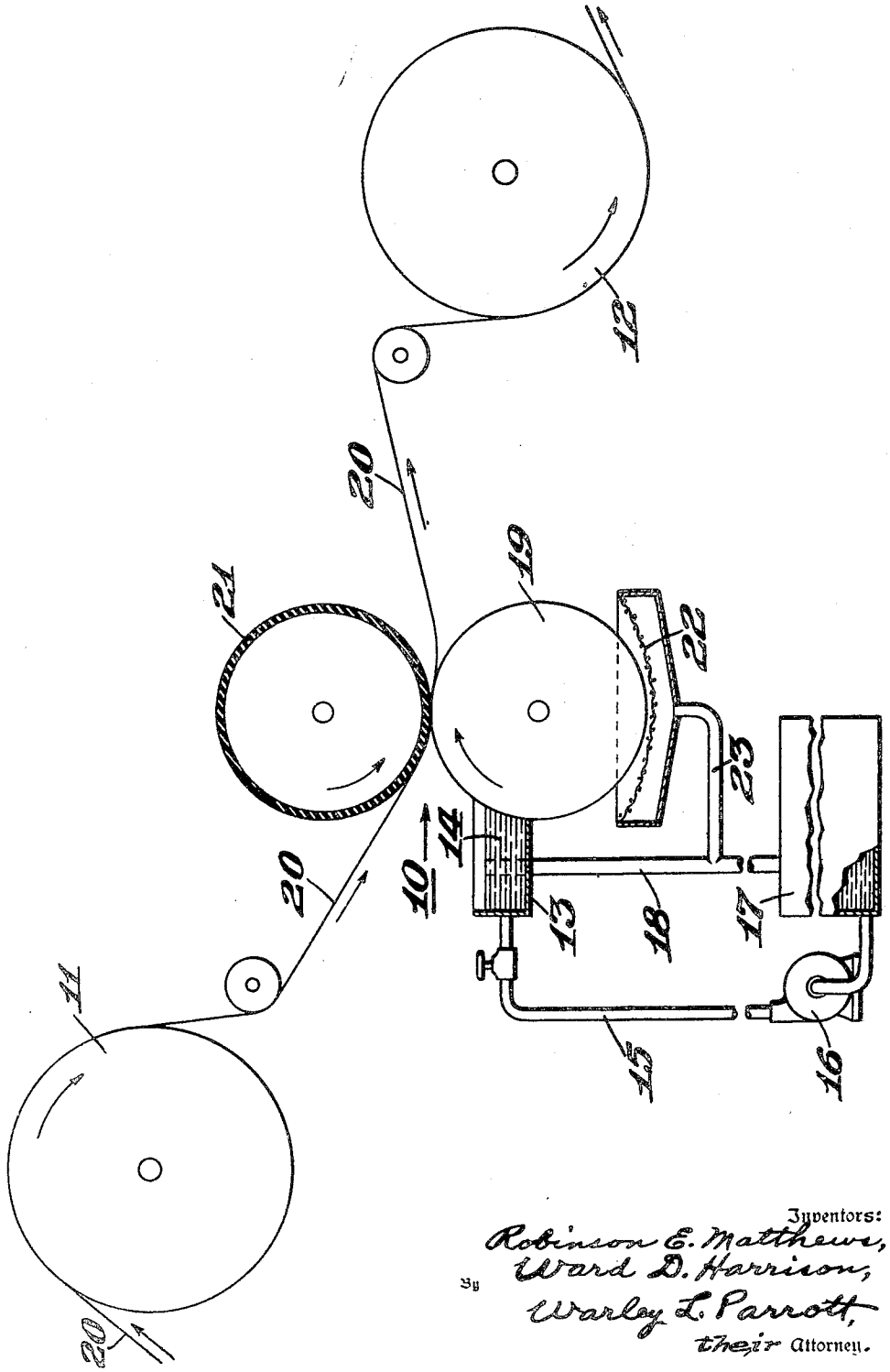
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CIGARETTE PAPER

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CIGARETTE PAPER

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Cigarette paper manufactured for use in machine made cigarettes is commonly of the combustible type, that is, it will burn easily when rolled in the regular cigarette in contact with cigarette tobacco. This type of cigarette does not require a forced draft or continued "puffing" by the smoker, but once lighted it will continue to burn until the entire cigarette is consumed.

The means employed to establish this continuous burning property of the cigarette paper in the rolled cigarette, is an alkaline filler, commonly referred to as chalk, which is incorporated in the cigarette paper sheet during manufacture thereof. A typical example of an alkaline filler is calcium carbonate that is added to the paper pulp suspension while the latter is in the beater or in the machine chest or just prior to formation of the pulp into a continuous paper web or sheet on the paper machine. The amount of filler used will vary with different grades and types of cigarette paper, and may commonly constitute about 20% to 30% of the total weight of the filled cigarette paper of the combustible type.

This cigarette paper containing the carbonate or other suitable types of filler is referred to in the trade as a "filled" paper. The filler has other advantages in addition to rendering the paper easily burnable. For example, it makes the paper more opaque and thereby produces a better appearing cigarette; also, it increases the drying rate of the cigarette paper on the paper machine so that greater production can thereby be obtained.

Along with these advantages, however, the filled cigarette paper has the disadvantage of being relatively weak when wet. The filled paper sheet is highly absorbent of moisture and after absorbing a substantial amount of water, which it will do very rapidly, it becomes relatively weak. In actual use this property shows up when the cigarette is smoked since the saliva in the smoker's mouth quickly wets the paper. Now, if the paper is too low in strength when it is wetted in the smoker's mouth the wet portion will pull away from the remaining dry portion of the paper and oftentimes stick to the smoker's lips. With certain types of smokers who chew or wet the end of the cigarette excessively, the cigarette paper of low wet strength will disintegrate too easily in the smoker's mouth.

In view of these characteristics of high quality cigarette paper when wet, it has been an important commercial problem to maintain all of the desirable properties of the cigarette paper such as easy burning, thinness, purity, whiteness,

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etc., and at the same time impart to the paper sufficient resistance to weakening or disintegration when it becomes wet in the smoker's mouth. Certain chemicals which would be helpful in establishing higher wet strength properties, cannot be used in the normal manner because of the alkaline character of the cigarette paper, which is imparted to the paper by the substantial amount of alkaline filler in the paper web. For example, it is not practical to incorporate acid catalyzed resins in the cigarette paper pulp while in the beater or machine chest, as is commonly done for other types of paper, since the acid or acid salt thus used would attack the carbonate filler.

In accordance with the present invention we have discovered a method and means for increasing the resistance of cigarette paper to disintegration when it becomes wet in the smoker's mouth. For this purpose the normal wet strength of the paper needs to be increased by a controlled amount since excessive strengthening would harm other desirable or necessary properties of the paper.

While this improvement in cigarette paper in accordance with our invention may be referred to as an increase in "wet strength," it should not be confused with the usual wet strength processes wherein resins, cellulose ethers, etc., are used for imparting to the paper a wet strength as great as 50% to 100% of the dry strength of the paper. Such wet strength values are commonly used in map paper, blueprint paper, moist food wrappers, tea bag paper, paper towels, etc. In contrast thereto the wet tensile strength of the improved paper of our invention may be in the order of 5% of the dry tensile strength of the paper. Nevertheless, this renders the paper sufficiently resistant to the common deleterious effects of moisture during smoking, and at the same time does not adversely affect the necessary porosity, opacity and many other required physical characteristics of high grade cigarette paper.

We have found that we can obtain this desired, relatively slight, increase in wet tensile strength of the cigarette paper, as compared with the dry tensile strength, by application of a very dilute aqueous solution of an urea formaldehyde polymer and an acid salt to the paper web. This solution is applied advantageously by means of a size press, to the partially dry paper web during the drying of the paper on a Fourdrinier paper machine. However, the application of the solution may be effected in other suitable ways, such as by spraying, transfer rolls, etc. Also it may

take place at any location in the dryer section of the paper machine or just prior thereto.

The amount of urea formaldehyde resin polymer which we use is almost infinitesimally small as compared with the usual amounts of 1% to 5% or more of this resin for producing high wet strength map paper or wrapping paper. As contrasted with this, we use resin amounts of less than one-tenth of 1% of the weight of the paper; a typical amount being represented by 0.025% of resin based on the weight of the finished dry paper.

As far as we are advised it has heretofore been considered impossible or impractical to use resins for producing high wet strength values in paper having such high alkaline filler content that the urea formaldehyde resin could not be catalyzed under the usual acid conditions. In the usual practice the setting of such resins is catalyzed by the presence of sufficient acid or acid salt to produce an acid pH in the pulp suspension or paper sheet.

The carbonate filled cigarette paper to which the treatment of our invention is applied to render it resistant to disintegration in the smoker's mouth, is normally definitely alkaline. For example, the untreated paper with carbonate filler will have a pH value of about 9.3. After treatment in accordance with our invention the finished paper has a somewhat lower pH value, such as for example 8.5, but is still definitely alkaline because of the large, alkaline filler content.

Despite this alkaline characteristic of the paper we have been able to set the urea formaldehyde resin polymer in the paper during the rapid manufacture thereof on the paper machine, and obtain the desired amount of increase in wet strength of the cigarette paper. An illustrative but non-limiting example of this increase is a wet strength value of 100 for the untreated paper and 150 for the treated paper, as determined by an accurate wet strength test.

We have been able to obtain these satisfactory results in the alkaline cigarette paper, by acidifying the aqueous resin polymer solution with a suitable amount of a water soluble acid salt; applying this acidified, aqueous resin solution to the paper web, and then heating it promptly to dry the paper and set the resin. The combination of the acid salt and heat (of drying on the paper machine) effects quick setting of the resin so that the paper which is impregnated therewith has the desired wet strength value practically by the time it comes off of the paper machine. Some slight increase in wet strength may take place during subsequent storage of the paper.

In actual commercial use of our invention we have obtained very good results when using acid ammonium salts for acidifying the resin solution. Specific examples of such salts are monoammonium phosphate, diammonium phosphate and ammonium sulfate. These salts may be used singly or in different combinations and satisfactory results obtained. Our experience shows that at least one acid salt is necessary since heat alone is not sufficient to set the resin and obtain the desired increase in wet strength, during manufacture of the paper on the paper machine. The following table shows pertinent data and illustrates the effects of the different acid salts in combination with the urea formaldehyde resin, in varying amounts.

Table

Group	Test No.	Per Cent in Paper				Solution pH	Paper pH	Grams Wet Tensile Strength
		R*	MAP*	DAP*	AS*			
A	1	0	0	0	0	----------	9.3	105
	2	.025	0	0	0	7.8	9.3	105
	3	0	.25	.06	.31	6.0	8.5	115
B	4	.025	.01	0	0	6.1	9.3	110
	5	.025	.03	0	0	5.7	9.3	120
	6	.025	.09	0	0	5.4	9.1	135
	7	.025	.22	0	0	5.0	8.9	140
	8	.025	.31	0	0	4.9	8.7	150
	9	.025	.63	0	0	4.7	8.2	150
C	10	.025	0	.31	0	7.8	8.8	150
	11	.025	0	.630	0	7.7	8.6	150
D	12	.025	0	0	.31	4.6	8.9	140
	13	.025	0	0	.630	4.1	8.8	150
E	14	.012	.25	.06	.31	6.0	8.5	135
	15	.025	.25	.06	.31	6.0	8.5	150
	16	.050	.25	.06	.31	6.0	8.5	200
	17	.100	.25	.06	.31	6.1	8.5	200+
	18	.200	.25	.06	.31	6.0	8.5	200+

R*=Urea formaldehyde resin.
MAP*=Monoammonium phosphate.
DAP*=Diammonium phosphate.
AS*=Ammonium Sulfate.

As indicated in the above table, the test results have been grouped into five groups A, B, C, D and E. The group A is a miscellaneous group and shows that without any treatment of the paper the wet strength value is relatively low; that use of the resin alone, without any acid salt, will not give the desired increase in wet strength; and that use of the acid salts alone, without any resin, will likewise not give the desired increase in wet strength.

Group B shows the results obtained when using a single acid salt, i. e., monoammonium phosphate, in varying amounts, and in combination with a constant amount of the urea formaldehyde resin. It will be noted that the wet tensile strength of the paper so treated increases with the increasing amounts of the monoammonium phosphate, and the solution pH and paper pH decrease with the increasing amounts of the monoammonium phosphate. The higher and more desirable wet strength values, e. g. 150, are obtained with the higher percentages of the monoammonium phosphate and lower pH values of the resinous solution.

In group C another acid salt is used, namely, diammonium phosphate. The results here show that desirable wet strength can be obtained with as little as 0.31% of diammonium phosphate and 0.025% of resin in the paper.

Group D is the same as group C except that ammonium sulfate is used as the acid ammonium salt and gives substantially the same results as

the diammonium phosphate shown in group C. The ammonium sulfate being a salt of a stronger acid gives a lower solution pH value than is obtained with the diammonium phosphate salt. It is interesting to note in this regard that the desired wet strength values are obtainable with solutions having acid pH values of as low as about 4 and as high as about 7.8.

The test data in group E show the results obtained when using all three of the acid salts, namely, monoammonium phosphate, diammonium phosphate and ammonium sulfate, in combination with varying amounts of the urea formaldehyde resin. In certain respects, this combination is the most advantageous since it provides desirable high wet strength values, gives a relatively high acid pH value in the treating solution, and lowers the pH value of the final paper to about 8.5. These data also show that if a wet strength value of about 150 is desired, it is not necessary to increase the amount of resin above the infinitesimally small amount of 0.025% since such an amount will give a wet strength value of about 150. Larger amounts of resin give higher wet strength values that are not needed for the purpose of preventing disintegration of the cigarette paper when it becomes wet in the smoker's mouth, as discussed above.

A supplemental advantage of the use of all three of the ammonium salts shown in group E is the improvement produced thereby in the burning and ash characteristics of the cigarette paper. These latter features are disclosed in our copending application Serial No. 511,692, filed November 25, 1943, now abandoned. It is of advantage that this combination of the three salts with the urea formaldehyde resin may be used for acidifying the resin and increasing the wet strength in accordance with our present invention, and concomitantly produce the improvement in features disclosed in our said copending application. However, it is to be understood from the above data that the present invention is not dependent upon the use of all three of these salts or, in fact, upon the combination of two or more of these salts. As above shown, any one of the salts taken alone will serve satisfactorily to set the resin and thereby make possible the increase in wet strength of the paper which characterizes our present invention.

A typical but non-limiting example of the procedure followed in treating cigarette paper in accordance with our invention is as follows. An ammonium salt, for example monoammonium phosphate, in amount of 3.14 lbs. is dissolved in a suitable small amount of water and the resulting solution is diluted to 50 gallons in a suitable tank. Into this solution is added ⅛ of a pound, on a dry weight basis, of urea formaldehyde resin polymer. The polymer is in the form of a clear, syrupy liquid. It will be noted that the amount of ammonium salt here used is large with respect to the amount of urea formaldehyde. Both the ammonium phosphate and the urea formaldehyde polymer are easily dissolved in the water solution. The resulting 50 gallons of aqueous resin and salt solution is applied by size press operation at a controlled rate such that it will treat 500 pounds of finished dry paper. This is accomplished by use of the equipment illustrated in the accompanying drawing and in accordance with the following description.

As shown in the single diagrammatic view, the composition is applied at an intermediate position in the drying end of a Fourdrinier paper machine. In other words, the applicator or size press, indicated generally at 10, is located after the first few drying rolls and before the several remaining drying rolls. We have obtained good results with a size press located between the fifth drying roll, such as indicated at 11, and the sixth drying roll, such as indicated at 12, of a machine having ten drying rolls.

The specific location of the size press is important mainly from the standpoint of applying the composition to the paper when the latter has the proper or most desirable moisture content as referred to hereinabove. In one specific, but non-limiting commercial application, we have obtained very desirable results with paper having a moisture content of about 50%, as it leaves the drying roll 11, and a moisture content of about 65% after application of the chemical composition at the size press 10 or just before the treated paper reaches the next drying roll 12.

The applicator system comprises a box member 13 containing the chemical composition 14, which is continually supplied through a suitable conduit indicated at 15 and connected with a pump 16 and supply tank 17. The pump 16 maintains continuously the desired level of liquid composition in the box or trough 13. The continuous overflow of liquid is returned through a conduit 18 which projects upward into the trough 13 to the desired overflow level. A metal pick-up roll 19 rotates in contact with the composition 14 and in fact takes the place of one side member of the trough 13. The thin liquid composition picked up by the roll 19 is brought into contact with the moist web of paper 20 and causes good permeation and impregnation of the paper sheet. Furthermore, the paper sheet or web, as it reaches the size press, still contains considerable water and the wet web is very receptive to further wetting with the composition.

To effect impregnation and to remove the excess liquid from the paper web, a rubber covered press roll 21 is superimposed on the roll 19. The principal amount of the excess liquid flows back over the upper left portion of the roll 19 and into the supply trough 13. Some lesser amount of the excess liquid drips from the roll 19 and is caught by the strainer member 22 and is returned to the supply through conduit 23. After the treated paper passes around the drying roll 12 and similar succeeding drying rolls it is ready to be wound up and used.

Various modifications and changes may be made in the above described materials, products and procedures without departing from the scope of our invention as defined in the appended claims.

We claim:

1. A combustible, non-waterproofed, highly water absorbent cigarette paper having a pH of about 8.5, containing about 20–30% of calcium carbonate based on the weight of the filled cigarette paper, and polymerized urea formaldehyde resin in an amount from between about 0.025% to about 0.10% which effects an increase of about 50% to 100% in the wet strength of the cigarette paper.

2. A combustible, non-waterproofed, easily water-absorbent cigarette paper having sufficient wet strength to prevent disintegration when wet in the smoker's mouth, said paper having a pH of about 8.5 to 9.3 and containing about 20% to 30% calcium carbonate filler, about 0.025% to 0.10% urea formaldehyde resin polymer based on the weight of the filled cigarette paper, about

0.01% to 0.63% of a water soluble acid ammonium salt that effects setting of said urea formaldehyde resin polymer, and said amount of polymer effects an increase of about 50% to 200% in the wet strength of the cigarette paper.

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