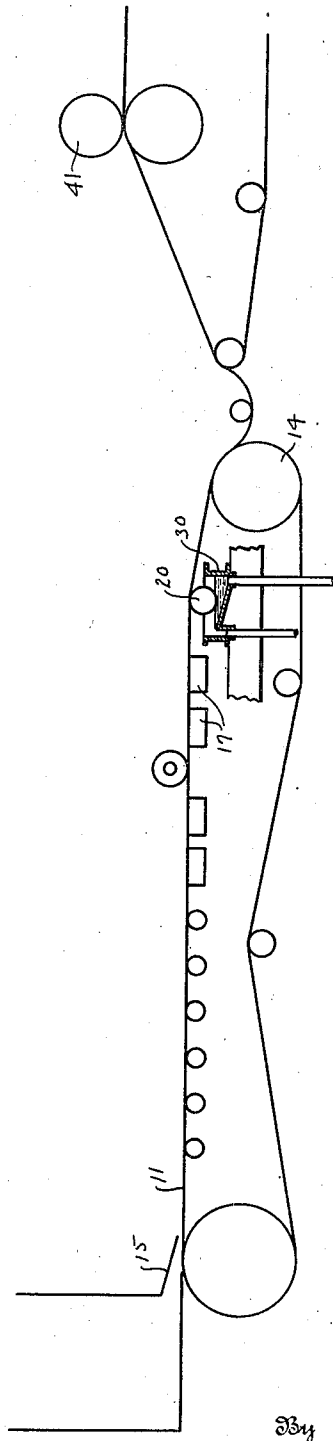


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PAPER MANUFACTURE

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This invention relates to the manufacture of paper.

One of the principal objects of the invention is to provide a method of forming a sheet of paper which comprises flowing a paper making fibrous stock lacking, or deficient in, mineral or filler material onto a forming wire to effect initial wet web formation and then adding mineral or filler material to the wire side of the wet web to incorporate the same on and into the wet web to produce upon the resulting sheet of paper characteristics of a sheet normally made by a different process.

Another object of the invention is to provide, in the manufacture of paper, for incorporating the preponderating part of mineral or filler material into and upon the paper web in course of manufacture, as a delayed paper making operation when the forming sheet has reached a predetermined initial wet web formation.

Still another object of the invention is to provide, in the manufacture of paper, for adding all, or substantially all, of the mineral or filler material by applying it to the wire side of the sheet after a predetermined wet web initial formation has been produced.

Still another object is to provide a sheet of paper initially formed from fibrous material abnormally deficient in mineral or filler material and having a dominant proportion of the mineral material incorporated into and upon the initially formed wet web as an integral part of the originally completed sheet of paper.

Still another object is to provide a sheet of paper initially formed from low grade unfilled stock deficient or lacking in filler or mineral material, and having one surface of the characteristics normally incident to such formation, and the other surface, secondarily formed by the incorporation of mineral or filler material into and upon the initially formed wet web, and having markedly different and superior characteristics, suitable for half-tone printing and the like.

Other objects and advantages will be apparent from the following description and the appended claims.

The present invention is a development upon the invention disclosed in the patent to William S. Bair, 1,875,208, assigned to the assignee of this present application. For descriptive purposes, the invention is set out by way of description of a preferred embodiment which has actually been used in commercial manufacture to produce a totally new commercial paper. Under such practicing of the invention use is made of so-called

ground wood pulp, such as is ordinarily used in the manufacture of newsprint, low grade catalog paper, and the like. Ground wood pulp, as is well known, comprises, principally, material secured by grinding the pieces of wood against a stone. Because of its deficient felting characteristics such ground wood is ordinarily mixed with a considerable quantity of sulfite, or other chemical pulp, which serves as a binding to give the limited degree of strength needed in a finished sheet of this character. In making papers from such materials, the fibrous stock is deficient in mineral or filler material, as compared with other fibrous stock furnishes used for making sheets of higher characteristics. For example, in making newsprint out of ground wood ordinarily no filler or other mineral loading materials are added. Other grades of paper are made utilizing substantial quantities of ground wood pulp, in which mineral or filler material is added to the stock to produce a somewhat superior grade of paper, although even this paper is not comparable to the better grades of so-called book paper. The papers to which particular reference is made are those of low grade, such as used for printing newspapers, catalogs such as those of the large mail order houses, and the like. While papers of this character are suitable for low grade printing, and picture reproduction, they are not suitable for making better grade cuts and color reproductions; and by the practicing of this invention, a paper can be made from such low grade stock, in which one surface has comparatively much superior characteristics, being adaptable for the making of good cuts and color reproductions.

In practicing the present invention such fibrous material stock is flowed onto the forming wire in the usual manner with the resultant production of an initially formed wet web of paper. As the forming paper web moves up to the regular suction box zone, it gives the appearance of a pool or sheet of water suspension, but as the wire moves along and the suction boxes act upon the forming web, the water sheen or glitter disappears as more water is removed and the sheet assumes the initial wet web formation. At such time it has generally the appearance of damp or moderately wet sheet of newspaper. In the formation of a sheet from fibrous stock there is a rush or escape of water downwardly through the wire with consequent washing out from the forming fibrous stock suspension of a large proportion of the mineral or filler material, if any is included in the stock originally; and the resulting sheet

would be abnormally free from filler or mineral material on the wire side. This escape or washing out of the mineral material varies somewhat as the freeness of the stock varies; and when no filler, or an abnormally small amount thereof, is included in the original stock the resulting web will be comparatively quite porous. Furthermore there is a depositing of the coarser or larger fibers on the wire first to form a filter mat which catches the remaining fibers, including those small enough to pass through the wire, and the filler material. The wire side is thus abnormally low or entirely devoid of filler. And also the table rolls, in operation, carry water up to flush the wire side of the forming web and further free it from mineral material. A sheet made from such stock without mineral or filler material originally added thereto would of course be unusually porous throughout. Such a sheet has a low ash content, of the order of 2% and any filler added according to this invention will change the characteristics of the wire side; but even if some of the ultimately included mineral or filler material is added in the original stock, the addition of a dominant or preponderating proportion of such mineral material as in this invention will impart characteristics to the additive side of the sheet which are markedly different from those which would normally attend upon the use of an original fibrous stock material not deficient in mineral material in such large measure. As the forming web reaches this initial wet web formation state, the sheet has assumed its initial and definite formation and a large part of the original water of the stock has been removed. The percentage of water still remaining in the initially formed web will vary somewhat (depending on the character of the stock as to freeness, its inherent size, the speed of the wire, the mount of suction used, etc.) as well understood. But it may be said, generally, that the amount of water remaining at this zone has been so considerably reduced that the web at this stage has a high degree of water absorption capacity or receptivity. With a web processed to form a good grade of book paper, for example, such initially formed sheet or web as it leaves the suction box zone ordinarily will have about 81% to 86% of water. Also because the amount of filler in the sheet thus formed is relatively low, the web by comparison is relatively receptive for the incorporation and retention of additional paper forming material therein and thereupon. When the forming paper web has reached this initially formed and receptive state a suspension of mineral filler or paper making material is passed through the wire against the traveling web and will thus be introduced and incorporated into and upon the paper web in a definite, delayed, paper making step. This additional paper forming material preferably comprises a mineral filler or coating material such as a finely divided clay or carbonate. Also a proper proportion of sizing material such as casein, starch or the like, is ordinarily used. The composition of the additive material will be varied to give the resultant effect desired.

In the referred to commercial practicing of the invention, the usual ground wood pulp is used for forming a sheet adaptable for use in mail order house catalogs. Such material is used for the main part of the catalog; but where color illustrations are needed grades of paper of the types known as book or coated paper are ordinarily used. In this commercial operation this

invention is used to produce upon the wire side of the paper being manufactured, finished characteristics comparable to such usual papers, so that color reproductions can be made on such side. In securing this desired result, a suspension containing 6% of mineral or filler, such as a finely divided carbonate material, or coating clay with 5-7% of starch on the mineral has been satisfactorily utilized as the additive material. The starch can be of any suitable kind but satisfactory results have been secured where the starch used comprises 33% of a tapioca starch and 67% of corn starch. With such a suspension of additive material, and an initially formed wet web made from a ground wood containing stock of the character described, the finished sheet of paper, in operation, has received and retained approximately 2½% by weight of the mineral material desired for giving the other characteristics to the paper, which is the equivalent of about ¾ pounds per ream for 33 pound paper. Of course, the quantity of additive material may be varied to produce desired predetermined surface characteristics upon the wire side of the paper; and the quantity of mineral retained by the wet web can be regulated by variation in the water content of the wet web at the time of application, by the structural characteristic of the sheet as to its porosity, by the concentration of the additive suspension of filler or mineral material, and by the rate at which it is applied to the initially formed web.

Where working with an initial wet web formation substantially free from filler at the time of the application of the filler thereto, the additive material is incorporated into and upon the finished sheet; and by suitably controlling the proportioning and the rate of application of the additive suspension, a sheet may be produced which has characteristics, as to surface coating and as to filler, normally present in sheets of paper formed according to entirely different paper making processes and utilizing quite different original fibrous stock materials. When so added to an initially formed web made from a stock containing substantially no filler or mineral material, the finished sheet will have one surface substantially free of mineral material, and the other surface will have characteristics which, depending upon the consistency and material of the additive suspension, the rate of application, etc., will approximate those of a usual book paper, (a) made from a much better grade of fibrous material and having all of the filler material which is finally contained within the finished sheet included within the original stock flowed onto the forming wire, or (b) when formed as under the Bair patent invention, having all of the mineral material in the initially formed web included in the original stock as flowed onto the forming wire. By properly controlling operations the amount of mineral thus added may be made so substantial that the surface characteristics of the wire side may be greatly varied. For example with a ground wood containing stock which is entirely free from filler, or quite abnormally so as compared with an ordinary non-ground wood book furnish, so much filler may be added and retained upon the surface of the wire side as to impart thereto the appearance and printing characteristics of a book paper made in the usual way from a non-ground wood normal filler content stock, and even the characteristics of a lightly coated sheet can be secured, a final sheet having as much as 2½%, or more,

of the filler retained in and upon the surface of the wire side. Such a wire side surface as prepared according to this invention and having book paper surface characteristics, is satisfactory for half-tone work. In addition, the ground wood pulp, because of the presence of lignins and other original wood materials, is more opaque than sheets made by the other and usual processes to have the same weight and surface characteristics.

Various forms of apparatus may be used in carrying out the present invention; but the apparatus of the drawing, which is somewhat diagrammatically shown and which is the same as that disclosed in the above referred to Bair patent, has been satisfactorily used. In the practicing of the invention, the stock is flowed from the head box or inlet 15 onto the forming wire 11, with the resultant formation of the initial wet web, as the water escapes downwardly through the wire. Additional water is withdrawn within the suction box zone, the suction boxes being designated by the numeral 17. Positioned beyond the suction boxes is a guide roll 20 which dips into a supply of additive suspension material maintained within the trough 30. This additive suspension material, when of the composition specified above is successfully used with ground wood stock, but will be varied to give the desired addition of filler or coating characteristics. The guide roll carries the additive suspension up to and through the wire against the wire side of the formed web which is in a highly receptive state and it is there incorporated into and upon the wire side of the web. The amount incorporated into the web, and the amount which remains as a superficial surfacing layer will depend upon the composition of the additive suspension, the rate at which it is applied, the point of application, the character of the initially formed web, etc. Also other apparatus for applying the additive suspension may be used. For example, it may be applied to the lower of two squeeze rolls between which the paper passes, or to the lower roll of a pressure couch, or elsewhere within the range of the initially formed wet web characteristics.

After the additive material has been thus applied, the initially formed web passes over the couch 14, which is shown as of the usual suction type; or it can be passed through a press couch, and then passed through the usual presses 41 and dried, with subsequent calendering if desired, to produce the completed paper, with such surface finish upon the sheet, or the superficial coating thereon, as would result from this processing.

While the product and the apparatus and method for producing it, herein described, constitute preferred embodiments of the invention it is to be understood that the invention is not limited thereto, and that changes may be made therein without departing from the scope of the invention as particularly pointed out.

What is claimed is:

1. The method in the forming of a sheet of paper to have predetermined surface characteristics upon the wire side which comprises flowing onto a forming wire a fibrous stock deficient in mineral material for producing said desired ultimate surface characteristics upon the wire side, effecting initial formation of the paper web, and adding mineral material in a suspension through the wire to said formed web which is deficient in mineral material to major degree, prior to completion of formation of said web and while said web is wet and in receptive condition, to incor-

porate a dominant amount of mineral material upon the wire side of said web to produce in the wire side of the finished sheet of paper characteristics of controlled kind differing from those which would have resulted from completion of the manufacture of the paper without such dominant addition and comparable to those present in a sheet of paper ordinarily formed from fibrous stock having the preponderating proportion of mineral material normally included in the original stock.

2. The method in the forming of a sheet of paper which comprises flowing a suspension of fibrous material substantially free of or deficient in filler onto a forming wire, effecting an initial definite web formation, and adding to the wire side of the web prior to completion of formation of said web and while said web is wet in its initially formed receptive state additional mineral material to produce on said side only the characteristics of a sheet normally made from a stock comprising fibrous material and filler in proportions normally used to secure predetermined surface characteristics.

3. The method in the forming of a sheet of paper which comprises flowing onto a forming wire a stock of such character that without the addition of other material the finished sheet would have an ash content of the order of 2%, effecting a preliminary definite wet web formation, and adding mineral filler to the wire side of said web while wet in its initially formed receptive state as a definite paper making step to incorporate added mineral filler into and upon said side only of the sheet to provide characteristics therein of a filled paper sheet having an ash content materially in excess of 2%.

4. A method in the forming of a sheet of paper having predetermined surface characteristics which comprises flowing onto a forming wire a fibrous stock having the amount of mineral material therein limited to a predetermined subnormal low proportion on the dry weight of the fibers in said stock, said amount being materially less than that normally contained within a finished sheet of the surface characteristics desired, effecting initial formation of the paper web, and adding mineral material to said web while still in course of processing and while wet and in a receptive condition, said mineral material being added in a suspension and to the wire side of said web, to incorporate a predetermined additional substantial amount of mineral material upon the wire side only of the said web to incorporate into and upon the wire side a dominant amount of mineral material, the dominant amount of mineral thus added to the wire side being controlled to produce in the wire side of the finished sheet of paper characteristics of controlled kind differing from those which would normally have resulted from completion of manufacture of the paper without such dominant addition.

5. As a product of manufacture, a sheet of printing paper or the like having a body portion comprising substantial quantities of ground wood and deficient in mineral or filler material for the ultimate characteristics desired and having a substantial quantity of mineral or filler material incorporated upon one surface only thereof, whereby said last named surface has characteristics comparable to those present in a sheet of paper ordinarily formed from fibrous stock and having the preponderating proportion of mineral material included in the original stock.

6. As a product of manufacture, a sheet of paper having a body portion comprising a web of fibrous material, a substantial proportion of said fibrous material being ground wood, said web containing a predetermined limited amount of mineral or filler material incorporated therein by addition to the fibrous stock before said web is formed, and having a dominant quantity of mineral material incorporated upon and penetrating into one surface thereof during the manufacturing process, whereby said last named surface has surface characteristics of controlled kind differing materially from the characteristics which would have resulted from completion of the process of manufacture of the paper without such dominant addition thereto.

7. As a product of manufacture, a coated sheet of paper having a body portion comprising a web of fibrous material, containing a preponderance of ground wood, and having a substantial quantity of finely divided mineral material incorporated in and upon one surface of said ground wood containing web while in course of processing into the finished sheet of paper and while wet and in receptive condition, the amount of mineral material thus incorporated being controlled to provide a light weight coating thereon.

8. As a product of manufacture, a sheet of paper having a body portion comprising a web of fibrous material, containing a preponderance of ground wood, and having a substantial quantity of finely divided mineral material incorporated upon and penetrating into one surface thereof while in course of processing into the finished sheet of paper and while wet and in receptive condition, the amount of mineral material thus incorporated being controlled to provide a light weight coating thereon, said coating as thus added comprising a surface zone and layer containing from 2-3 pounds per ream of finely divided mineral material.

9. As a product of manufacture, a sheet of paper having a body portion comprising a web of fibrous material containing a preponderance of ground wood, and having a dominating quantity of finely divided mineral material incorporated upon and penetrating in decreasing proportion into the wire side surface of said formed web while in course of processing into the finished sheet of paper and while wet and in receptive condition, the amount of mineral material thus incorporated being controlled to provide a predetermined weight of coating thereon, said coating as thus added to the ground wood containing formed web comprising a surface zone and layer of finely divided mineral material effective to impart thereto determined surface characteristics not normally attainable with a web composed of such fibrous material with body portion included mineral material.

10. The method in the formation of a sheet of paper, as a continuous paper making operation, to produce a formed sheet having the characteristics of a ground wood sheet on one side and the characteristics of a surface impregnated book paper on the other side, which comprises flowing a ground wood fibrous paper making stock onto

a forming wire, permitting the flow of water through said forming wire to effect formation of a ground wood paper web and to carry away through the wire part of the finer material in said stock to leave the wire side of said web deficient or substantially devoid of included mineral material distributed therein, and thereafter bringing a suspension of mineral filler material into incorporating contact with the wire side of said moving formed web to incorporate and retain in the wire side surface only a dominant quantity of such mineral sufficient to give a dominant and controlling quantity of mineral in excess of 2% of the dry weight of the paper.

11. The method in the formation of a sheet of paper, as a continuous paper making operation, to produce a formed sheet having predetermined unusual surface characteristics controlled by unusual quantity and distribution of mineral material therein, which comprises flowing a fibrous paper making stock having a limited quantity of mineral filler material therein, permitting the flow of water through said forming wire to effect formation of the paper web and to carry away a major proportion of said mineral material from the wire side of said forming web, and thereafter incorporating a dominant amount of mineral into said wire side of the web to add a major and surface controlling amount of said mineral distributed in and upon said wire side only.

12. As a new product of manufacture, a sheet of paper formed as a continuous operation and having a fibrous body portion of ground wood fibrous material, and a dominant quantity of mineral filler material incorporated primarily in the wire side surface of said ground wood sheet and uniformly distributed therein to impart to said surface printing characteristics substantially equivalent to a light weight coated book paper.

13. As a product of manufacture, a sheet of paper having a body portion comprising a web of fibrous material substantially free of or deficient in filler, and having upon one surface thereof a light weight coating of finely divided mineral material, said coating penetrating in decreasing proportion into the body portion of the web from said surface, the opposite surface being substantially free of said finely divided mineral material, and said sheet having the characteristics of having the finely divided mineral material incorporated thereupon while wet and on the wire side thereof.

14. As a product of manufacture, a sheet of paper having a body portion comprising a web of fibrous material substantially free of or deficient in filler, and having upon one surface thereof a light weight coating containing up to approximately 6% of finely divided mineral material, said coating penetrating in decreasing proportion into the body portion of the web from said surface, the opposite surface being substantially free of said finely divided mineral material, and said sheet having the characteristics of having the finely divided mineral material incorporated thereupon while wet and on the wire side thereof.

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