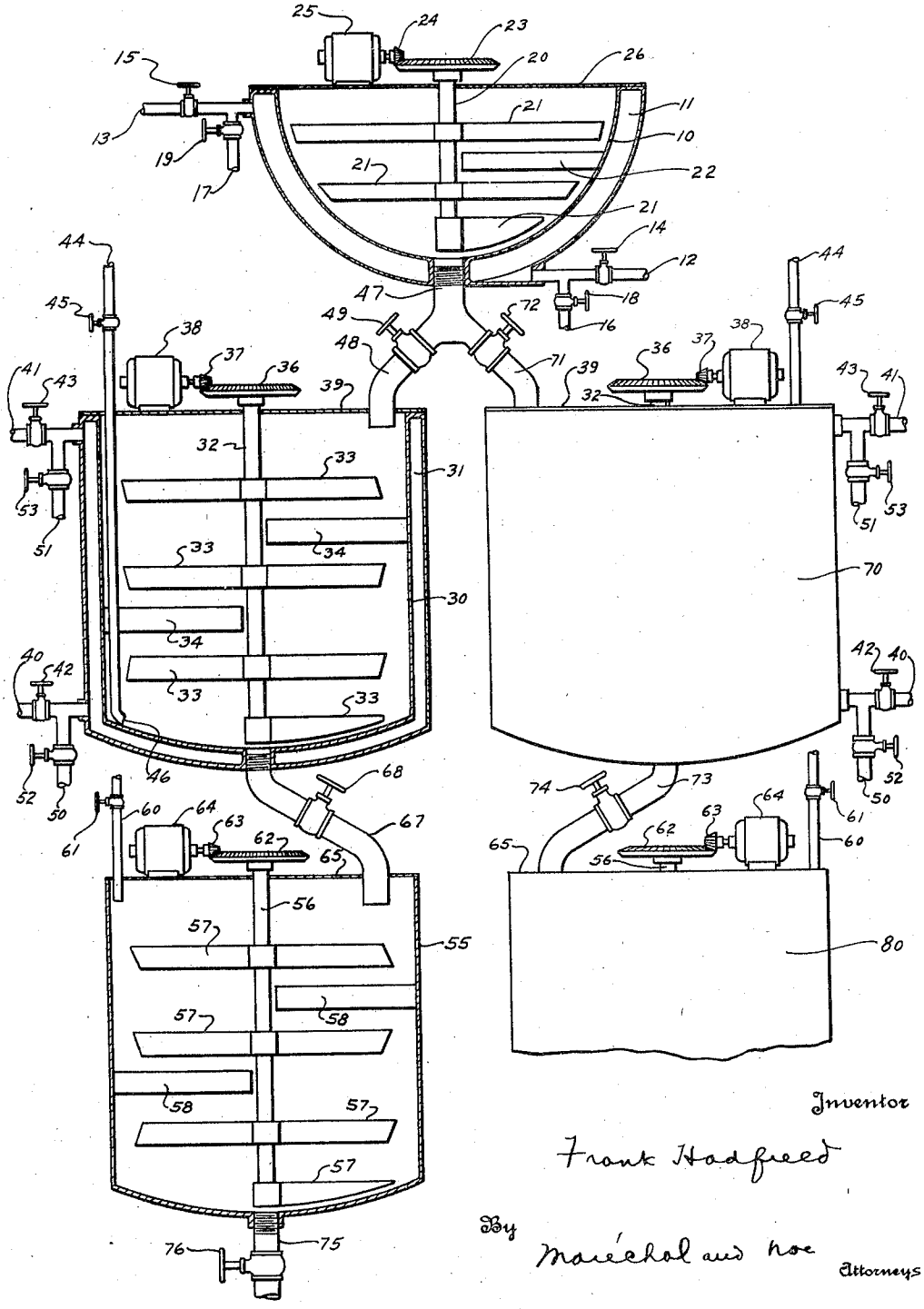
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PAPER MANUFACTURE

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PAPER MANUFACTURE

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1 Claim. (Cl. 91—68)

This invention relates to the manufacture of paper, and particularly to the manufacture of coated paper.

One of the principal objects of the invention is to provide a method of preparing a coated paper having a superior surface which is suitable for offset printing, which method is economical and effective in operation, and is simple and easily controlled.

Still another object of the invention is to provide a superior coated paper having a surface coating sized with a mixed starch-casein size.

Another object of the invention is to provide a method of preparing a mixed starch-casein sizing solution, and of preparing a coating composition containing such a sizing solution.

Still another object of the invention is to provide apparatus for carrying out the above method and for forming the above product.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing and appended claim.

In the drawing, in which a preferred embodiment of apparatus is illustrated, the single figure is an elevational view, partially diagrammatic and partly in section, of apparatus constructed in accordance with this invention.

According to this invention, the uncoated paper or raw stock as received from the paper machine is given a surface coating with a coating composition containing a mixed starch-casein size. It has heretofore been quite the common practice in the coating of paper to employ casein as a size for binding the filler and other ingredients of the coating composition effectively on the surface of the paper sheet. It is well recognized that a highly effective size is necessary for surface coating work,—that is, a size which has more binding power than is ordinarily necessary for use in binding the fibers together in the body of the paper as formed. Especially is this so in the case of printing paper, where the mineral filler and other ingredients are apt to "pick off" or become dislodged during the printing operation. Starch of itself does not possess sufficient binding power to hold the mineral filler effectively on the surface of a sheet for coated paper used in high grade printing work in magazine and book grade. Casein has been considered superior to starch for coating work, because of the high binding power of casein and because casein sized coated paper is practically damp proof and therefore can be used where the humidity is high without undue cockling or curling of the sheet.

The cost of casein is relatively high,—in fact more than double the cost of a good quality of starch. It is therefore desirable from the economical aspect to use a cheaper size, such as starch, along with casein. The mixing of starch and casein in a coating color for the coating of magazine and book grades of paper has not been heretofore practical in economical commercial operation, as an objectionable reaction readily takes place in the sizing solution or coating mixture which renders the resultant product practically worthless for coating work. The present invention provides a method whereby starch may be incorporated with casein in controlled proportions to form a mixed starch-casein size while maintaining the solution properties of the same, and to permit the incorporation of this mixed starch-casein size with a filler suspension to provide a coating mixture suitable for the production of a superior coated paper which is sufficiently damp proof and in which the filler and other ingredients are effectively held on the surface of the sheet for various kinds of printing, including magazine, book and offset printing.

Referring to the drawing, a casein solution tank is indicated at 10, this tank having a jacket 11 with suitable inlet and outlet connections 12 and 13 having therein control valves 14 and 15 respectively for the introduction of steam into the jacket in order to heat the contents of the tank 10. The jacket 11 is also provided with inlet and outlet connections 16 and 17 provided with valves 18 and 19 respectively for the introduction of a cooling medium such as cold water into the jacket. A central vertical shaft 20 mounted in suitable bearings carries agitating paddles 21 which cooperate with suitable baffles 22 protruding from the wall of the tank intermediate the paddles 21 to permit an effective agitation of the contents of the tank. The upper end of the shaft 20 is provided with a bevel gear 23 meshing with a bevel pinion 24 carried on the extended end of an armature shaft of a motor 25 seating on the cover 26 of the tank.

In the preparation of the casein solution, the tank 10 is supplied with the desired amount of cold or tepid water, generally water at a temperature about 32° F. to 80° F. being satisfactory. A predetermined amount of casein is then added to the tank during agitation of the contents. This preliminary treatment in cold or tepid water serves to swell the grains and makes them more receptive for the alkali which is later added. It is desirable not to add water at a temperature materially higher than 80° F. at first,

as a partial cooking of the outside of the granules is apt to result at higher temperatures, and a lumpy mixture may result. A solution containing from about six parts of water to one part of casein by weight up to about twelve parts of water to one of casein gives a satisfactory solution which will blend well with the starch solution which is separately prepared, while at the same time undue dilution is avoided. After the casein has been allowed to stand in the cold or tepid water for about five minutes with agitation, then an alkaline material, such as sodium carbonate, sodium hydroxide, borax, or other similar alkaline compound, is added. Sodium carbonate is preferred for this purpose, and is preferably first made up into a solution containing about three parts of water to one part of sodium carbonate by weight. Sufficient alkaline solution is added to the casein mix to effect the solution of the casein. When sodium carbonate is used, about 12% to 15% of Na_2CO_3 on the dry weight of the casein gives satisfactory results. The mixture is then heated with agitation until solution is effected. Accurate control of the heating, while avoiding unduly high temperatures or direct steam injection which is injurious, is obtained by means of the heating jacket with valve controlled steam connections. The mixture is not heated above 172° F., as above this temperature the binding properties of the casein are apt to be deleteriously affected. However, below 150° F. it is difficult and requires a long time to effect solution of the casein. Consequently it is preferred to heat the solution between 168° F. and 172° F., within which temperature range a satisfactory clear solution is obtained in about thirty minutes with effective agitation.

A starch solution tank **30** having an exterior jacket **31** is also provided with a central vertical shaft **32** containing suitable agitating paddles **33** cooperating with stationary baffles **34** fixed to the wall of the tank **30**. The shaft **32** is provided with a bevel gear **36** meshing with a bevel pinion **37** carried by the armature shaft of a motor **38** seating on the cover **39** of the starch solution tank. Inlet and outlet connections **40** and **41** having control valves **42** and **43** respectively are provided for introducing a cooling medium into the jacket **31** of the starch solution tank. A steam supply pipe **44** having a control valve **45** extends down into the interior of the tank **30**, and opens into the interior thereof as indicated at **46** in order to introduce steam directly into the contents of the tank **30** for heating purposes, direct steam injection not being injurious to the starch.

The starch to be dissolved is added to a measured quantity of cold water with agitation. A modified or oxidized starch, or one which is rendered readily soluble and free flowing, and which forms what is termed "a thin boiling" solution, is used. The starch-water mixture is then heated up by the direct injection of steam to a temperature above 170° F., preferably approaching the boiling point in order to obtain quick solution. About one part by weight of starch to three to six parts by weight of water gives a satisfactory thin boiling solution while avoiding undue dilution. Preferably about one part of starch to four parts of water by weight is used. Continuous agitation at high temperatures effects rapid dissolving of the modified starch. With certain modified viscous starches having an acid reaction, so-called acid gums, improved results are obtained by the addition to the gum of a small amount, such as about ½% by weight, of an alkaline material such as borax, soda ash and the like, giving a better mixing and more adhesive gum solution. This alkali is preferably added to the cold water in which the starch is to be dissolved, prior to the cooking or heating thereof.

The casein solution is then mixed with the starch solution with agitation. The casein solution can be flowed into the starch solution, or vice versa, this depending upon the relative proportions of the ingredients. Thus, when a relatively large proportion of starch is used with reference to casein, the latter is flowed into the starch solution. For this purpose, the casein tank **10** is preferably positioned at a higher elevation than the starch solution tank **30**, and is provided with a bottom outlet **47** connected by a gravity feed pipe **48** having a control valve **49** with the upper portion of the starch solution tank **30**. In order to avoid injuring the binding properties of the casein, particularly where using more starch than casein, the starch solution which has been previously heated up to about 200° F. or above to effect solution is then quickly cooled by introducing a cooling medium into the jacket **31**. The temperature of the starch solution is preferably brought down to approximately that of the casein solution, so that the two solutions are mixed when at approximately the same temperature. A temperature range of about 150° F. to 172° F. gives satisfactory results for the mixing of these solutions, a temperature approaching 170° F. being preferred. The temperature is kept high enough to avoid objectionable thickening and bad blending, while at the same time the temperature is maintained below that which will injure the binding properties of the casein. It is to be noted that one solution is flowed slowly with agitation into the other solution under controlled temperature conditions, which is found to permit in practical operation the effective mixing of these solutions while maintaining the solution properties thereof.

Satisfactory results are secured with mixtures of various proportions when prepared in accordance with this invention. A sizing composition containing as little as 10% by weight of casein together with 90% by weight of starch has been used in actual commercial operations with very satisfactory results. The mixed starch-casein solution is then cooled further by the introduction of cooling water into the jacket **31** preparatory to the mixing of the size solution with a water suspension of filler, particularly where fillers other than clay are used. For this purpose, branch pipes **50** and **51** having control valves **52** and **53** respectively are preferably provided for introducing a cooling medium, such as cold water, into jacket **31** of tank **30**. Of course, where time and storage conditions permit, atmospheric cooling may be used.

The filler suspension of the coating composition may be prepared in any conventional manner. As illustrated, a filler suspension tank **55** is provided with a central shaft **56** carrying stirring blades **57** which cooperate with baffles **58** carried by the wall of the tank in securing an effective mixing of the filler and suspension liquid such as water which is added thereto by the pipe **60** having the control valve **61**. The agitator is driven by means of cooperating bevel gears **62** and **63** from a motor **64** seating on the cover **65** of the tank.

A measured quantity of filler is added to the tank 55, and then a proportioned quantity of water is introduced by the pipe 60 in order to make a suspension of the desired consistency depending on the weight of coat required. The usual fillers may be used; clay, satin white, blanc fixe, and carbonate fillers are preferred for the coating of printing paper such as book or magazine paper. The starch-casein solution having been cooled down to a temperature preferably below 140° F. by the introduction of cooling medium into the jacket 31 is then allowed to flow slowly through the outlet 67 controlled by valve 68 into the filler suspension tank 55, while the filler suspension is being agitated. By the addition of the size slowly and at a fairly constant temperature, a satisfactory mixing of the size and filler suspension without objectionable thickening or coagulation is secured. When sufficient size making and storage facilities are available, it is desirable to cool the sizing solution to temperatures as low as 70° F. before introduction into the filler suspension, thereby obtaining increased sizing efficiency. The sizing solution is stirred during the cooling thereof.

The proportions of mineral filler to size may be varied depending upon the character of paper required. Satisfactory results for printing paper are secured by using about 70% to 85% by weight of mineral filler to 15% to 30% by weight of mixed starch-casein size. Very satisfactory results have been secured in commercial operation with a coating mixture containing by weight approximately 72% to 77% of filler such as clay, satin white, or carbonate filler, 20% to 25% of mixed starch-casein size, the balance being alkali, foam oil and other ingredients customarily used in coating mixtures. A mixture of filler is preferably used, such as about one part by weight of satin white to three parts by weight of a carbonate filler, such as a precipitated calcium carbonate, this giving a coated paper with a high finish.

In order to obtain a substantially continuous operation for continuous coating work, a plurality of starch solution tanks are provided. A second starch solution tank is illustrated in the accompanying drawing at 70 having a gravity feed pipe 71 controlled by a valve 72 for the supply of casein solution from the casein tank 10 thereto. The tank 70 is constructed similarly to the tank 30, so that further detailed illustration and description is unnecessary. A considerable quantity of casein solution may be initially made up in the tank 10 and maintained at the desired temperature range by means of the jacket 11. A batch of starch solution may be made up in one of the tanks 30 or 70, while the casein solution is being allowed to flow slowly from the tank 10 into the other starch solution tank containing a previously prepared starch solution maintained at the desired temperature for mixing. The mixture after agitation and cooling may then be flowed into the filler suspension tank 55, and a fresh supply of starch and water then added to the starch solution tank for the preparation of a fresh batch, while additional casein solution is being allowed to flow slowly from the tank 10 into the other starch solution tank 70. Additional filler suspension tanks, such as the tank indicated at 80, may also be used depending upon the requirements of the installation. The starch solution tank 70 is connected by a feed pipe 73 having control valve 74 with the filler suspension tank 80. Each filler suspension tank is provided with a bottom outlet 75 controlled by a valve 76 for supplying the coating mixture to the coating machine.

Heretofore it has been the general practice to employ a special sizing treatment for paper in order to prepare it for offset printing, in which method of printing the paper comes in contact with a water dampened rubber blanket. Coated paper may be prepared in accordance with the present invention which is very satisfactory for offset printing, without employing such a special sizing treatment. Where a coated paper for offset printing is desired, the coating composition is prepared as outlined above, except that a coating composition which is substantially neutral in reaction is used to provide a coated paper having a substantially neutral surface, which gives no deleterious acid or alkali effects upon being dampened in offset printing. This neutral reaction is obtained by proper control of the solution of the casein, by using ammonia to dissolve the casein in place of soda, soda ash or borax. The excess ammonia used in effecting solution is removed during the heating of the material, so that substantial neutrality of the material is obtained. A substantially neutral starch solution is likewise employed. Offset printing paper prepared in accordance with this invention is also free from any objection due to "greasing", which is the term applied in the printing industry where portions of the cylinder of the printing press other than the printing plate are affected by some chemical in the paper coating, causing the surrounding portion of the print to be smeared with ink.

Material economy is effected by the use of the coating composition containing a substantial proportion of starch. The resulting starch-casein sized coated paper has a softer surface than a casein sized coated paper, and is superior for printing inasmuch as there is less wear upon the plates during the printing process and the surface of the paper has better ink affinity. The coated paper of the present invention is effectively damp proof.

While the forms of the invention herein described constitute preferred embodiments thereof, it is to be understood that the invention is not limited to these precise forms, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claim.

What is claimed is:

A coated paper adapted for printing and book paper, comprising a sheet having a surface coating containing approximately 70% to 85% by weight of a mineral filler including a major proportion of carbonate filler and a minor proportion of satin white, and approximately 30% to 15% by weight of a mixed starch-casein size containing approximately 90% starch and 10% casein.

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