

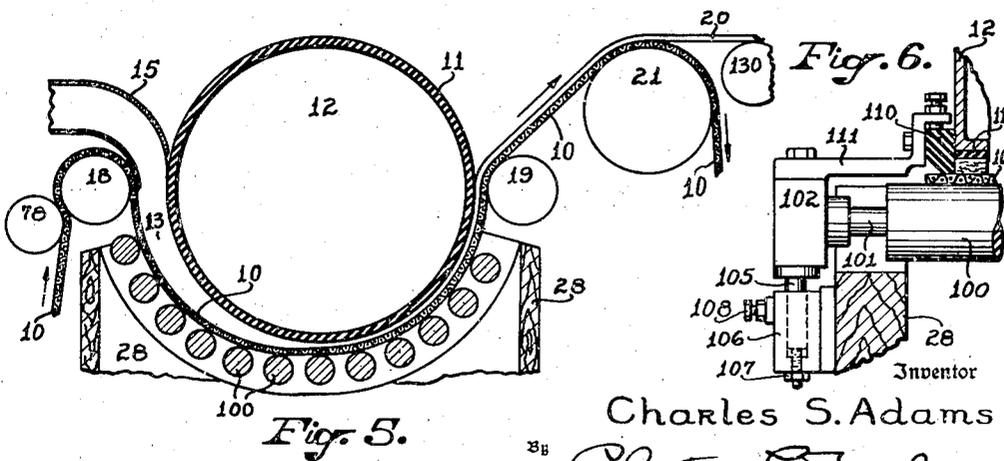
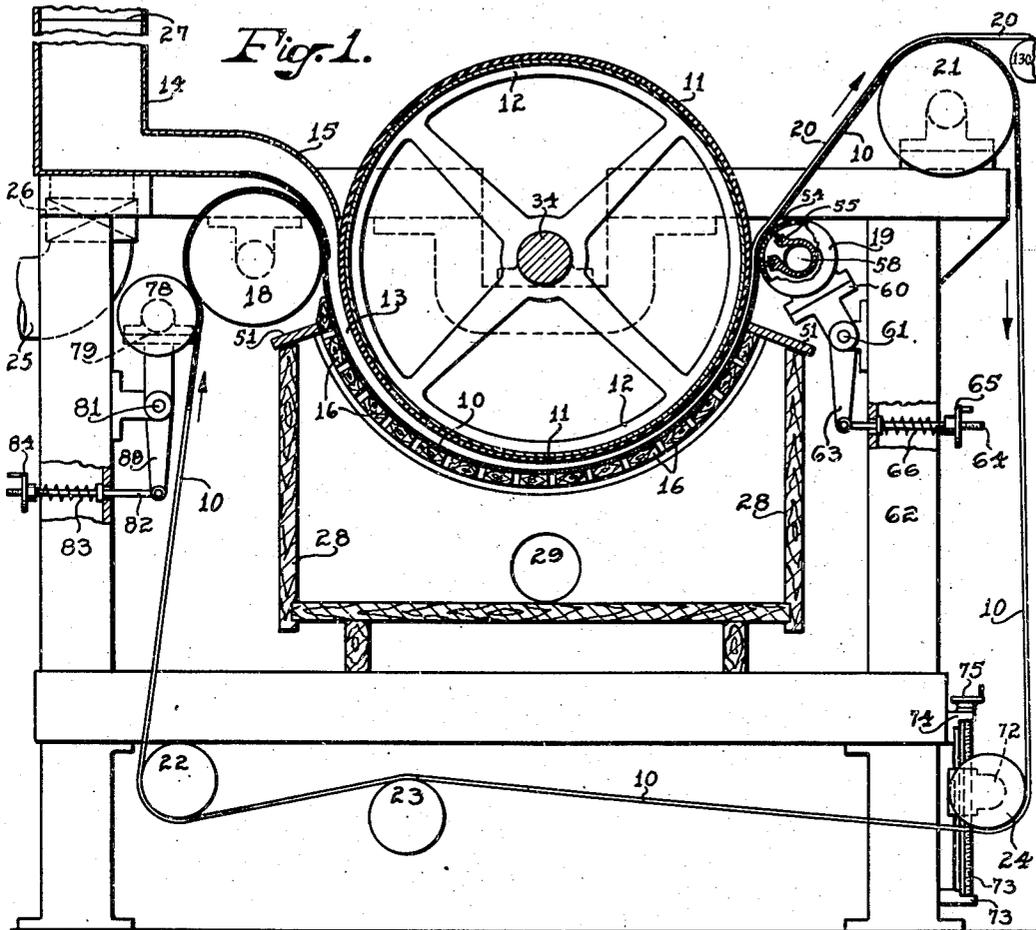
June 14, 1949.

C. S. ADAMS
PAPER MAKING MACHINE

2,473,269

Filed Sept. 2, 1944

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

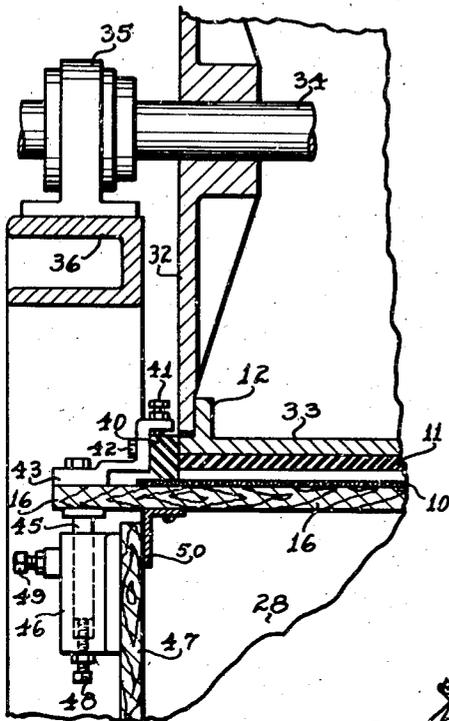


Fig. 2.

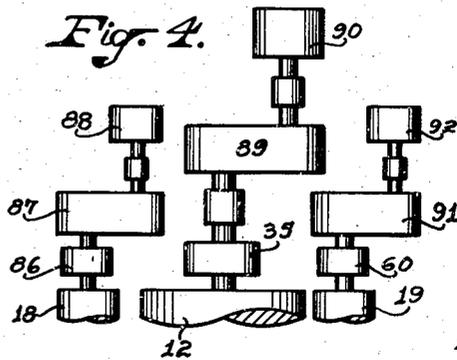


Fig. 4.

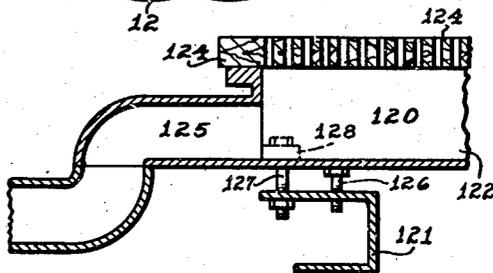


Fig. 8.

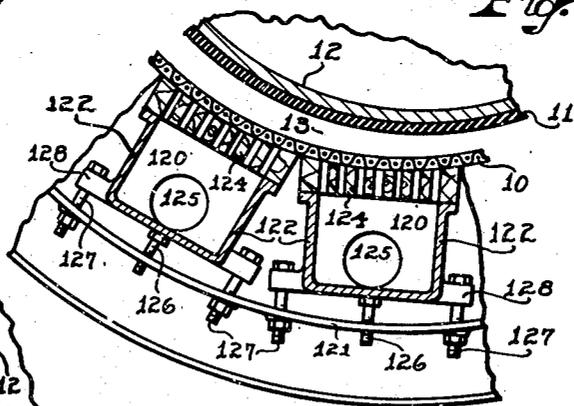


Fig. 7.

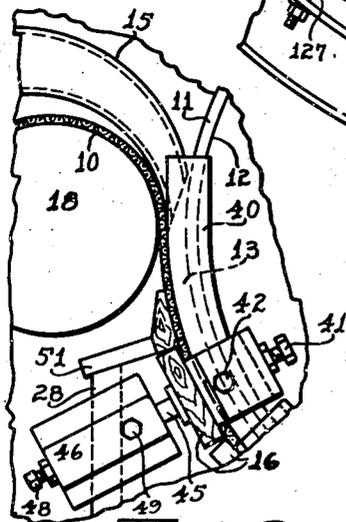


Fig. 3.

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UNITED STATES PATENT OFFICE

2,473,269

PAPERMAKING MACHINE

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Application September 2, 1944, Serial No. 552,508

6 Claims. (Cl. 92-43)

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This invention relates to paper making machines and more particularly to a machine of the type in which paper pulp is laid on an endless travelling wire.

According to the Fourdrinier method of making paper, a high velocity pond of pulp suspended in water is flowed onto a rapidly travelling endless wire screen supported in a substantially horizontal plane on a set of closely spaced table rolls. The top side of the pond and the sheet that is forming on the wire is exposed to the still air, while the under side is travelling at the high wire speed. This causes windage which tends to orient the stock and straighten out the fibres into a horizontal alignment. This frictional drag of the air disturbs the formation and travel of the stock materially and should be minimized. Also, the production speed of making the paper is limited by the rate drainage of water from the stock which depends chiefly upon the force of gravity plus such effect as is had by the capillary action of the table rolls. Yet, the paper stock should be laid at a comparatively rapid rate to prevent reflocculation. That is, if the stock remains quiescent relative to the wire, the fibres tend to collect in bunches or to flocculate. It is therefore desirable to lay the fibres rapidly and yet under conditions which cause a satisfactory intermatting thereof. Moreover, the Fourdrinier structure is long, complicated and expensive and occupies a large space in the plant. The wire is also long and comparatively fragile and wears out frequently, and the necessity for frequent replacement thereof requires that the machine lie idle for considerable periods of time.

A primary object of this invention is to overcome such problems and to provide an efficient paper making machine in which the web is laid on a travelling wire screen and which will cause the formation of the paper web at a more rapid rate than heretofore deemed practicable, or which will accomplish desirable paper making results at lower speeds.

A further object of the invention is to provide a machine of this type in which the water is removed from the stock under pressure greater than that provided by the force of gravity.

A further object is to provide a machine in which the opportunity for reflocculation of the pulp is materially decreased.

Other objects are to overcome the detrimental effects of windage and to avoid subjecting the stock or the sheet derived therefrom to any

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frictional drag which would tend to disturb the paper formation.

Another object is to provide a machine in which the pressure applied to the stock that is being laid on the wire may be regulated as desired.

A still further object of this invention is to provide a compact and short paper making machine of simple construction in which the pulp is laid on a travelling wire but wherein that wire is short and comparatively inexpensive and may be readily and quickly replaced. Other objects will be apparent in the following disclosure.

In accordance with my invention, I propose to lay paper stock on an endless travelling wire by forcing the stock under a regulatable pressure into a converging throat between the wire and an impervious surface of a travelling wall, such as a rotating cylinder, which preferably moves at substantially the same surface rate as that of the wire and wherein all of the stock introduced into the throat is formed into the web.

Referring to the drawings which illustrate preferred embodiments of this invention:

Fig. 1 is a somewhat diagrammatic vertical transverse section through a machine embodying the principles of this invention and wherein an endless wire is supported on adjustable bars;

Fig. 2 is a fragmentary longitudinal section thereof;

Fig. 3 is a detail showing the deckle mounting;

Fig. 4 is a diagrammatic plan of the motor drives;

Fig. 5 is a fragmentary transverse section showing a modification wherein the wire is supported on rolls;

Fig. 6 is a sectional detail showing the roll mounting;

Fig. 7 is a fragmentary vertical section of a modification having suction boxes supporting the wire; and

Fig. 8 is a longitudinal section through one of the suction boxes and associated parts.

As shown particularly in Fig. 1, a preferred embodiment of this invention comprises a moving endless wire screen 10 supported beneath an impervious travelling wall, such as the solid peripheral surface 11 of a cylinder 12, which preferably travels at substantially the rate of the wire. The wire and the impervious wall are so positioned as to provide a converging throat 13, and pulpstock is introduced into the wide end of the throat from a head box 14 and through a supply nozzle 15. The shape of the throat 13 depends primarily on

the configuration of the wire, and this is best predetermined by means of a perforated bottom wall structure therebeneath formed of a perforated flexible plate, or spaced bars or rolls or other suitable construction. The shape of the throat may be varied by adjusting this bottom wall. The structure shown in Figs. 1 and 2 comprises a set of wooden slats or bars 16 arranged to form an arcuate wall beneath the cylinder 12. The endless wire 10, which may be made the same as the standard Fourdrinier wire screen, may comprise a fine wire mesh screen of required permeability supported on a coarser wire mesh or other highly pervious body.

The wire may be driven in the direction of convergence of the throat, as indicated by the arrows, by means of a power driven roll 18 located at the entrance end of the throat. A roll 19, preferably power driven, is located at the narrow end of the throat and spaced from the surface 11 of the cylinder 12 by such distance as is required for the thickness of the web of paper 20, the parts being so arranged as to form a closure for the throat at that end. Further suitably mounted rolls 21, 22, 23 and 24 serve to return the wire beneath the paper forming zone, and suitable provisions may be made in accordance with standard practice for guiding the wire, just as blankets, felts or wires are guided in the paper making industry. The formed paper web 20 may be separated from the wire where the latter bends around the roll 21.

The nozzle 15 is an elongated pipe of rectangular cross section fitting closely between the surface of the wire as it passes over the roll 18 and the outer surface of the cylinder 12, so that the stock may flow into the converging throat 13 under a pressure determined by the head of stock in the head box 14. The stock may be admitted through pipe 25 and the height thereof in the box 14 may be regulated by suitable valve mechanism 26. That is, the top surface 27 of the stock may be raised or lowered by manipulating the inlet valve to obtain the desired pressure within the paper forming throat. The bottom bars 16, which limit the downward movement of the wire and determine the shape of the throat, are mounted above a vat 28 arranged beneath the paper forming zone to receive the water from the stock, and this water may be suitably removed through an exit pipe 29 located near the bottom of the vat.

The primary function of the cylinder 12 is to provide an impervious upper wall for the space or throat within which the paper web is formed. This cylinder, which may be the standard size employed in a cylinder mold machine, may be formed (Fig. 2) of two end walls 32 supporting a cylindrical wall 33 made of cast iron or other suitable material. The outer periphery 11 of the cylinder is preferably formed of hard rubber of suitable composition vulcanized to the iron cylinder 33. The cylinder is mounted on trunnions or a shaft 34 carried by suitable adjustable bearings 35 mounted on a portion 36 of the framework of the machine.

The two side walls of the throat 13 may be formed by two spaced stationary arcuate shaped deckles 40, made preferably of hard rubber, which are so mounted (Figs. 2 and 3) that the face portions, near the edge, of the travelling wire 10 and the ends of the cylinder rub against two faces of the deckles. Various constructions taken from the Fourdrinier machine art may be employed for this purpose. Each deckle may be

held in position by means of two adjusting screws 41 and 42 carried by an angle plate 43 suitably mounted on the cross bars 16 or the framework of the machine. The screw 41 holds the deckle downwardly against the wire, while the screw 42 pushes the deckle inwardly against the adjacent end of the hard rubber layer 11 of the cylinder. Thus, as the cylinder and wire travel they make a sufficiently satisfactory rubbing contact with the deckle to prevent any material leakage of the pulp.

Although the bars 16 may be permanently positioned, it is preferable to make them adjustable so that the shape and width of the forming throat 13 may be varied. This may be accomplished, as shown particularly in Fig. 2, by mounting each end of each bar 16 on a slidable post 45. Each post is mounted for sliding radially of the cylinder 12 within a socket in a metal bracket 46 which is suitably secured to an end wall 47 of the vat. A screw 48 threaded into the body 46 engages the bottom end of the post 45 and adjustably positions the bar 16 radially of the cylinder. A set screw 49 engages the side of the post 45 and aids in holding the bar 16 immovable. Thus, the bars may be adjusted radially of the cylinder and form an arc of variable length or distance from the cylinder. An angle plate 50 carried by each bar 16 slides against the inner face of the wall 47 and prevents any material amount of water from escaping at this point. Since the bars 16 are moved radially outwardly and thus spread apart tangentially relative to the cylinder, suitable provisions may be made to close the gaps, except adjacent to the wire, and make a substantially air-tight casing so that, if desired, a vacuum may be applied within the casing to aid in the removal of water from the paper web. Each end bar 16 (Fig. 1) may have attached thereto a slide plate 51 which slides in a radial direction across the top of the vat 28 and thus prevents water from splashing outwardly at this point.

The amount of pulpstock introduced into the throat 13 depends upon the hydraulic head in the box 14 and the rate of withdrawal of paper pulp in the web 20 and the rate of removal of water. The volume or capacity of the forming throat is determined by the positions of the bars 16. The rate of removal of water from the throat is determined by the pressure and the sizes of the openings between the bars, as well as the influence of gravity and other conditions.

One or more suction devices, such as a suction roll, may be provided at the exit end of the machine to remove further water from the paper web 20. As illustrated in Fig. 1, the roll 19 may be made as a suction roll. This roll, which may be of standard construction, has a perforated peripheral wall 54; and a stationary U-shaped wall 55 within the roll has rubber wipers rubbing against the inner surface of the revolving periphery of the roll. The water is drawn into the suction chamber formed between these walls 54 and 55 and it is carried outwardly through an exit pipe 58 suitably connected with apparatus designed to exhaust the air and water from the roll.

This suction roll 19 may be adjustably mounted relative to the periphery of the cylinder 12 by means of a rocking lever support 60 carrying the bearings of the roll. The lever is pivoted at 61 on a bracket carried by the framework 62 of the machine. The lower arm 63 of the lever is adjustably positioned by means of a threaded draw

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bar 64 carrying a hand operated wheel 65 threaded thereon. A spring 66 within a cavity in the frame through which the draw bar passes bears at its opposite ends on the frame and the hand wheel and thus urges the roll 19 under an adjustable resilient pressure towards the cylinder 12 and against the pull of the wire.

In order to adjust the tightness of the wire and to make it readily removable, the roll 24 (Fig. 1) may be mounted on adjustably positioned bearings 72 supported by rods 73 threaded there-through. Each rod is rotatably supported at its two ends by brackets 74 carried by the machine frame 62, and it is adjustably positioned by means of a hand wheel 75 so arranged that the rod 73 may be threaded through the bearing bracket 72 and thus move the roll 24 up or down as required.

At the left hand end of the machine, a further roll 78 is resiliently and adjustably mounted in position to hold the wire tightly against the driving roll 18. This roll 78 may have each of its bearings 79 suitably mounted on the upper end of a lever 80 pivoted at 81 on a bracket carried by the framework. The lower end of the lever has a draw bar 82 pivotally connected thereto and a spring 83 and hand wheel or adjusting nut 84 serve to hold the roll 78 resiliently against the wire, as will be readily understood.

The operation of this machine involves so positioning and moving the wire 10 that it will hug the cross bars 16 and not be drawn up against the periphery of the cylinder 12. To this end, I propose to drive the roll 18 at such a rate relative to that of the roll 19 that the rolls tend to hold the wire somewhat loose within the throat. This may be accomplished by various types of driving mechanism such as an electric motor assembly diagrammatically illustrated in Fig. 4. That is, the roll 18 suitably carried by bearings 86, is driven through a speed reduction gearing mechanism 87 by an electric motor 88. Likewise, the cylinder 12 carried on its bearings 35 is driven through a gear reduction 89 by means of an electric motor 90. The roll 19 carried by its bearing support 60 is driven through a gear speed reduction device 91 by means of an electric motor 92. The electric motors may be of the direct current constant speed type controlled by rheostats in the field windings. It is to be understood that the gear reduction devices are so constructed that the peripheries of the rolls 12, 18 and 19 move at the same surface rate. If desired, the electric motor 88 may be so controlled that it attempts to drive the roll 18 at a slightly greater rate than the others so as to insure that the wire hugs the cross bars. This drive may be of the standard sectional electric drive type involved in driving the different rolls of a Fourdrinier paper machine, which comprises synchronous motors and resistance controls so arranged as to move the wire and the cylinder surface at the same rate.

A set of rolls 100 (Figs. 5 and 6) may be substituted for the stationary cross bars 16. In order that these rolls may be adjustably positioned, their bearings may be mounted substantially the same as the adjustable bars 16. Each of these rolls 100 may have its mandrel 101 supported in a bearing housing 102 carried on a post 105 that is movable radially of the cylinder 12. That is, the post 105 slides in a socket within the bracket 106 mounted on one of the walls 28 of the vat, and the post is vertically moved by means of the screw 107 and locked in place by

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the set screw 108. The deckle construction is substantially as above described, wherein the stationary rubber deckle 110 is carried by the iron bracket 111 mounted on the bearing support 102 so that the deckle will be moved as the rolls 100 are adjusted in position. These rolls 100 carry the wire 10 without frictional drag since they are freely rotatable and move with the wire. They also aid somewhat by capillary action in removing water that passes through the wire. The various construction details above described may be incorporated in this modification to provide a vat construction, and if desired, to provide for a partial vacuum to aid in removal of the water.

If a vacuum is to be used for removing water, I may employ the construction shown in Figs. 7 and 8. In this arrangement, a set of suction boxes 120 are adjustably mounted on an arcuate frame support 121. Each box may be of standard construction used on the Fourdrinier machine. As shown, it comprises walls 122 forming a hollow body closed at its top by a perforated wooden plate 124 having its upper surface shaped in the form of an arc to fit substantially against the travelling wire 10. Each box has an exit pipe 125 communicating with its interior and leading to a suitable suction apparatus which exhausts the air from the suction box and carries off the water withdrawn from the pulp on the wire. The suction box may be vertically moved by means of a screw 126 threaded into the brackets 121 and engaging the bottom of the box. Further screws 127 carried by lugs 128 projecting from the side of the box serve to hold the box in position. Thus, by means of these two screws, the box may be moved radially of the cylinder 12 to vary the width of the web forming throat.

The suction boxes may be arranged to form the bottom support for the wire throughout the entire length of the throat 13. Hence, suction may be employed to withdraw the water from the pulp throughout the entire length of the paper forming zone as distinguished from the standard Fourdrinier practice wherein suction is employed only at the dry end of the table section. This aids in further speeding up the formation of the paper web, since I supplement the pressure of the pulpstock entering the nozzle 15 by the partial vacuum set up within the suction boxes. Thus, the paper is laid on the wire in the short distance of only a few feet represented by less than half of the periphery of the cylinder 12 as compared with the long table section of the Fourdrinier machine.

The operation of the machine will be apparent in view of the above disclosure. Pulpstock is introduced under the pressure of such head as is provided in the head box 14 and this stock flows into the converging throat 13 between the wire 10 and the rubber face 11 of the cylinder. The wire and the cylinder are moving at the same surface rate, and the stock travels at substantially that rate so that there is the minimum of frictional drag on the web at any point. The water passes rapidly through the openings between the cross bar 16 (Fig. 1) or the rotatable rolls 100 (Fig. 5) or it is removed into the suction boxes 120 of Fig. 7. The water escapes through the wire 10 as the pulp travels towards the narrow end of the throat and the paper web is laid progressively on the wire without undue agitation and without flocculation. One or more suction rolls 19 dry the web sufficiently for its next stage treatment. The taper of the forming zone is such

that substantially the entire length of the zone is employed in the removal of water and the laying of the web, and the rate of stock flow is regulated to insure that the forming throat is kept filled with stock. Thus the stock is formed into a web within a tapering cavity whose top and bottom walls move synchronously. Since the roll 12 has a solid surface that is non-receptive to the paper stock and the wire and its associated supports are perforated, the paper is laid wholly on the wire and not on the face of the cylinder 12.

In this construction the cylinder has a diameter of from 3 to 8 feet and the arcuate tapering throat extends a considerable distance around that cylinder, such as illustrated. The suspension of pulp in water is preferably introduced at substantially the rate of movement of the wire screen and the opposed cylinder surface, and the shape of the throat is so adjusted relative to the type of pulp being treated that the pulp suspension moves forward at substantially that same rate throughout the length of the throat. Hence the pulp is substantially quiescent as regards the two adjacent moving surfaces of the cylinder and wire, and there is but little surface drag on the pulp. Consequently, the intermatting of the fibres or the texture of the paper is determined chiefly by the fact that the fibres settle out of suspension onto the adjacent relatively stationary wire as the water passes through the latter. The rate of paper making is determined therefore primarily by the speed of movement of the wire and the hydrostatic pressure on the pulp suspension which is involved in gravity and suction, if used, and the hydraulic head in the pulp supply box, as well as the centrifugal force set up by the rotating cylinder. Thus, the paper is formed on the wire under comparatively quiescent conditions, and it is removed continuously from the paper making zone and thereafter stripped from the wire by the aid of the roller 130 adjacent to the return wire roll 21.

It will now be appreciated that various modifications may be made in the construction and equivalent features substituted for those above described. Also, the paper maker may control the texture of the paper and the rate of its formation by varying the shape of the throat and the head of the pulpstock supplied thereto as well as by varying the rates of the moving parts. The above disclosure is, therefore, to be interpreted as illustrating the principles of this invention and my preferred embodiments thereof and not as imposing limitations on the claims appended hereto.

I claim:

1. A paper making machine comprising a moving, endless, pervious, fine mesh screen wire arranged for the formation thereon of a paper web deposited from an aqueous suspension of paper pulp stock, a traveling wall located only above and opposed to the wire in a relatively fixed relationship which is impervious and non-receptive to the paper stock, means for movably supporting the wall, a fixed support which predetermines the configuration of the wire and provides for the passage of water therethrough, side walls adjacent to the edges of the wire, said wire and walls forming a gradually tapering throat of fixed and predetermined shape which converges from a wide stock entrance to a closed end where the paper web on the wire contacts with the traveling wall, controllable driving mechanism for moving both the wire and the traveling wall at the

same rate towards the closed end of the throat without disturbing the throat shape, means for removing the water that has passed through the wire, and regulatable means including a conduit that makes a substantially water-tight connection with said entrance for maintaining the throat filled with an aqueous paper stock suspension under a controlled hydraulic head which determines the rates of water removal and paper formation, the throat providing for the progressive concentration of a suspension of pulp fibres and the formation of a paper web on the wire by the forced removal of the water during the period of travel of a portion of the wire and the associated pulp from the entrance to the closed end of the throat.

2. A paper making machine comprising a rotatable cylinder having an impervious, non-receptive, peripheral surface mounted to rotate about a horizontal axis; an endless, pervious, moving screen wire arranged substantially wholly beneath the cylinder for the formation thereon of a paper web deposited from an aqueous suspension of paper pulp stock, a fixed support providing a free passage of water therethrough which holds the wire in a predetermined arcuate shape around and spaced from the lower portion of the cylinder periphery and forms a tapering throat of fixed configuration converging from a wide stock entrance to a closed end where the paper web on the wire contacts with the cylinder, walls forming the sides of the throat, means including a conduit making a substantially water-tight connection with said stock entrance for maintaining the throat filled with a paper stock suspension under a variable hydraulic pressure which forcibly removes the water and controls the rate of paper formation, said throat being shaped to provide space for freely floating paper fibres which become intermatted gradually and form a web on the wire as the water is forced through the wire, means for rotating the cylinder, means for moving the wire at the peripheral rate of the cylinder and in the same direction towards the closed end of the throat without changing the configuration of the throat materially and means for removing the water that drains through the wire.

3. A paper making machine comprising an endless, pervious, moving screen wire arranged for the formation thereon of a paper web deposited from an aqueous suspension of paper pulp stock, rolls having horizontal axes which support the wire, a traveling wall spaced above the wire which is impervious and non-receptive to the paper stock, adjustable means for maintaining the wall and the moving wire in a fixed relationship and forming a tapering throat of predetermined shape which converges from a wide stock entrance to a closed end where the paper web on the wire contacts with the wall, driving connections for moving both the wire and the wall at the same rate towards the closed end of the throat without changing the throat configuration, means for removing the water that has passed downwardly through the wire, controllable means including a conduit that makes a substantially water-tight connection with the throat entrance for maintaining the throat filled with a paper stock suspension under a variable hydraulic pressure which determines the rate of pulp stock movement and suction means for removing water from the paper on the wire web as it leaves said throat, the taper and dimensions of the throat being related to the permeability

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of the wire so that a suspension of freely floating fibres becomes concentrated in said throat and the fibres are laid as a paper web on said wire during their passage through the throat.

4. A paper making machine comprising a rotatable cylinder having an impervious, non-receptive peripheral surface mounted to rotate about a horizontal axis, an endless, pervious, moving screen wire mounted in an arcuate shape beneath the cylinder and arranged for the formation thereon of a paper web deposited from an aqueous suspension of paper pulp stock, a set of spaced, adjustable supports beneath the wire which predetermine the configuration of the throat and provide for the drainage of water therefrom, side walls, said cylinder, wire and side walls forming a tapering, arcuate throat converging from a wide stock entrance at one side of the cylinder to a closed end at the other side where a paper web laid on the wire contacts with the cylinder periphery, means for moving the wire towards the closed end of the throat at a rate which maintains the pulp suspension quiescent, means for rotating the cylinder in the same direction and at the same peripheral rate, means including a conduit that makes a substantially water-tight connection with said entrance for maintaining the throat filled with said pulp stock suspension under a regulatable hydraulic head which controls the rates of water removal and paper formation and causes the water to move substantially at the rate of wire movement, means for withdrawing water from beneath the wire and means for supporting the formed paper web outside of said throat and removing water therefrom, the throat structure providing for the progressive concentration of said suspension at a rate determined by the hydraulic head and

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the deposition of all of the pulp on the wire as it moves with the pulp through the throat.

5. A paper making machine according to claim 2 in which the fixed support for the wire comprises rollers beneath the wire which are adjustably mounted for movement towards and from the cylinder axis.

6. A paper making machine according to claim 2 comprising suction means for reducing the atmospheric pressure beneath the wire where it forms a wall of the throat and thus aiding the hydraulic pressure on the stock within the throat to hasten the water removal.

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