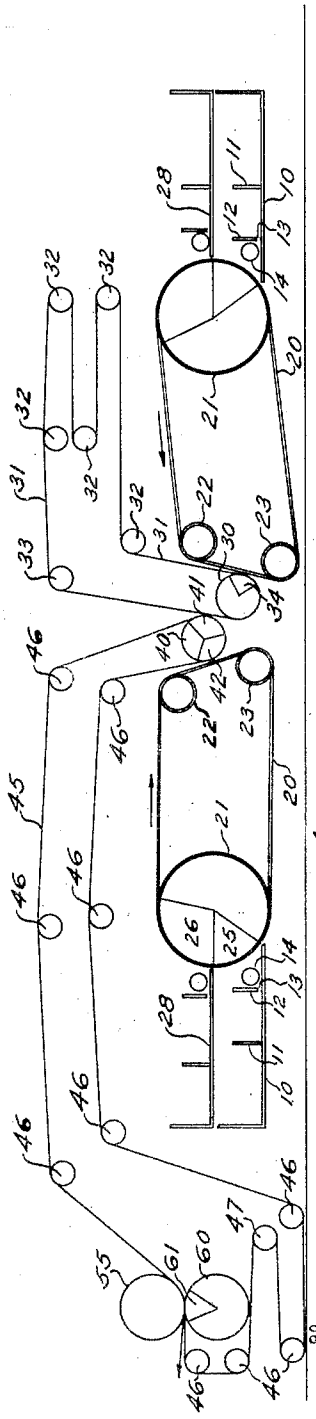
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METHOD OF AND APPARATUS FOR MANUFACTURING PAPER

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METHOD OF AND APPARATUS FOR MANUFACTURING PAPER.

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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 paper which is effective in producing a formed sheet or web of paper of hitherto unknown and superior characteristics.

Another object of the invention is to provide a method of forming a paper sheet having an improved and superior surface as it comes directly from the forming machine which makes for a correspondingly improved or superior surface in the final product after calendering or other treatment.

Another object of the invention is to provide apparatus for carrying out such method, which is also adapted for greater efficiency and economy in operation.

Other objects and advantages of the invention will be apparent from the accompanying drawing and the description set out below.

The drawing illustrates a diagrammatic elevation of a preferred embodiment of a paper-forming machine adapted for carrying out the method of this invention.

In the manufacture of paper it is the general practice to flow paper-forming "stock" onto a traveling wire. This stock comprises pulp made from the separated fibers of wood or the like suspended in water. Admixed as constituents of the stock finely-divided clay or the like known as "filler" may be used and also other constituents,—as well understood. As the stock is flowed onto this traveling wire the water of the stock escapes through the wire. In conventional practice the wire is made of considerable length, the length depending upon the rate of travel, so as to provide a sufficient time element to permit the escape of the desired quantity of water from the stock before the formed web is removed from the wire and subjected to subsequent treatment such as pressing, drying, calendering, and the like.

A considerable proportion of the water of the stock which escapes through the wire, probably as much as ninety per cent (90%), flows through the wire in the first few feet of travel, the remainder of the water which escapes through the wire escaping therethrough during the remaining distance of travel. In this first few feet of travel of the wire there is quite a rush of water therethrough and concomitantly some of the finely-divided filler and the like, and the very fine or short fibers tend to flow away with the water. But the longer fibers and larger particles of filler and the like are stopped by the wire and deposited thereon as the initial web or sheet of paper. This initial web or sheet of paper which is formed constitutes in effect a filter sheet or mat which, when compared to the wire, is quite dense and therefore tremendously slows down the subsequent flow of water through it.

The method which forms this invention takes advantage of such formation of a filter mat. In carrying out this method the stock is flowed onto the wire in two stages. The bulk of the stock is first delivered upon the wire, the greater part of the water escaping therefrom during the initial formation zone; and after the web or mat of paper is thus formed on the wire an additional supply of stock, preferably of rather particular character, is flowed onto this formed mat. The stock which is initially flowed on may be of any conventional character. In fact it may be of poor character when judged by present known standards and in comparison with the desired characteristics of the finished paper which is being made. It may be not at all capable of forming a finished paper of the desired quality. But the stock which is flowed on thereafter is of suitable high grade and when incorporated on the filler mat as a surface layer will impart to the finished sheet the desired characteristics irrespective of the character of the material underlying it. In making so-called "book" paper, for example, the stock which is flowed on in the second stage preferably consists of fine small fibers, very finely-divided filler material, etc. Inasmuch as this second supply of stock is flowed over the previously-formed web or mat of paper, and during subsequent travel of the wire is bonded therewith into an integral sheet, the character of the original web or mat is of little importance so long as it has sufficient strength. For the additional quantity of stock which is flowed on will spread out over the initially formed web or mat of paper and form a surface layer therefor which is of very fine quality, and has very smooth and desirable surface characteristics. By varying the character of this second supply of stock which is flowed on, in the second stage, to the previously-formed web or mat the final character of the paper may be controlled as desired.

Obviously many forms of machines might be constructed for carrying out this method; but the machine shown in the drawing constitutes a very satisfactory and simple form of mechanism which is not only adapted for an efficient and economical practical carrying-out of the method; but also is peculiarly advantageous in that it permits of forming a sheet of paper which is composed of two component sheets each formed according to this method, and so combined that the resulting composite sheet has both its outer surfaces of the superior characteristics which result from the formation of a web of paper according to this method. Such a paper is entirely free from "two-sidedness".

In this illustrated form of apparatus the initial paper-forming stock, including such filler, and other usual constituents, as desired, is flowed simultaneously upon two "wet end" forming parts respectively designated, generally, by the letters "A" and "B." As shown these two forming parts are oppositely arranged. That is, they are positioned in general alignment with their respective delivery ends—the ends which correspond to the couch roll end of a conventional Fourdrinier machine, and from which the formed wet web of paper is removed from the forming wire—adjacent each other; while their respective inlet ends—the ends at which the stock is delivered or flowed onto the forming wires—are spaced apart. Except for such mechanical changes and rearrangement of parts as are incidental to one of the forming parts being "left handed" while the other is "right handed" these two wet ends are similar in construction and operation.

Each of these wet ends comprises an initial flow box 10 to which stock is supplied in any suitable conventional manner. Satisfactory results may be secured with the type of flow box shown. The stock is delivered to each of these initial flow boxes back of the partition 11 and overflows that partition into the space back of the slice 12. This slice is adjustably mounted so that the extent of the "inlet opening" 13 may be varied to meet varying operating conditions. An agitator 14 which is shown as comprising a perforated roll, of known type, is associated with the inlet opening to stir up the stock and maintain uniform distribution of the fiber and filler as the stock is flowed onto the wire. This agitator is driven in suitable manner from the driving mechanism of the forming part, as is well known in the art.

The stock flowing from the inlet orifice is delivered onto an endless wire, of the usual characteristics found in wires for paper making, so far as concerns mesh, the material of which it is made, etc. This stock is so controlled as to character, and as to amount delivered onto the wire, as to produce the body portion or filter mat above referred to; and after this initial formation the additional stock is flowed on, as described below. In the apparatus as shown, the wire is very much shorter than the wires used on conventional Fourdrinier parts. For, by subjecting the stock upon the wire to suction, as it is flowed onto the wire, the rate of escape of water through the wire in the initial forming zone can be materially increased. In fact, in the apparatus shown herein, as large, or even a larger, percentage of the water in the stock may be withdrawn as the stock travels on the wire through a suction zone of a comparatively few inches, as will be withdran in the conventional Fourdrinier machine having a wire of a length of many feet.

The total length of the wire may therefore be cut down to very small proportions. In Fig. 1 is shown a forming wire, with associated suction means, of the character generally described just above. This wire 20, as shown, has an overall length of approximately eighteen feet, but this particular length is not an essential; though a short length wire is desirable from the viewpoint of low original cost, low operating cost, and low maintenance cost. It is supported upon, and travels over, a suction roll 21—which in its location, and part of its function, corresponds to the conventional breast roll as used in the usual Fourdrinier type machine—and two supporting and guide rolls 22 and 23. These guide rolls serve substantially the same function as the conventional couch roll, guiding and supporting the wire, and being located in that zone of the wire from which the formed web of paper is picked off or removed from its wire. Preferably these two rolls are spaced apart a distance corresponding generally to the diameter of the roll 21. This construction is not essential, and if desired one roll at the delivery end may be used, or a plurality of rolls as desired. The primary function and purpose of these rolls is to support and guide the wire. It is desirable, however, to use two rolls which are adjustable with respect to each other so that the tension of the wire may be adjusted as desired. The particular means for adjustably mounting these rolls is not shown, since any suitable mechanism of types well known in the paper-making industry may be used for this purpose.

The roll 21 is a suction roll. It is preferably a hollow drum, the surface of which is perforated to permit the ready flow of water therethrough. Located inside of the roll, and in fixed position are two suction boxes 25 and 26. The suction boxes are so located within the roll 21 that the stock flowed onto the wire from the inlet opening is delivered onto the wire within the suction zone. Preferably two suction boxes are used, although of course one box could be used if desired. The first of these suction boxes, that designated at 25, which is located beneath the ini-

tial or fire-stage delivery zone of the stock is under lower vacuum than the other box 26, which is located beneath what may be called the secondary portion or stage of the paper-forming zone. As the initial stock is flowed onto the wire the water of the stock flows very readily through the wire, and considerable acceleration of this flow is secured with a comparatively low vacuum. But as the water escapes in this initial suction zone a mat of fiber builds up on the wire which acts as a filter mat and cuts down the rate of flow, and in the second suction zone therefore the forming paper web is subjected to increased suction, due to increased vacuum, to cause removal of the water at the desired rate.

As this filter mat is formed in the initial forming zone, a secondary supply of stock is flowed thereon, the escape of water from the stock through the filter mat being facilitated by the higher vacuum existing in the second suction box. But because of the resistance of the filter mat to the flow of water therethrough, the rapidity of flow is less than in the initial forming zone, even under the effect of the higher vacuum. And preferably this secondary stock is of better character than the stock in the initial flow box. In the manufacture of book paper, for example, this stock may comprise primarily a mixture of filler, short fine fibers, with perhaps some size and like materials, which mixture may for convenience be called a surface mixture. This secondary stock, or surface mixture, is supplied in any suitable manner to the secondary flow box 28, which is positioned to deliver the secondary stock upon the filter mat on the wire, after the filter mat has been suitably formed, and which is the same in construction as the initial flow box 10. If this method were being carried out on a conventional Fourdrinier machine, this secondary stock should be delivered onto the mat upon the wire at the termination of the initial forming zone. In the form of apparatus shown herein, wherein the initial forming zone is of decreased extent due to the more rapid withdrawal of the water of the stock through the wire, the secondary stock will be delivered onto the web at a considerably less distance from the point of delivery of the initial forming stock to the wire than would be the case with a conventional Fourdrinier type of machine,—but still at about the termination of the initial forming zone. That is to say, whatever type of machine may be used for carrying out this method the point of delivery of the secondary forming stock, or surfacing material, will depend upon the character of the initial web of paper, and not upon any arbitrary distance from the inlet of the initial flow box. The secondary stock should preferably be delivered upon the filter mat when that mat has reached a condition of such characteristics that it will sustain the secondary stock thereon somewhat as a pool so that the escape of the water of the secondary stock will be substantially uniform and the finely-divided material of the secondary stock will be uniformly distributed as a surface material of high quality, of fine texture, and of smooth finish.

In the apparatus as shown the secondary flow box is located to deliver the secondary stock upon the filter mat at substantially the beginning of the zone of higher vacuum. In this apparatus the entire suction zone of the roll 20 has a surface extent of some thirty-five inches, although this may be varied as needed to meet varying conditions. And the initial forming zone has an extent of approximately ten inches.

In the secondary forming zone the suction which tends to draw the water through the filter mat also tends to draw the surface material down into the interstices of the body portion of the web or filter mat and to thus bond the materials of the two stages of stock together to incorporate them into an integral sheet.

When the stock is initially flowed onto the wire in the ordinary Fourdrinier machine, the finer material of the stock, such as the finely-divided filler, fine and short fibers, etc., tend to flow through the wire without being stopped. By the use of suitable filter mechanisms, this finely-divided material may be recovered from the waste or "pan" water and this recovered material functions very satisfactorily as constituents for the secondary stock, or surfacing material. Of course any suitable material may be used, but this recovered material is of fine character and tends to give an exceptionally good surface to the paper, a surface finish which makes the paper far superior to any papers of the character heretofore made.

The precise construction of the roll 21, and of the suction boxes 25 and 26 are not shown in detail, since they may be of the character shown and fully described in the patent to William H. Millspaugh, Reissue No. 13,100, reissued April 12, 1910; or of any other suitable known construction.

At the delivery end of each of the wet end portions A and B is a suction roll, the primary function of which is to pick the formed web of paper from the forming wire and deliver it onto a conveying belt of felt or the like. The direction of travel of the wires in the two wet ends A and B is opposite, the wire in the wet end A traveling in a clockwise direction, as indicated by the arrow, and the wire in the wet end B traveling in a counter-clockwise direction as indicated by the arrow. These directions of travel may be varied with suitable variations in the cooperating parts. The suction roll cooperating with the delivery end of the wet end B is designated by the numeral 30. It too may be of the general

construction shown in the above designated Millspaugh patent. This roll has passing thereover an endless felt belt 31, of the conventional character used in paper machinery, which belt is supported by a plurality of supporting and guide rolls 32; one of these supporting rolls being designated by the numeral 33, this particular roll being adjustably mounted. The adjustable mounting of the rolls 22 and 23 is such that the wire carried by those rolls may be held against the felt carried by the suction roll 30 with any desired operating pressure. Also, as shown these two rolls 22 and 23 are arranged with their axes in a plane inclined against the direction of travel of the wire,—as a result of which the wire passes over the roll which is located closer to the suction roll and at an obtuse angle, while passing over the other roll at an acute angle. Because of the rapidity with which the water may be withdrawn from the web of paper, in the suction zone of the rolls 21, high-speed production may be secured. And the speed of travel of the wire may be so great that there is a tendency for the web to jump off of the wire if its direction of travel is abruptly changed as the wire passes over the roll 22. By arranging the roll 22 so that the rapidity of change of direction is decreased this tendency is overcome.

The suction roll 30 is preferably positively driven at a speed which will give the felt 31 substantially the same rate of travel as the wire 20. The suction box 34 within the roll 30 is located so that the zone of contact of the felt carrier 31 and the wire 20 lies within the suction zone. As the wire carries the formed web of paper into this suction zone the paper is picked off of the wire and held against the felt carrier, and then travels along the felt carrier around the roll 30.

The suction roll 40, which is associated with the delivery end of the wet end portion A is similar in construction and operation to the suction roll 30, but is provided with two suction boxes 41 and 42. This roll also has a felt carrier or conveyor 45 traveling thereover, which is supported by suitable rolls 46, one of these rolls being designated by the numeral 47 and being preferably adjustable to vary the tension of the felt-carrier belt. As shown the felt carrier passing over the suction roll 40 is pressed into contact with the wire, or the web of formed paper on the wire 20 of the wet end portion A. It also is pressed into contact with the felt 31. One of the suction boxes of this roll 40, the one designated 41, provides a suction zone for the felt 31 while the other suction box 42 provides a suction zone for the wire 20 of the wet end portion A. As a result, during operation, the suction box 42 picks off of the wire of the wet end portion A the traveling formed sheet of paper, which travels around the suction box 40 with the wire face of the paper away from the suction roll. As this web of paper travels around the suction roll it passes in surface contact with the web of paper from the wet end portion B which is being carried by the felt 31, the wire face of this latter web of paper being also outwardly presented. As the two component webs of paper pass through the zone of contact of the suction roll 40 with the felt 31 they are pressed together, with the wire faces against each other to form a composite sheet in which the other two or non-wire faces form the final surface of the completed composite sheet of paper. This composite sheet of paper travels over the felt 45, in the direction of the arrow.

As stated above the roll 33 is made adjustable. This adjustment is with respect to both the suction roll 30 and the suction roll 40. With respect to the suction roll 30 adjustment of the roll 33 effects the tension of the felt. But of course this tension may be adjusted by making any of the other rolls 32 adjustable. With respect to the roll 40 the roll 33 is made adjustable so that the pressure of the felt 31 against the suction roll 40 may be varied to give desired operating conditions. It is to be noted also that direct contact of the suction rolls 30 and 40 with either of the rolls 22—23, or with each other, is avoided. As a result ordinarily accurate construction and adjustment of these rolls is all that is necessary as they bear against flexible wires or felts and not against rigid or unyielding parts.

Adjacent the delivery point from the felt 45 the sheet of paper passes between two press rolls 55 and 60. These rolls may be of any suitable conventional construction. Preferably, however, the upper roll 55 is a conventional press roll, while the lower roll 60 is a suction roll, of the type of the above Millspaugh patent. These two rolls exert pressure upon the paper and squeeze out of the paper some of the water which is still in it. This water which is expressed tends to collect in the nip and to unduly wet the paper at that point. By using the suction roll 60 which has the suction box 61 so positioned therein as to provide a suction zone adjacent this point of contact, this expressed water is removed. This suction roll has an additional function in that it prevents the web of paper lifting off of the carrier and following around the upper press roll as it has a tendency to sometimes do.

After the formed sheet of paper, which is now free from almost all of the moisture originally in the stock, passes through the press rolls it may be subjected to further pressing and is then picked off of the felt 45 in the conventional manner and thence passed through suitable drying mechanism, after which it may be given any additional treatment that may be desired, such as calendering, or super-

calendering. Either with or without such treatment it may be rolled for use, or it may be subsequently coated, or otherwise treated, to give any other desired characteristics.

However, as the paper is formed and travels through the mechanism described the two wire faces of the component webs are positioned together, inside the body of the final formed sheet, and the two surfaces presented in this composite sheet are identical, in that each outer surface constitutes the upper surface in the forming part, and constitutes the surface which has been in contact with the respective conveyor belts 31 and 45. These two surfaces therefore are exactly alike and so two-sidedness is not present.

Not only is two-sidedness not present in a paper manufactured according to this method, on the machine shown, but the character of this paper is far superior to that of any paper heretofore known. Paper made by this method, and subjected to the calendering which is usually used to produce so-called "machine-finish" paper, will be as good as or superior to what is now known as "super-calendered" paper. And paper made according to this method if super-calendered will be as good as or better than many grades of conventional coated paper. In this paragraph reference is made particularly to the paper known as book paper which is far superior in quality and finish to paper such as used in newspapers. Furthermore superior grades of paper for other uses may be likewise made.

Of course it is not necessary that this method be carried out upon a machine such as shown herein. But where two-sidedness is a detriment the machine shown herein lends itself very satisfactorily to the manufacture of paper which is free from two-sidedness. Where a paper with superior finish on only one side is desired this method may be readily practiced on a conventional fourdrinier, as explained above.

While the method herein described, and the form of apparatus for carrylng this method into effect, constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made in either without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In the manufacture of paper, the method of forming a web comprising the steps of first forming a filter mat of fibrous stock, and flowing onto the surface of the filter mat a suspension of filler, and short fibers.

2. In the manufacture of paper, the method of forming a web comprising the steps of first forming a filter mat of fibrous stock, and then flowing tray water onto the surface of the filter mat.

3. In the manufacture of paper, the method of forming a web comprising the steps of first forming a filter mat of fibrous stock, recovering filler and fibrous material from the resulting tray water, and then flowing onto the surface of the filter mat a suspension of such recovered filler and fibrous material.

4. In the manufacture of paper, the method of forming a web comprising the steps of flowing fibrous stock onto a traveling forming wire, applying suction to the wire throughout a zone adjacent the zone of delivery of said stock to the wire to form a fibrous filter mat with a short travel of the wire, then flowing a suspension of surfacing material on top of said fibrous filter mat while the same is still on the traveling wire, and applying suction throughout a zone adjacent the zone of delivery of said surfacing material to cause bonding of such surface material with the filter mat and the formation of the desired surface thereon.

5. In the manufacture of paper, the method of forming a composite web having the same surface characteristics on both sides thereof comprising the steps of forming a filter mat of fibrous material, flowing a suspension of fibrous material onto said filter mat to form a controlled surface thereon, simultaneously forming a second similar filter mat and flowing a suspension of fibrous material onto said filter mat to form a controlled surface on one side thereof, bringing these two webs into contact with each other so that the unsurfaced sides are put together, and uniting said webs.

6. In the manufacture of paper, the method of forming a composite web having the same surface characteristics on both sides thereof comprising the steps of first forming a filter mat of fibrous material on a traveling forming wire, then applying a surface layer of clay and short fibers to the top of said filter mat while the same is still on the wire, simultaneously forming a second filter mat of fibrous material on a second traveling forming wire and applying a similar coating to the top of said second filter mat while the same is on the wire, removing each component web from its wire and at the same time turning the wire side of each component web out, bringing the component webs into contact with each other so that the wire sides are put together, and uniting said webs to form a single composite web.

7. In the manufacture of paper, the method of forming a composite web having the same surface characteristics on both sides thereof comprising the steps of flowing a suspension of fibrous stock onto a traveling forming wire, applying suction to the wire throughout a zone adjacent the zone of delivery of said stock to the wire to form a fibrous filter mat on the wire, flowing surfacing material on top of said fibrous filter mat while the same is still on the traveling wire, applying suction to said surfaced web throughout a zone

adjacent the zone of delivery of said surfacing material to cause bonding thereof with the filter mat and the formation of the desired surface thereon, simultaneously forming a second similarly surfaced component web on a second traveling forming wire, removing each component web from its respective wire, bringing said component webs into contact with each other so that the wire sides are put together and uniting said webs.

8. In apparatus of the character described, the combination with a traveling forming wire; of two inlets in spaced relation feeding onto said wire to form a web of paper, and suction means for removing the formed web from the wire at the delivery end.

9. Apparatus of the character described, comprising a traveling wire, two inlets in spaced relation feeding onto said wire to form one component web, a second traveling wire disposed adjacent to the first wire, two inlets in spaced relation feeding onto said second wire to form a second component web, suction means for removing each component web from its respective wire, and suction means for uniting said component webs to form a single composite sheet.

10. In the manufacture of paper, the method of forming a web comprising the steps of first forming a filter mat of fibrous stock, on a traveling wire, a considerable portion of the length of which said wire travels in a substantially horizontal path, adding to the surface of the said filter mat suitable surfacing material, and maintaining suction on said resulting web of paper throughout the zone in advance of the horizontal portion of the traveling wire.

11. In apparatus of the character described, a rotary suction forming roll, a plurality of suction zones within said forming roll, an inlet for fibrous stock feeding onto said roll opposite a zone of suction to form a fibrous filter mat, and a second inlet for feeding a surfacing material onto said formed filter mat opposite a second suction zone, the degree of suction in said second suction zone being higher than in said first suction zone.

12. In the manufacture of paper, the method which comprises flowing a suspension of fibrous material in water onto a wire to form a filter mat, and thereafter flowing onto said filter mat a suspension of filler and the fibrous material escaping from said forming filter mat into the tray water.

13. In apparatus of the character described, a rotary-forming roll, a controlled suction zone therein extending throughout only a portion of the circumference of said rotary-forming roll, an inlet for flowing fibrous stock onto said rotary-forming roll at a zone which is under suction to form a fibrous filter mat, and a second inlet in spaced relation to said first inlet for flowing a surfacing material onto said fibrous filter mat while the same is still on the rotary-forming roll and under suction.

14. In apparatus of the character described, a rotary-forming roll, a plurality of controlled suction zones therein, said suction zones extending throughout only a portion of the circumference of said rotary-forming roll, an inlet for flowing fibrous stock onto said rotary-forming roll at one of said suction zones to form a fibrous filter mat, and a second inlet in spaced relation to said first inlet for flowing a surfacing material onto said fibrous filter mat while the same is still on the rotary-forming roll and at a second suction zone.

In testimony whereof I hereto affix my signature.

JOHN TRAQUAIR.