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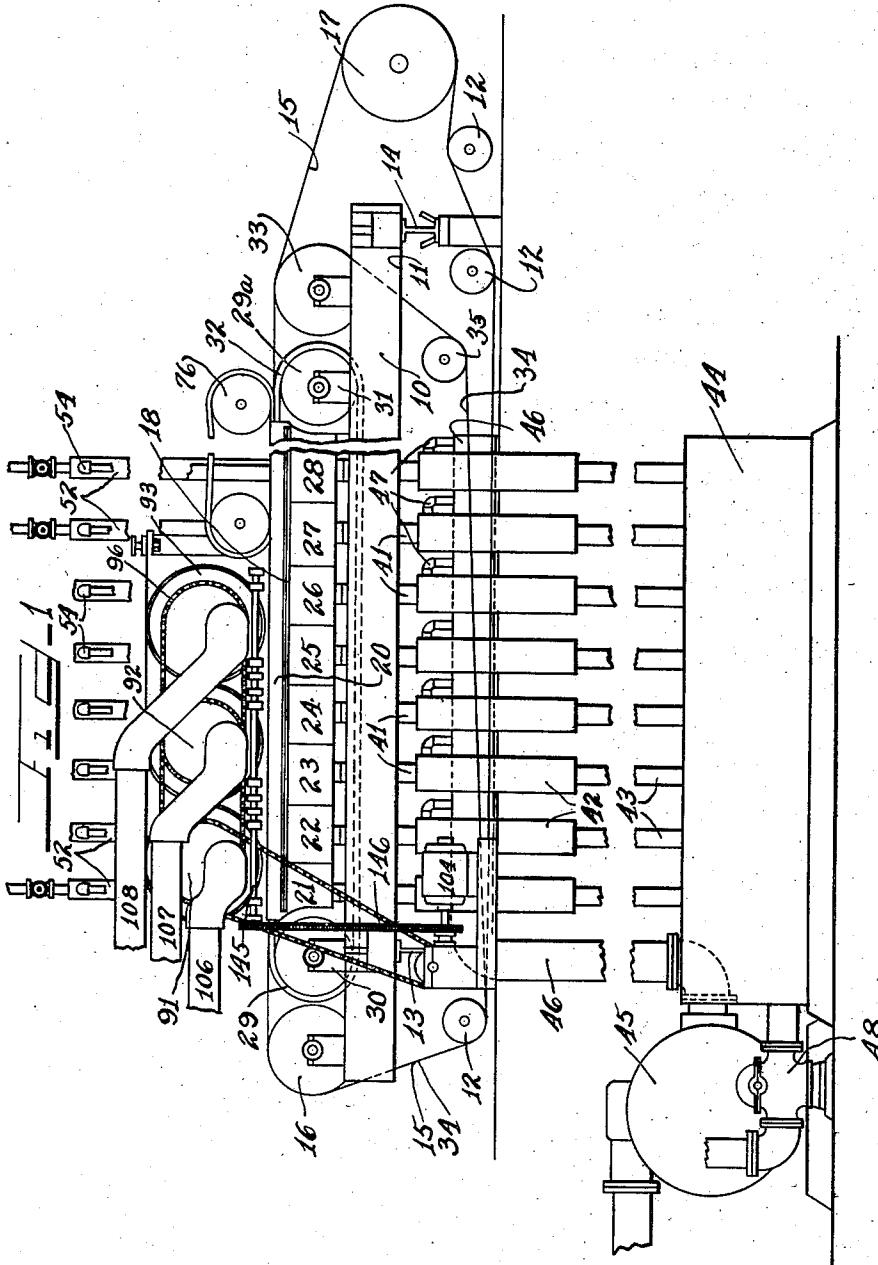
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METHOD OF AND APPARATUS FOR MAKING PAPER

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METHOD OF AND APPARATUS FOR MAKING PAPER

Application filed June 27, 1931. Serial No. 547,214.

This invention relates to a method of and apparatus for making fibrous web material. More particularly the invention relates to a method of and apparatus for making paper
5 of a somewhat stratified character yet unlike paper or board made on a multiple cylinder machine, of a unitary nature, incapable of separation into its constituent layers upon soaking in water.

10 It is common practice in making heavy paper or board on a multiple cylinder machine to use different stock finishes in the different cylinder vats in order to obtain desired characteristics in the finished product,
15 and particularly to obtain a cheap product of good surface appearance. For instance, board is frequently made having a filler of cheap or inferior stock and surface layers of higher quality, long fibered stock.

20 However, multiple cylinder machines are inherently incapable of high speeds and unsatisfactory for making anything but the heavier grades of paper and board. Furthermore, in multiple cylinder machines, the
25 partially formed webs from successive cylinder moulds are not inseparably united but are merely united by pressure while in a moist state, as by passing in superimposed relation on a carrier felt between press rolls. Consequently, paper made on a multiple cylinder
30 machine has a tendency to separate when moistened into its constituent layers.

It is also known to make multi-ply paper on Fourdrinier machines by the use of several
35 forming wires but, aside from the greater expense of manufacture, such multi-ply paper is also subject to similar objections to those above referred to.

The present invention contemplates the
40 manufacture of a somewhat stratified yet unitary sheet of paper or like fibrous web material on a single Fourdrinier forming wire by the use of novel means and methods.

In my U. S. Letters Patent No. 1,833,351
45 entitled "Paper making machine", filed July 15th, 1929 and granted November 24, 1931, I have described a novel type of paper making machine in which the paper stock upon its flow onto the forming wire is immediately
50 ly subjected to suction and a substantially

continuous suction is applied to the forming wire until a moist coherent web has been formed. I have also described in my copending application entitled "Paper making machine", Serial No. 496,146, filed November
55 17th, 1930, a particular, advantageous type of stock distributing device for use in a paper machine such as disclosed and claimed in my U. S. Patent No. 1,833,351 above referred to. In my copending application entitled "Paper
60 making machine", Serial No. 505,355, filed December 29th, 1930, I have described and claimed a fiber crossing device to be used in combination with the forming part of a paper machine and particularly in conjunction with
65 the type of paper making machine described in the two applications above referred to.

I have now developed improvements in connection with the type of paper machine disclosed in the applications referred to and
70 have also devised a novel process for the preparation of a paper web. The improvements on my new paper machine comprise the use of a plurality of the aforesaid devices for effecting a more uniform and even
75 distribution of stock onto the forming wire to prevent the formation of eddy currents and to insure a well formed sheet. The use on a machine of only a single such device is described in my above referred to applica-
80 tions and by my present novel arrangement of duplicating or multiplying said devices on the machine, I am able to produce in a simple, uniform, and single operation, sheet material containing two or more inseparable
85 layers of materials comprising the sheet.

This is accomplished by allowing stock from the first distributing means to flow onto a portion of the forming wire which is immediately subjected to suction to start the
90 formation of the web on the wire. The partially formed web as it advances on the wire then passes under a second distributing means wherein paper stock of a different composition, or of the same composition but
95 treated in a different method, or fillers or finishing materials of any sort, such as clay, blank fixe and the like is caused to be superimposed on the partially formed web to form thereon an inseparable layer. The web which
100

now consists of two layers, thoroughly matted and bonded together, may next be passed under additional distributing means for the superpositioning thereon of additional and other layers. It is thus possible to build up a web containing as many layers as desirable and also containing finishing materials or other surfacing materials on the surface of the web which are so intermingled with the paper stock in the web itself that a separation is impossible.

It is therefore an important object of this invention to prepare paper of a somewhat stratified character yet inseparable and unitary. It is a further important object of this invention to provide a machine for the preparation of paper built up of two or more layers, in which the stock as it flows into the machine is immediately subjected to the action of suction and wherein stock flow evening and distributing devices are employed to deliver the stock onto the forming wire in a manner calculated to produce a well formed sheet.

Another important object of this invention is to devise a process for the preparation of a paper sheet having a multiplicity of inseparable layers, which process is both economical, efficient and simple in its operation.

In the preparation of a high grade book paper, for example, it is possible by my improved process to form a sheet, the two sides of which are formed from a high grade of pulp that will give a good finish and proper appearance to the sheet while the center of the sheet may be formed from a lower grade and consequently lower priced stock, and in this way greatly reduce the cost of production of the finished paper.

Furthermore, in the preparation of a high grade book paper it is necessary that the paper be loaded with comparatively expensive clays and the like to lend the proper degree of opacity to the sheet, essential in modern printing papers. In the paper machines now on the market a large percentage of the expensive clay passes through the forming wire in suspension immediately after the paper stock containing clay commingled therein flows onto the wire. Since the clay is in a more finely comminuted state than the fibers and also heavier than the fibers, it tends to settle out and pass through the forming wire, thereby necessitating a very complete reuse of the white water passing through the wire if losses of the expensive clay are to be minimized.

With the arrangement of this invention, as is more fully hereinafter described, it is possible to supply the first stock distributing device with unloaded long fibered stock and allow this to form a matted layer of fibers directly on the bare forming wire. This partially formed web may then be passed under a second stock distributing device containing

clay in the stock. The clay accordingly is held on the already partially formed web, the fibers of which serve as a filter to resist the passage of the clay through the wire. The practically continuous suction applied beneath the wire carrying the stock or web, however, impregnates the partially formed web with the clay applied thereto from the second stock distributing device and thereby gives the desired degree of opacity to the sheet and also aids in obtaining a good finish on the sheet.

It is another important object of this invention to prepare a high grade finished paper having an intermediate layer or filler of cheaper paper stock material, thereby greatly reducing the production cost of the high grade paper, without destroying or cheapening the appearance or utilization of the final product itself.

Another important object of this invention is to prepare paper, or other fibrous sheet material, composed of a multiplicity of inseparable layers bonded together by fibers common to the successive layers.

By the utilization of a multiplicity of stock distributing devices in my novel paper machine I am also enabled to prepare a paper sheet in which the pliability of the finished sheet may be controlled to a nicety by supplying the first and last stock distributing compartments with a comparatively long fibered stock while supplying the center stock distributing compartment with a shorter fibered stock which not only acts as a filler for the long fibers but also results in the formation of a more pliable sheet. This is due to the fact that the weaker fibers are in the center of the sheet where the stresses are smallest when bending or crumpling of the finished sheet is effected.

It is therefore a further object of this invention to provide a process wherein the pliability of a paper web may be readily controlled.

Other and further objects of this invention will become apparent from the disclosures in the specification and the accompanying drawings.

This invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

On the drawings:

Figure 1 is a broken front side elevational view of the forming part of a paper machine embodying the principles of my invention and shown more or less diagrammatically.

Figure 2 is an enlarged fragmentary sectional view taken longitudinally of the forming part of the machine and transversely of the stock distributing devices.

Figure 3 is a fragmentary sectional view taken substantially along the line III—III of one of the stock distributing devices in Figure 2.

Figure 4 is a fragmentary sectional view taken substantially along the line IV—IV of one of the stock distributing devices in Figure 2.

As shown on the drawings:

The reference numeral 10 indicates the supporting frame of a table structure, including side beams 11 mounted for lateral removal upon tracks 13 and 14. The specific structure for the removal of the table portion 10 need not be described, since many forms of construction for this purpose are well known in the art. A forming wire 15, trained around a roll 16 at one end of the machine and a couch roll 17 at the other end of the table structure, cooperates with a suction device indicated as a whole by the reference numeral 18. A plurality of rolls, such as idling rollers 12, serve their usual function.

The suction device 18, which embodies the features shown in my prior copending application Serial No. 378,236 comprises a stationary box-like hollow member 20 preferably formed in a plurality of transversely divided sections, 21, 22, 23, 24, 25, 26, 27 and 28, each section forming a separate suction unit wherein the degree of suction may be individually controlled and varied to suit the operating condition. The stationary suction member 20 is supported upon the side beams 11 by means of brackets which are not shown.

Rolls 29 and 29a, suitably journaled in bearing supports 30 and 31, respectively, are mounted from the side beams 11 at the head and couch roll end of the suction member 20 respectively.

An endless perforated cover, or belt, 32 is trained around the rolls 29 and 29a to pass over the open top of the suction member 20.

One of said rolls 29 or 29a is adapted to be suitably driven (driving means are not shown) in a manner to cause the belt 32 to travel with the forming wire 15 at the same rate of speed.

Between the roll 29a and the couch roll 17 there is mounted on the side beams 11, a roll 33, preferably of the same diameter and size as the roll 29a. A wire 34, of a coarser mesh than that of the forming wire 15, is trained around the roll 33 and the roll 16 to cooperate with the traveling belt 32 in supporting the upper run of the forming wire 15 as it passes over the suction device 20. The lower run of the coarser wire 32 passes around a roll 35 and joins the forming wire 15 as it passes around an idler roll 12 at the head end.

Each of the separate suction units 21 to 28 inclusive is connected by means of a suction pipe 41 to a separator 42 having a lower barometric leg 43 extending into a well or tank 44 for receiving the water extracted from the stock and web on the forming wire 15. A blower fan 45 is suitably connected by means of a header pipe 46 and connections 47 to the upper ends of the separators 42 to apply the

desired degree of suction to the units 21 to 28 inclusive. A pump 48 may be used to return white water (water containing paper stock) from the well or container 44 for further use in the process.

In the upper portion of the hollow suction member 20 there are mounted a plurality of longitudinally extending troughs 49 (Figures 2, 3 and 4), which are adapted to be filled with water from a plurality of transversely extending pipes 51 (Figure 2) extending through the rear wall of the suction member 20. Each of said pipes 51 is connected to a standpipe 52 (Figure 1) provided with an overflow pipe 54, whereby a sufficient head is created to cause the water in the troughs 49 within the suction member 20 to exert an upwardly acting hydraulic pressure against the traveling cover or belt 32 that counterbalances, or substantially counterbalances the downwardly acting atmospheric pressure caused by the suction. The entire mechanism is explained in greater detail in my U. S. Patent No. 1,833,351 referred to above.

The troughs 49 within the suction member 20, more fully described in my copending application referred to, are machined on their upper faces to provide plane surfaces for supporting the traveling cover or belt 32. A water seal 50 (Figure 2) is maintained at the end wall of the troughs within the suction member 20 to maintain the suction between the suction member 20 and the traveling belt or cover 32.

The forming structure of the paper machine thus far described is substantially that described and claimed in my U. S. Patent No. 1,833,351 referred to above, containing in addition, however, a description of a coarser wire 34 which is employed in the present structure to support the forming wire and the corrugations of the traveling cover or belt 32 to prevent the closing up of openings in the wire such as might take place if the wire rested directly upon the corrugations of the traveling belt 32.

An additional feature embodied in my present invention is the provision of a plurality of stock delivering means indicated generally by the reference numeral 90. While I have shown three such stock delivery units, 91, 92 and 93, it is to be understood that any number greater than one may be used without departing from the principles embodied in my invention. Any unit not desired to be used may be cut out of operation by merely cutting off the feed supply. Thus I may operate units 91 and 92 alone or if desired, I may use only alternate units.

Compartment 91 is mounted directly over sections 21 and 22 of the suction box 22. Compartment 92 is mounted directly over sections 23 and 24, and compartment 93 is mounted directly over sections 25 and 26 of the suction box 20. Each of the compartments 91, 92 and

93 comprises cylinders 94, 95 and 96 mounted for rotation and driven by chain or belt drive by a motor 104 (Fig. 1). Each cylinder 94, 95 and 96 is equipped at each end with an annular supporting ring 97 best shown in Figures 3 and 4. The supporting rings 97 are mounted to rotate on rollers 98 and 99, said rollers being supported on a suitable frame structure.

- 10 The frame structure preferably comprises a pair of side walls 85 resting on and supported by side rails 86. An end wall 87 also secured to the side walls 85 and spaced at its lower edge above the forming wire 15 as at 88
15 (Fig. 2) extends transversely of the wire to serve as a retaining wall for a pond of paper stock 89 that is created above the forming wire.

- The fourth retaining wall of compartment
20 91 is an adjustable slice 100 which separates compartment 91 from compartment 92. The slice 100 is supported also from the side walls 85 and is vertically adjustable by any suitable adjusting mechanism, such as shown at
25 101. Compartment 92 is defined by slice walls 100 and 102 and by the side walls 85. Likewise compartment 93 is defined by slice walls 102 and 103 and side walls 85.

- Paper stock of the same or different furnish is delivered through pipes 106, 107 and 108 into the interiors of the rotating cylinders 94, 95 and 96, respectively by means of connecting, transverse conduits or pipes 109, 110 and 111, respectively. For example, a process of making a pliable paper sheet as mentioned above may be effected by delivering
30 through pipe 106 into conduit 109 a long fibered stock and through pipe 107 into conduit 110 a short fibered stock while a long fibered stock of the same variety as delivered
40 into conduit 109 is supplied to conduit 111. A strong pliable sheet will thus be built up on the forming wire which has a short fibered filler and a long fibered outer layer.

- 45 Conduits 109, 110 and 111 extend the full length of the cylinders 94, 95 and 96, respectively, and have longitudinally extending slots 112, 113 and 114, respectively, on their upper sides and a plurality of apertures such
50 as 115 on their lower sides. The conduits may be suitably supported in a stationary position by any means, as by a bracket 116 (Figs. 3 and 4), at each end of the conduit. Any suitable means for preparing the stock
55 delivered into the interior of the cylinders 94 to 96 inclusive may be used.

- The longitudinal slots 112, 113 and 114 and the spaced apertures, such as shown at 115, allow the escape of stock both upwardly and
60 downwardly to prevent settling out and the accumulation of any stock within the conduits 109 to 111 inclusive. As shown in Figure 2, the stock fills the conduits 109, 110 and 111 and discharges through the longitudinal slots
65 112, 113 and 114 down over the sides of said

conduits into the rotating drums 94, 95 and 96, thereby building up a head within the drums. The amount of head depends primarily upon the adjustment of the slices 100, 102 and 103 and the rate of delivery of stock
70 to the conduits.

While I prefer to discharge the stock into the interior of the drums through the agency of a tubular conduit of suitable diameter it will be understood that my invention contemplates the use of any suitable trough structure or other means for delivering and distributing the stock into the rotating cylinder through one or both ends thereof.

The stock is confined at the ends of the rotating cylinders 94, 95 and 96 by end walls such as the partition 120 supported from the conduit 109 (Fig. 3). Escape of stock through the joints between the walls and the periphery of the cylinders 94, 95 and 96 is
85 prevented by suitable packing 121.

The stock delivery cylinders 94, 95 and 96 are of foraminous construction throughout their entire length intermediate the partition walls 120 and in their preferred embodiments
90 comprise a cylinder having rows of small holes 122 closely arranged together and through which the stock flows into the ponds formed above the wire 15. These holes 122 provide nozzle-like delivery orifices which
95 serve to mix the fibers of the stock as it passes through and to break up bunches or collections of fiber if any should reach this point of the machine. The stock thus flows onto the wire 15 in a condition of uniform distribution and with absence of any eddy currents. In connection with the rotating cylinders 94, 95 and 96 there is provided in the interior of each cylinder troughs 123, 124 and 125 containing suitable draining means shown
100 at 132, 133 and 134. Directly above the cylinders 94 to 96 inclusive are mounted shower pipes 129, 130 and 131 to direct a stream of water downwardly against the outside of the foraminous cylinder to clean out the holes
105 122. The water is drained into the troughs 123, 124 and 125 and doctor bars 126, 127 and 128 secured to one end of the troughs are adapted to scrape against the inner surface of the rotating drums to cause any dirt or water adhering thereto to flow down into the troughs.
110

In addition to the rotating drums 94, 95 and 96 there are also provided further mechanisms for producing an even and uniform flow of stock and for preventing the uneven settling of fibers in the ponds of stock formed directly above the forming wire 15. These mechanisms comprise a plurality of reciprocally mounted agitating members 140. Each
115 of these agitating devices or members 140 comprises a rod 141 pivotally mounted as at 142 to a link 143 eccentrically mounted as at 144 to an eccentric shaft 145 (Fig. 1). Said shaft 145 is adapted to be driven through a chain
120 125 130

or belt 146 from the driving shaft of the motor 104.

Said bars 141 are provided with spaced transversely extending blades 147 which are spaced slightly above the forming wire 15 and when oscillated by means of the driving means described above, including the eccentric 144, serve to keep the stock in gentle agitation to prevent uneven and too rapid settling out in the ponds formed above the forming wire 15.

It will be apparent from the foregoing description that as soon as the stock passes into the interiors of the rotating foraminous drums 94 to 96, inclusive, it is subjected to a suction action acting through the traveling belt 32, coarse wire 34 and the forming wire 15 as it passes over the hollow suction member 20. The result is that an initial deposit of the fibers occurs before the stock passes out from the ponds formed in the compartments directly over the forming wire under the lower edges of the slices 100, 102 and 103.

Due to the fact that there is no great velocity of flow in the direction of the wire within the ponds, settling is effected under a relatively quiescent condition and due to the distributing and aiding action of the rotating foraminous drums 93 to 96, inclusive, and the agitating devices 140, the deposit of stock on the forming wire prior to its passage beyond the slice from one compartment to another and beyond the slice in the last compartment results in initial matting or bonding of the fibers. Because the fibers have no common general direction but are pointing in all directions, this initial web forming step is closely similar to what occurs in the formation of hand made sheets. This obviously makes for the formation of a stronger and better sheet of paper.

Until the forming wire 15 passes beyond the couch roll end of the suction device 20, the stock on the wire is subjected to continuous suction action, so that the removal of water from the stock is rapid and continuous. The degree of suction to which the stock is subjected may be varied due to the provision of the separate suction units 21 to 28 inclusive as hereinabove stated.

From the foregoing description of the apparatus of my invention, its mode of operation will be readily understood. It will be appreciated that upon apparatus such as described, paper having novel and improved characteristics can readily be made. More especially is such a machine adapted for the manufacture of paper having a somewhat stratified or composite character yet remaining also essentially unitary in nature and thus differing from multiply paper made on a multiple cylinder machine.

While characteristically adapted for use in the manufacture of paper of the composite nature above described, the machine of my

invention may also be used in the manufacture of paper from a single stock furnish. In any case, the formation and hence the strength and quality of the paper is much improved over that of paper made on the ordinary Fourdrinier machine.

I am aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than necessitated by the prior art.

I claim as my invention:

1. In a paper machine, a forming wire, a suction device associated therewith and a plurality of revolving reticular drums mounted over the wire and suction device and cooperating with each other to feed the stock onto said wire.

2. In a paper machine, a forming wire, a suction device associated therewith, a plurality of means forming several ponds over a portion of the wire subject to the action of said suction device and a revolving reticular drum mounted in each pond through which the stock flows onto said wire.

3. In a paper machine, a stationary suction device, a forming wire traveling thereover, means including more than one slice defining over said wire a plurality of enclosed spaces, a perforated drum mounted transversely of said wire within each of said enclosed spaces and means for introducing stock into each of said drums to flow through the perforations thereof onto said wire.

4. In a paper machine, a pair of spaced rolls, a stationary suction device positioned therebetween, a forming wire trained around said rolls to travel over said suction device, members including a plurality of slices defining more than one pond for stock over portions of said wire subjected to suction and a stock distributing means mounted within each of said ponds.

5. In a paper machine, a plurality of spaced parallel rolls, an endless forming wire trained therearound, a stationary suction device operatively associated with the greater portion of the upper run of the wire, walls including a plurality of slices defining a plurality of ponds for stock above a portion of said wire subjected to suction and means within said walls for uniformly distributing stock to each of said ponds and maintaining a head of stock ahead of each slice.

6. In a paper machine, a plurality of spaced parallel rolls, an outer forming wire traveling thereover and trained therearound, a sectional hollow suction member positioned within the loop of the forming wire, an endless perforated belt operatively associated with said suction member through which suction is applied to the forming wire, a relatively coarse wire traveling with and between

said belt and forming wire over the surface of said hollow suction member, walls including a plurality of slices defining a plurality of ponds for stock over a portion of the forming wire subjected to suction and a rotating flow evener and stock mixing cylinder in the path of the stock flowing to each of said ponds.

7. In a paper machine, a pair of spaced rolls, a stationary suction device positioned therebetween, a forming wire trained around said rolls to travel over said suction device and a series of adjustable stock feeding devices cooperating with each other to deliver a predetermined amount of stock in distinct stages to said wire as it advances over said suction device.

8. In a paper machine, a pair of spaced rolls, a stationary suction device positioned therebetween, a forming wire trained around said rolls to travel over said suction device, a primary adjustable stock feeding device to deliver a predetermined amount of stock to the raw forming wire, a secondary stock feeding device to deliver a predetermined amount of stock to the partially formed web from said primary device and a third stock distributing device to aid in building up the web on said forming wire, all three stock distributing devices cooperating to produce a unitary web of paper.

9. The process of forming a paper web which comprises delivering in distinct stages stock to the forming wire from a plurality of ponds created over the forming wire as the forming wire advances under said ponds.

10. The process of preparing a paper sheet, which comprises delivering stock to the forming wire of a paper machine from a pond created over said forming wire, superimposing additional stock from separate ponds created over the forming wire as said wire advances and thereby building up a paper sheet composed of inseparable layers.

11. The process of forming a paper sheet composed of inseparable layers, which comprises advancing the forming wire of a paper machine under a plurality of stock distributing devices to superimpose successive layers of stock upon the forming wire and continuously applying suction to said forming wire and stock thereon to remove the greater portion of the water therefrom.

12. The process of preparing a paper sheet which comprises delivering unloaded stock to a forming wire subject to suction from a pond created over the wire, superimposing loaded stock from another pond created over the wire upon the partially formed web of said unloaded stock, applying further suction to penetrate said loaded stock into said unloaded stock layer and maintaining said suction to remove the greater portion of the water from the stock on the forming wire.

13. The method of forming fibrous web

material, which comprises depositing fibrous material in aqueous suspension from a quiescent pool onto a traveling foraminous surface subject to suction, a partial deposition of said fibrous material thereby occurring to form a matted fibrous web and delivering from a second quiescent pool at a successive point in the travel of said surface a further quantity of fibrous material in aqueous suspension over said matted fibrous web while still on said traveling foraminous surface and subject to suction.

14. The method of forming fibrous web material, which comprises delivering separately and successively from quiescent pools unloaded and loaded stock to a traveling foraminous surface subjected to continuous suction from the point of first delivery of said stock to the point at which most of the water has been removed from said stock.

15. The process of preparing web material which comprises delivering stock to a traveling horizontal forming wire subject to suction and building up said web on said wire by successive simultaneous applications of stock thereto while continuously applying suction to said forming wire along its travel from the point of initial deposition of stock thereon until a coherent composite web is formed.

16. In the process of preparing a paper sheet, the steps which comprise delivering a long fibered stock to the bar forming wire of a paper machine, advancing said wire, superimposing a short fibered stock upon the partially formed long fibered stock web, superimposing a layer of long fibered stock on said short fibered stock and continuously applying suction to said forming wire along its travel from the point of initial deposition of stock thereon until a moist coherent web is formed, thereby forming a paper sheet composed of layers inseparately bonded together to form a unitary web.

17. In the process of preparing a paper sheet, the steps of delivering stock to the forming wire of a paper machine, building up a paper web by further application of stock to the wire at spaced points along its length and continuously applying suction to said wire along its travel from the point of initial deposition of stock thereon until a moist composite web is formed.

In testimony whereof I have hereunto subscribed my name at Beloit, Rock County, Wisconsin.

EARL E. BERRY.