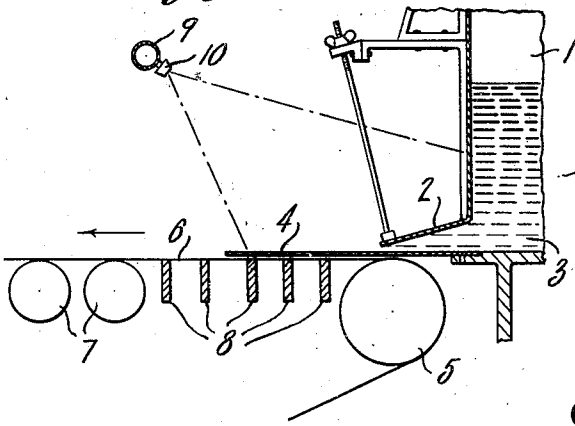
Sept. 15, 1936. R. C. HURREY 2,054,630

METHOD AND APPARATUS FOR MANUFACTURING PAPER

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Fig. 1.



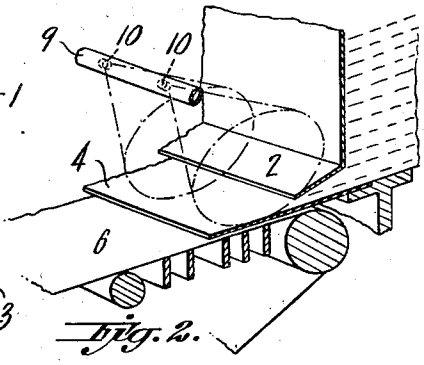


Fig. 2.

Fig. 3.

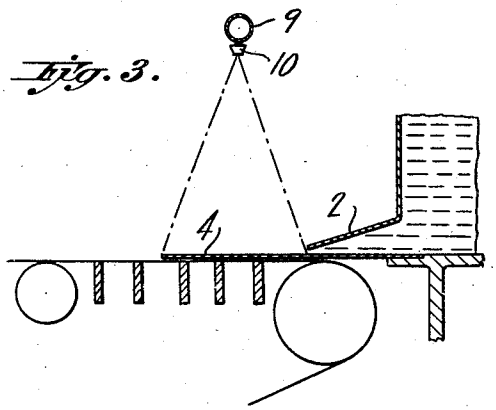


Fig. 5.

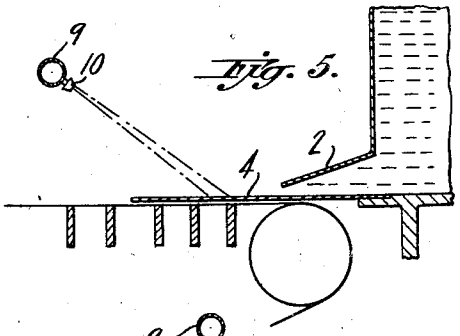


Fig. 6.

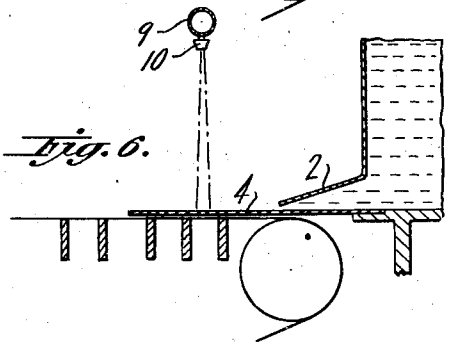


Fig. 4.

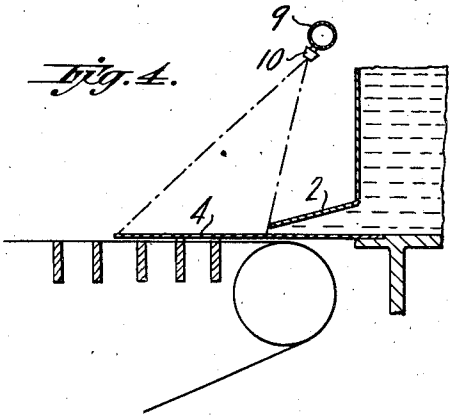
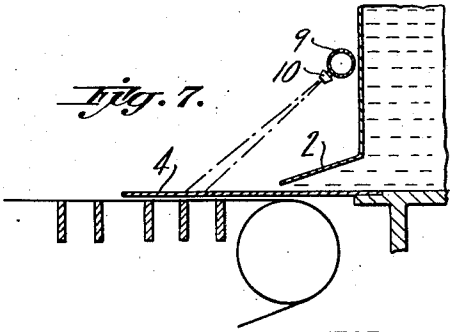


Fig. 7.



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Fig. 8.

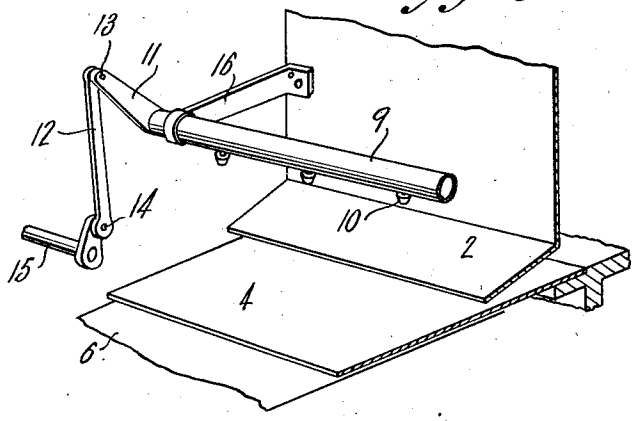


Fig. 9.

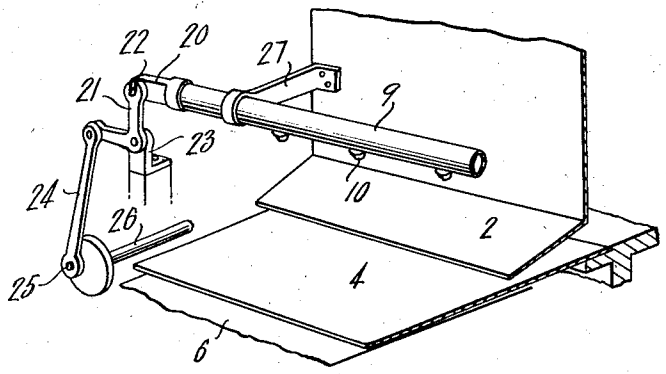
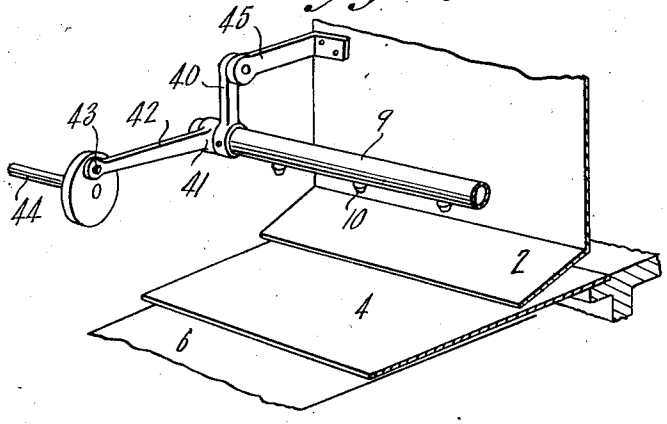


Fig. 10.



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METHOD AND APPARATUS FOR MANUFACTURING PAPER

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Application May 5, 1934, Serial No. 724,049

14 Claims. (Cl. 92—44)

One of the objects of my invention is to improve paper formation so as to reduce the early drainage and to increase the retention of any filler such as clay, calcium carbonate or the like, which may be present in the furnish.

A further object of my invention is to provide a means for securing a chemical reaction in the pulp mix as it is applied to the wire. This may be done for the purpose of improving brightness, color setting, sizing, or to disperse foam or for various other reasons which will appear in greater detail hereafter.

A further object of my invention is to increase the speed at which a given furnish can be formed into paper.

A further object of my invention is to eliminate and/or to minimize the necessity for shaking the wire.

These and other objects will appear in connection with the detailed description which follows.

Heretofore every effort has been made to insure the smoothest possible stream of pulp being supplied to the wire. As a result the fibres have approached the wire more or less aligned in the direction of their movement, i. e.: following the flow lines of the water.

As a result, at the time the pulp stream approaches the first table rolls an enormous drainage occurs before there is any appreciable felting. This drainage may amount to as much as 60% of the total water removal and has a tendency to produce extreme two-sidedness as well as to lose any filler which may be present. I have found that by the use of certain mechanical forces tending to disrupt the flow lines, the fibres, immediately upon or before reaching an area of drainage, can be made to assume more transverse positions and to become felted. As a result, when the fibres are in the drainage area they tend to retard the movement of water through the wire, and thus greatly increase the retention of filler and improve the general formation of the sheet.

It is well known that for the purpose of setting color in paper manufacture some form of mordant is frequently necessary. Unfortunately, the mordant frequently is chemically inimical to other ingredients of the mix, and if added to the mix in the earlier stages of its treatment, will either lose its efficacy as a mordant or will react adversely to the other ingredients of the mix so as to deteriorate such ingredients or to produce foaming which is disruptive of the web formation. Alum is probably the commonest form of mordant, but is by no means the only form since almost any acidic material will act to some extent as a mordant. In particular the reaction between alum and a filler such as cacium carbonate is undesirable. If the alum is added at the beaters to the furnish containing calcium carbonate, foaming on a very serious scale is apt to develop when the furnish is diluted and run out on the wire. This occurs because the alum in concentrated form enjoys an appreciable time of contact with the carbonate in concentrated form. It has been thought heretofore that the time of contact or the intimacy of mixture between the alum and the calcium carbonate were the determining factors on foaming. My own experiments lead me to believe that foaming is due to the relative concentration of the two materials when they come in contact. When a concentrated stream of alum is fed into the beaters an appreciable time must elapse before there is any great distribution, and the alum in concentrated condition has therefore a considerable time to act upon the carbonate in equally concentrated condition. If the alum be applied to the wire when the mix is in a condition of maximum dilution, a very mild alum solution can be used and despite the utmost intimacy of contact the concentrations involved are not sufficient to produce any deleterious effect. I have found that less than ⅕ the amount of alum normally used in a given furnish is necessary when the alum is applied at the wire.

I have found that by directing, partly against the slice itself, and partly against the pulp stream, a series of high velocity sprays, I secure a decidedly improved formation. The effect of this is to disrupt the flow lines of the fibres and cause preliminary felting before any substantial drainage has occurred. This effect is greatly increased and improved by extending the apron a substantial distance outwardly from the slice so that the sprays act on the pulp stream entirely or almost so in the area of the apron. When the already felted mass reaches the drainage area it promptly forms a filter cake, greatly reducing drainage in the early stages. As a result of such reduction any filler such as calcium carbonate or clay is retained to a far greater extent than would ordinarily be the case, and the phenomenon of two-sidedness is accordingly reduced.

By having each spray emerge from the nozzle in the form of a hollow cone it is possible to direct the upper half of the cone against the slice and the lower half of the cone against the pulp stream. In case a chemical effect is desired or

if any material such as filler or additional stock or coloring matter is to be added by means of the spray, this arrangement provides a stream of the added material which flows out on top of the main pulp stream emerging from the slice. This upper stream is promptly and thoroughly mixed by the action of the lower half of the spray which, at high velocity and having a component opposed to the direction of pulp flow, violently encounters the pulp stream immediately upon its leaving the slice. As a result, the added material is incorporated in the felt (which, it is believed, actually begins to form at this point) with the utmost thoroughness.

In the drawings,

Fig. 1 is an end elevation showing one form of my invention;

Fig. 2 is a perspective view of the arrangement shown in Fig. 1;

Figs. 3 and 4 show alternative arrangements of the sprays illustrated in Figs. 1 and 2;

Figs. 5, 6 and 7, respectively, show possible arrangements of a different type of spray;

Fig. 8 shows an arrangement for oscillating the spray pipe about its own axis;

Fig. 9 shows an arrangement for reciprocating the spray pipe transversely of the machine;

Fig. 10 shows an arrangement for reciprocating the spray pipe parallel to the direction of pulp flow.

The invention is shown in Fig. 1 as consisting of a head box 1, having a slice 2 which regulates the flow of pulp 3 onto the forming wire. An apron 4 extends beyond the slice over the breast roll 5. The wire 6 coming around the breast roll passes under the apron. The wire and apron are supported intermediate the breast roll and the first table roll 7 by a series of set boards 8. These boards are shown as five in number, three of them underlying and supporting the apron, the other two serving to support the wire intermediate the end of the apron and the first table roll. The number and location of these set boards may, of course, be varied, and it is also within the scope of my invention to use any other suitable means of support. It is also within the scope of my invention to terminate the apron at or near the lip of the slice.

A pipe 9 is placed above the wire and runs transversely across the entire width of the machine. This pipe is equipped with various nozzles 10 which direct a spray at high velocity in the form of a hollow cone against the pulp stream and, as shown in Fig. 1, partly against the slice. The nozzles are so spaced that the spray circles overlap and cover the entire width of the slice. It will be noted that approximately half of the spray area lands on the pulp stream and the other half is directed against the slice. That portion which is directed against the pulp stream has a substantial component of motion opposed to the flow of the pulp stream. The velocity of the spray is sufficient to penetrate the pulp stream. As a result there is violent agitation of the pulp stream at all points where the spray cuts into it. Due to the component of the spray opposed to the flow of the pulp there is a decided tendency to arrange the fibres transversely to the direction of pulp flow and thus to bring them into felted condition. This reaction is almost instantaneous and forms the pulp into a felted web, thus greatly reducing the tendency to drainage, and conserving any filler while improving the formation of the sheet.

In case a chemical effect is desired or if it is desired to add solid material such, for example, as is contained in the white water, to the pulp stream, the arrangement shown in Fig. 1 is especially advantageous. The upper portion of the spray being directed against the slice produces a thin stream of fluid which runs down the slice and forms a fluid layer on top of the pulp stream emerging from the slice. The lower half of the spray violently agitates the two layers and results in thorough mixing. In this way two-sidedness is almost entirely avoided.

In Fig. 3 the nozzles are shown directed vertically downward so that the entire area under spraying action is subjected to components of motion in every possible direction. This tends to insure a uniform felting of the fibres in all directions and to equalize the tearing strength of the sheet in all directions.

In Fig. 4 nozzles are inclined so as to direct the spray generally in the direction of pulp flow. This is especially advantageous where extreme web speeds are desired. It is possible that the arrangement shown in Figs. 1 and 3 might, at web speeds upwards of 1200 feet per minute, result in too violent a reaction between the spray and the flow of the pulp. It is necessary, using any nozzles of this sort, to have sufficient velocity in the spray to insure proper distribution, and there is, as a practical matter, a fairly abrupt upper limit to the velocity at which the spray can remain effective. When extreme web speeds are used, the arrangement shown in Fig. 4 still produces a resultant between the spray and pulp stream which is opposed, as a matter of relative motion, to the flow of the pulp stream.

Figs. 5, 6 and 7, respectively, correspond to Figs. 1, 3 and 4 except that in each the spray is projected in the form of a flat sheet rather than in the form of a hollow cone. In the installation shown in Fig. 5 a flat spray is directed on an incline substantially opposed to the direction of the flow of the pulp stream. Such a spray effects a momentary damming up of the particles into a thicker layer of fluid and at the same time violently agitates it. In particular this type of agitation tends to roll the fibres in the backwash of the intersecting streams. The rolled mass is then flattened as it passes directly under the spray. This occurs as a continuous process and produces a type of felting which is particularly desirable for many kinds of pulp.

In the form shown in Fig. 6 the damming up just referred to occurs to a lesser extent than in the form of Fig. 5 and there is less tendency to roll the fibres in the backwash of the intersecting streams.

In the form of Fig. 7 there is little or no damming up except at extreme web speeds, and at extreme speeds the arrangement of Fig. 7 can be made to perform most of the functions of the forms of Figs. 5 and 6.

The beneficial effect of the use of all of the various forms of sprays above described is considerably increased if the apron be extended so as to underlie the entire area of spray activity. Such an extension of the apron permits the preliminary felting to take place as a result of the spraying action before any drainage can occur. As a result retention of the fibres and particularly of fillers such as clay and carbonate is considerably improved.

The arrangement shown in Figs. 8, 9 and 10 can be used with the type of nozzles shown in Figs. 1–4 or with the type shown in Figs. 5, 6 and 7. Also, the inclination of the nozzles may be in

accordance with any of the forms heretofore discussed.

In Fig. 8 the pipe 9 is shown as having a lever arm 11 clamped at one end. A link 12 is pivoted to the arm 11 at 13. The other end of the link is pivoted to an eccentric pin 14 driven by a shaft 15. The eccentricity of the pin 14 is less than the length of the arm 11 and therefore as the shaft 15 rotates the arm 11 will be oscillated and accordingly the pipe 9 with its nozzles 10 will oscillate about its own axis. The mechanism just described should be duplicated at both ends of the pipe 9 when extreme machine widths are used. This arrangement will be found desirable in certain cases, and if the oscillation be made extremely rapid the agitation of the pump stream and consequently the felting of the fibres will be improved.

In Fig. 9 the pipe 9, slidably supported in a bracket 27, is shown as having a clamp 20 at one end. A bell crank 21 is secured by a pin and fork connection 22 at one end to the clamp 20 and is fulcrumed to a suitable fixed member 23. A link 24 is pivotally joined at one end to an arm of the bell crank 21, and at its other end is pivoted to an eccentric pin 25 driven by a shaft 26. As the eccentric pin rotates the bell crank is rocked and draws the pipe back and forth in a direction transverse to the direction of flow of the pulp stream. This is a particularly desirable arrangement in that it insures great uniformity of the spraying action. In case one or more nozzles become wholly or partially plugged the spraying action will be maintained at almost its full efficiency by the action of adjacent nozzles which are brought into position by the reciprocation of the pipe. It will, of course, be understood that the support 27 will occur at both ends of the pipe, and in the case of especially wide machines it may be well to interpose one or more intermediate supports. In general it will not be necessary to duplicate the bell crank mechanism at both ends of the pipe, but this can be done if desired. The arrangement of Fig. 9 tends to produce the same effect as is now produced by shaking the wire, and when this installation is used the shaking can be reduced or even dispensed with.

In Fig. 10 is shown a bracket 45 to which is pivoted one end of a link 40. The other end of the link rotatably supports the pipe 9. A second link 42 has a strap 41 at one end, freely surrounding the pipe 9. At its other end, the second link 42 is pivotally secured to an eccentric pin 43 driven by a shaft 44. As the eccentric pin rotates, the pipe 9 is swung back and forth on the link 40 about the pivot of the bracket 45, in a direction parallel to that of the pulp stream. In this form it is usually necessary to duplicate the driving means at each end of the pipe.

In general the use of these sprays, producing an instantaneous preliminary felting of the fibres, accomplishes every purpose which is usually attained by shaking the wire. In many cases, and usually at upper web speeds, the shaking of the wire can be dispensed with if the sprays are installed. While I have mentioned the arrangement in Fig. 9 as particularly supplanting the shake, any of the arrangements above discussed will act to greater or less degree to produce that effect.

It is to be noted that the manufacture of paper is probably the most empirical of any major industry, and the practice will vary not only with every plant but actually with every machine. It differs with the types of pulp and with the other ingredients of each furnish. For that reason it is difficult, if not impossible, to state that any of the expedients above described is preferable under all circumstances. It will be necessary to determine the precise type of nozzle, its exact location and inclination and its preferred velocity individually for each installation. While I have stated that the extended apron is desirable, it is by no means essential, and the sprays may be placed at various distances from the slice and above the wire. Moreover, types of sprays other than the two basic types here discussed may be used effectively for various purposes. It is not therefore my intention to limit this invention to the precise forms herein disclosed, but only as set forth in the appended claims which are to be broadly construed.

I claim:

1. In the process of making paper, the steps which comprise supplying a measured stream of pulp to drainage areas and directing a fluid jet against said stream before said stream reaches said drainage areas.

2. In the process of making paper, the steps which comprise supplying the measured stream of pulp to drainage areas and directing against said stream a fluid jet having a component of motion acting oppositely to the flow of said stream.

3. In the process of making paper, the step which comprises directing a fluid jet against a pulp stream leaving the slice of a Fourdrinier machine at a velocity greater than that of the stream and in such a direction as to have a component of motion in the direction of the pulp stream before any fluid has drained from said pulp stream.

4. In the process of making paper, the step which comprises directing a fluid jet against a pulp stream leaving the slice of a Fourdrinier machine at a velocity greater than that of the stream and in such a direction as to have a component of motion in the direction of the pulp stream before any fluid has drained from said pulp stream, the velocity of such component being less than the velocity of the stream.

5. In the process of making paper, the steps which comprise, directing a high velocity fluid jet, in the form of a hollow cone, against the stream of pulp emerging from the slice of a Fourdrinier machine, the upper portion of said jet being directed against the slice and the lower portion against the stream.

6. In the process of making paper, the steps which comprise, supplying a measured stream of pulp to a traveling wire having no lateral movement, and directing a fluid jet against said stream to disrupt the same.

7. In a Fourdrinier machine, a traveling wire, a slice supplying a stream of pulp to said wire, a pipe mounted above said wire, a series of spray nozzles in said pipe, said nozzles being directed toward said wire to supply high velocity jets, and means to oscillate said pipe about its own axis.

8. In a Fourdrinier machine, a traveling wire, a slice supplying a stream of pulp to said wire, a pipe mounted above said wire, a series of spray nozzles in said pipe, said nozzles being directed toward said wire to supply high velocity jets, and means to reciprocate said pipe in a direction parallel to said wire.

9. In the process of making paper, the steps which comprise, supplying a measured stream of pulp to drainage areas and directing a fluid jet in the form of a hollow cone against said

stream before said stream reaches said drainage areas.

10. In the process of making paper, the steps which comprise, supplying a measured stream of pulp to drainage areas and directing a fluid jet in the form of a flat sheet against said stream before said stream reaches said drainage areas.

11. In the process of making paper, the steps which comprise, supplying a measured stream of pulp to drainage areas, directing a fluid jet against said stream before said stream reaches said drainage areas and reciprocating said jet in a direction transverse to the direction of flow of said stream.

12. In the process of making paper, the steps which comprise, supplying a measured stream of pulp to drainage areas and adding stock to said pulp by means of fluid jets directed against said stream before said stream reaches said drainage areas.

13. In the process of making paper, the steps which comprise, supplying a measured stream of pulp mixed with calcium carbonate to drainage areas and adding an alum solution to said pulp by means of fluid jets directed against said stream before said stream reaches said drainage areas.

14. A method of fixing the color of paper which comprises subjecting the stream of furnish emerging from the slice of a Fourdrinier machine to the action of a mordant applied as a high velocity jet directed against said stream after it emerges from the slice and before it reaches any drainage area of the wire.

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