June 13, 1933. H. L. KUTTER 1,913,678

PAPER MAKING MACHINERY

Filed July 16, 1930

FIG. 1.

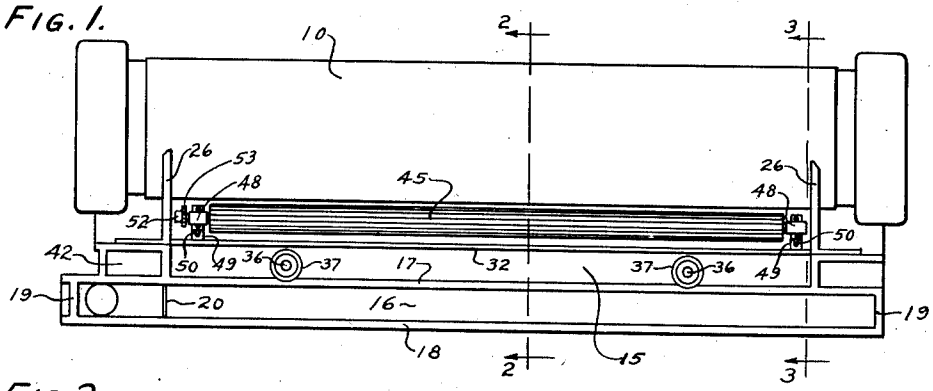


FIG. 2.

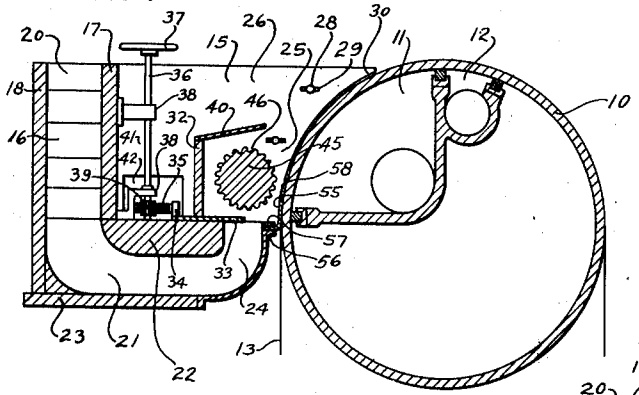


FIG. 3.

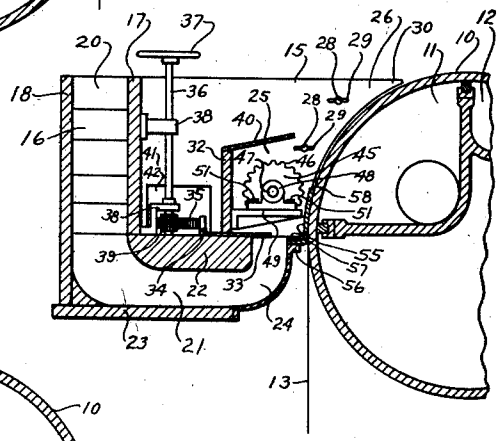
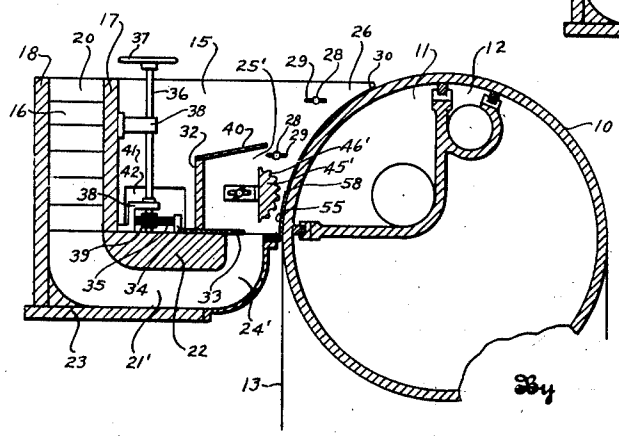


FIG. 4.



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UNITED STATES PATENT OFFICE

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PAPER MAKING MACHINERY

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This invention relates to the manufacture of paper, and more particularly to paper making machines for forming a traveling sheet of paper.

One of the principal objects of the invention is to provide a paper making machine of this character, which is simple and economical in construction, highly effective in operation, and is capable of forming a paper sheet of controlled high tensile strength in regular paper making operations.

Another object of the invention is to provide a paper making machine of this character having an efficient and effective agitating mechanism effective to exercise its effect on the flowing stream of stock as it is supplied to the forming surface to give a paper sheet of improved and controlled character as to strength and formation.

Still another object of the invention is to provide a paper making machine of the type having a rotary vacuum forming roll with an inlet construction which is highly effective in producing a paper sheet of improved and controlled character as to strength and formation.

Other objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawing in which like characters of reference designate like parts through the several views thereof—

Fig. 1 is a plan view of a paper making machine constructed in accordance with this invention;

Fig. 2 is a vertical sectional view taken on the plane of the line 2—2 of Fig. 1;

Fig. 3 is a vertical sectional view taken on the plane of the line 3—3 of Fig. 1; and

Fig. 4 is a view similar to Fig. 3 showing a somewhat modified form of construction.

Referring to the drawing, which discloses a preferred embodiment of the invention, a rotary vacuum forming roll is indicated at 10 having suction pockets 11 and 12 therein providing a suction forming zone. This roll may be similar in construction to the well known suction couch rolls, such as illustrated in the patent to Millspaugh Re. 13,100, reissued April 12, 1910. A traveling wire 13 may extend about a portion of the roll 10, this wire being of similar construction to the traveling wires used in connection with Fourdrinier machines and providing a traveling forming surface. Or the roll 10 may be provided with an outer peripheral forming surface of wire mesh or other suitable material. The surface of the roll 10 is perforated so that the suction effective in the pockets 11 and 12 is communicated to the forming surface for the rapid formation of a traveling sheet of paper as paper forming stock is supplied to the forming surface opposite the suction forming zone.

An inlet or vat 15 is provided for supplying paper forming stock to the forming surface of the rotary roll 10 opposite the suction zone 11 therein. As an illustration of a form of inlet which will function quite satisfactorily that construction which is disclosed in Millspaugh 1,753,800, dated April 8, 1930, is shown. Paper forming stock at dilute consistency, such as about ½% to 2%, is supplied to the vertical channel or compartment 16, of the inlet, defined by front and rear walls 17 and 18 and suitable side walls 19, an overflow partition 20 being provided for regulating the head of stock within this channel 16. A horizontally extending channel 21, defined by an upper wall 22 and a bottom wall 23 together with the side walls 19, communicates at one end with the bottom of channel 16 and is provided at its other end with an upwardly directed discharge port 24 feeding into a forming compartment 25 positioned at one side of the rotary forming roll 10 opposite the suction forming zone 11. The discharge port 24 of channel 21 extends transversely across the inlet and is preferably comparable to the width of sheet being formed, so as to give a more uniform distribution of stock to the forming compartment 25 across the width of the sheet. Forming compartment 25 has side walls 26 positioned adjacent opposite ends of the roll 10, the forward portions of these side walls being curved to approximate the curvature of the forming roll 10 and extending closely adjacent the forming sur-

face 13. These side walls may be adjustably connected to suitable parts of the framework of the machine or to extensions of the side walls 19 by means of the bolts 28 which pass through longitudinal slots 29 in the side walls, to thereby permit accurate adjustment of the front curved edges of the walls toward and away from the forming surface. Suitable flexible deckle straps, such as rubber deckle straps 30, may be supported by the forward ends of the walls 26 closely adjacent the forming surface.

The forming compartment 25 is also defined by a rear wall 32 mounted between the side walls 26. Rear wall 32 preferably extends to a height less than the height of the side walls 26, and is additionally supported by the part 22 of the framework of the inlet which forms an upper wall for the horizontal channel 21 and is connected to the front wall 17. The paper forming stock passes under a controlled head through the channels 16 and 21 and is discharged as a flowing stream through port 24 into the forming compartment 25 where it passes in a substantially tangential direction onto the forming surface 13 and is formed into a traveling sheet with only a relatively short travel by the suction effective in the suction compartments 11 and 12.

In order to regulate the volume of feed to forming compartment 25, a cut-off valve or plate 33 is provided to slide on wall 22 in a suitable recess in rear wall 32 and control the size of port 24. The rear portion of plate 33 carries an upstanding flange 34 which threadedly receives an adjusting screw 35 mounted for rotation in suitable bearings (not shown). A shaft 36 having control wheel 37 is rotatably mounted in brackets 38 and carries at its lower end a pinion 39 meshing with the screw 35, whereby adjustment of the plate 33 is effected. Carried by the upper portion of the rear wall 32 is an overflow plate 40 which serves to permit any excess of stock supplied to the compartment 25 to overflow into a rear compartment 41 from whence it is removed by a side channel 42 leading to a suitable stock or supply chest (not shown).

In paper making machines of this character having a rotary vacuum forming roll where web formation takes place rapidly, it is found that there is a tendency for the fibers of the stock to dispose themselves in the water of the stock along the direction of travel of the forming surface. The result is a tendency to decrease the crossing or interlacing of the fibers, with a resulting sheet having lowered tensile strength in one direction. The present invention provides an unusually efficient agitating mechanism positioned within the stock being supplied to the forming roll, to effectively agitate that stock so that as it is formed into the sheet the fibers of the stock will be suitably interlaced to provide both longitudinal and transverse strength to the stock. The mechanism illustrated is quite satisfactorily used in conjunction with an inlet construction having a maintained body of stock; or one in which the stock is supplied in the form of a flowing stream onto a forming surface, as illustrated in the drawing.

As shown, a rotary agitator roll 45 is mounted within the forming compartment 25 immediately above the discharge port 24 of the upwardly directed portion of channel 21 and in the path of the flowing stream of stock entering the forming compartment 25. This roll is provided with an irregular surface, as indicated at 46, being shown as provided with flutes. For example, a roll having a diameter of about seven inches with fluting or corrugations of about one-half inch in depth has been found to give very satisfactory results. This roll is positioned within the forming compartment 25 between the rear wall 32 and the forming surface 13, with its irregular, or fluted, surface being positioned to effectively affect the fiber stock at the forming surface 13. In actual practice, very satisfactory results have been secured where the surface of the roll approaches to within about one half inch of the forming wire 13; but effective results may be secured with greater spacing provided the spacing and configuration or shaping of the roll are so coordinated as to sufficiently affect the fibers in the stock in the zone of suction formation of the web, so that the fibers may not realign after being subjected to the roll action and before formation of the web.

The roll 45 is provided at each end with extended journals 47 which are carried by suitable bearings 48 mounted on bearing brackets 49 attached to the rear wall 32 of the forming compartment. An adjustable connection is provided between the bearings 48 and the bearing brackets 49 so as to permit accurate adjustment of the agitator roll toward or away from the forming surface 13. As shown, longitudinal slots 50 are formed in the bearing brackets 49 and bolts 51 passing through the bearings 48 extend through the slots 50 and are adapted to be held rigidly in adjusted position by nuts carried on the ends of the bolts beneath the brackets 49. One of the journals 47 of the roll 45 is extended as indicated at 52, and a drive sprocket or gear 53 is attached thereto and is adapted to be connected to a suitable motor or other driving means through a reduction gearing (not shown), whereby the roll may be driven at the desired speed.

It is found that in addition to the spacing, size and configuration of the agitator roll with reference to the forming surface, the speed of rotation of the agitator roll also has a bearing upon the strength and formation

of the sheet. Moreover, different rotative speeds are advantageously employed when the roll is rotated clockwise (as shown in Fig. 3) and when the roll is rotated counterclockwise. For example, with the roll rotating clockwise, that is, with the forward portion of the roll moving against the direction of travel of the flowing stream of stock onto the forming surface, better results are secured at relatively higher R. P. M., and conversely with the roll rotating counterclockwise or with the forward portion of the roll moving with the direction of travel of the stock, better results are secured with relatively lower R. P. M. The effectiveness is also dependent upon the rate of travel of the forming surface, the consistency of the stock, the weight per unit area of the sheet being formed, and other factors. By way of example, with a rotary forming roll having a surface speed of about 115 feet per minute and making about a 35 pound paper, using a seven inch diameter fluted agitator roll, better results were obtained with the roll rotating clockwise at a R. P. M. of about 38 than with a R. P. M. of about 12. On the other hand, with the same conditions and the roll running counterclockwise, better results were secured with the roll rotating at a R. P. M. of about 12 than with a R. P. M. of about 38. The speed of rotation, spacing, size, and fluting of the roll can be readily determined by test to give the best results in each case for the character of stock being treated, the rate of sheet formation, the weight per unit area of the sheet, and other factors.

The forward edge of the forming compartment 20 carries a flexible apron 55, such as a rubber or fabric apron, which may be conveniently clamped in operating position between an extending flange 56 formed at the upper portion of the conduit defining the channel 21 opposite discharge port 24 and a clamping plate 57 bolted thereto. This flexible apron, as shown, extends upwardly a substantial distance between the agitator roll 45 and the forming surface 13. Very satisfactory results have been secured when the free end of this apron terminates as indicated at 58 substantially in the plane of the longitudinal axis of the agitator roll 45, and opposite the portion of the roll which is most closely positioned with respect to the forming surface. The net result is that the operation of roll 45 is effective immediately in the zone of initial suction formation of the web. The apron blankets the portion of the forming surface opposite the forming compartment 25 below the effective agitating portion of roll 45, so that rapid suction formation is prevented in this area in advance of the effective agitating portion of the fiber crossing member. In a rotary vacuum forming machine of this character, suction formation of the web takes place very rapidly with only a few inches of travel of the forming surface 13 with roll 10. Consequently the agitator or fiber crossing member is effective immediately in the zone of suction formation and the resulting web is formed on the traveling surface with the fibers crossed and interlaced substantially in the manner in which they are displaced by the agitator. Good results may also be secured by constructing the inlet with a lip which directs the flowing stream of stock directly between the forming surface and the agitator and discharging the stock onto the forming surface at the zone opposite the effective agitating portion of the fiber crossing member, so that the agitator is thus effective immediately in the initial suction forming zone. The apron 55 is mounted for adjustment so as to vary the extent of the portion of the apron extending upwardly between the roll 45 and the forming surface 13. This is conveniently accomplished by loosening the attaching bolts clamping plate 57 to flange 56 and then withdrawing the apron from or inserting it into the space between clamping plate 57 and flange 56 to the desired extent and then reclamping in adjusted position.

Referring to Fig. 4, a somewhat modified form of construction is indicated in which a stationary agitator member 45′ is mounted within the forming compartment 25′ immediately above the upper end or discharge port 24′ of the upwardly extending portion of channel 21′. This member comprises a transversely extending beam which is adjustably connected adjacent its ends to the inlet so as to permit of adjustment toward and away from the forming surface 13. The forward surface of the member 45′ is preferably fluted or corrugated as indicated at 46′ to provide a surface similar to the surface of the fluted roll 45. This form of construction may be used advantageously with an inlet of the type shown in which the paper forming stock is introduced in a flowing stream into the forming compartment and onto the forming surface, the relative movement between the stock and agitator immediately in the zone of formation giving an effective fiber crossing and web formation of improved tensile strength and other characteristics. Where a box type inlet for confining a pool of stock adjacent the surface of a rotary vacuum forming roll is used, then a rotary agitator roll of the type illustrated in Figs. 1 to 3 is preferably used, the proper coordination of the speed of rotation and the spacing of the agitator roll together with the positioning of the effective agitating portion of the roll in the zone of initial suction formation, serving to effectively overcome the quiescence of the stock and to give a resultant sheet in which the fibers are effectively crossed and interweaved with relative-

ly high tensile strength. By a proper control of the spacing and rotation of the fluted roll, the positioning of the apron, and other factors mentioned above, the resultant tensile strength and formation of the sheet can be rather accurately controlled and varied to give a sheet of the character desired.

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

What is claimed is:

1. In apparatus of the character described, a rotary vacuum forming roll having a suction pocket providing a suction forming zone and having a forming surface thereon, means for supplying paper forming stock to said forming surface to form a traveling paper web, and a fiber crossing member positioned adjacent said forming roll in contact with the paper forming stock in the zone where said stream of stock is formed on said forming surface, said fiber crossing member having a fluted surface effectively positioned adjacent the said forming surface of said forming roll and in the initial suction forming zone.

2. In apparatus of the character described, a rotary forming roll having a suction pocket therein and a forming surface thereon, providing a suction forming zone about a portion of the surface of said roll, an inlet for flowing a stream of paper forming stock onto said forming surface at said suction forming zone, and a rotary roll positioned adjacent said forming roll and in the path of the flowing stream of stock in the zone where said stream of stock flows onto said forming surface, said roll having its surface positioned less than two inches from the forming surface of said rotary forming roll and in the initial suction forming zone.

3. In apparatus of the character described, a rotary vacuum forming roll having a suction pocket therein and a forming surface thereon, providing a suction forming zone about a portion of the periphery of said roll, an inlet for flowing a stream of fibrous stock onto the said forming surface including a tangentially arranged channel for delivering the stream of stock substantially tangentially onto the traveling forming surface at one side of said forming roll and opposite the said suction forming zone, and a fiber crossing member positioned opposite the said channel in the path of the flowing stream of stock, said member having a fluted surface positioned closely adjacent the said forming surface in the said suction forming zone.

4. In apparatus of the character described, a rotary vacuum forming roll having a suction pocket therein and a forming surface thereon, providing a suction forming zone about a portion of the periphery of said roll, an inlet for flowing a stream of fibrous stock onto the said forming surface including an upwardly directed channel for delivering the stream of stock upwardly onto the traveling forming surface at one side of said forming roll and opposite the said suction forming zone, a forming compartment into which said channel discharges positioned opposite the said suction forming zone at the side of said rotary forming roll, a rotary agitator roll positioned within said forming compartment above said upwardly directed channel in the path of the flowing stream of stock, the surface of said agitator roll being positioned closely adjacent the said forming surface in the said suction forming zone.

5. In apparatus of the character described, a rotary vacuum forming roll having a suction pocket therein and a forming surface thereon, providing a suction forming zone about a portion of the periphery of said roll, an inlet for flowing a stream of fibrous stock onto the said forming surface including an upwardly directed channel for delivering the stream of stock upwardly onto the traveling forming surface at one side of said forming roll and opposite the said suction forming zone, a forming compartment into which said channel discharges positioned opposite the said suction forming zone at the side of said rotary forming roll, a rotary agitator roll positioned within said forming compartment above said upwardly directed channel and in the path of the flowing stream of stock, the surface of said agitator roll being closely adjacent the said forming surface in the said suction forming zone, and a flexible apron carried by the forward edge of said forming compartment, said apron extending upwardly a substantial distance between said agitator roll and said forming surface, the free end of said apron being approximately in the plane of the longitudinal axis of said agitator roll.

6. In a paper making machine of the character described, having a rotary forming roll and means for supplying pulp stock to the roll surface for substantially instantaneous web formation thereon; an agitator positioned in the path of the stock flow and adjacent the position of instantaneous web formation, said agitator comprising a member having a fluted surface positioned close to the roll surface and extending along the length thereof.

7. In a paper making machine of the character described, having a rotary forming roll and means for supplying pulp stock to the roll surface for substantially instantaneous web formation thereon; an agitator positioned in the path of the stock flow and adjacent the position of instantaneous web formation, said agitator comprising a rotary fluted

roll positioned in such close proximity to the forming roll surface that the fluted surface of the agitator roll moves within the immediate zone of web formation.

8. In a paper making machine of the character described, having a rotary forming roll and means for supplying pulp stock to the roll surface for substantially instantaneous web formation thereon; an agitator positioned in the path of the stock flow and adjacent the position of instantaneous web formation, said agitator comprising a rotary roll positioned close to the forming roll surface and extending along the length thereof, the agitator roll having flutes extending longitudinally of the roll.

In testimony whereof I hereto affix my signature.

HERMAN L. KUTTER.