No. 840,228. PATENTED JAN. 1, 1907.

S. MILNE.

PAPER MAKING MACHINE.

APPLICATION FILED DEC. 3, 1904.

Fig. 1.

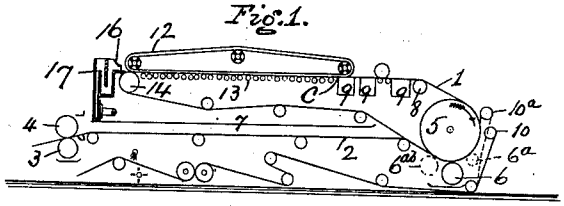


Fig. 3.

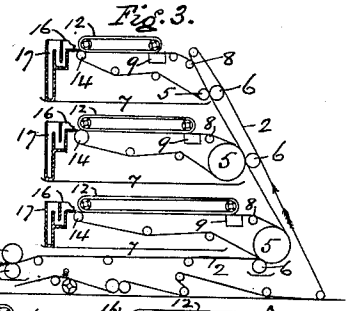


Fig. 2.

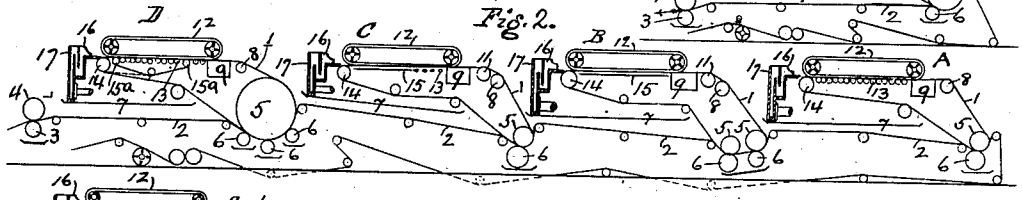


Fig. 4.

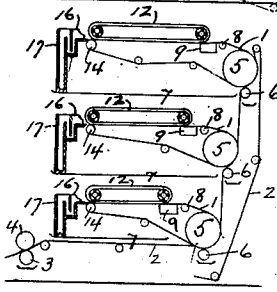


Fig. 5.

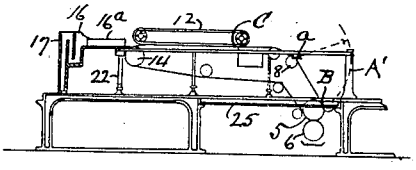


Fig. 7.

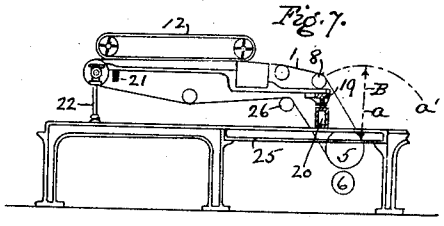


Fig. 6.

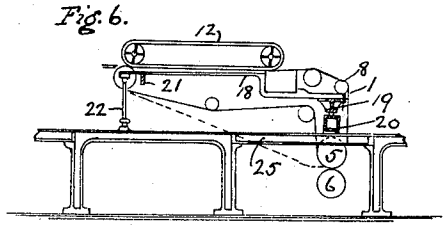
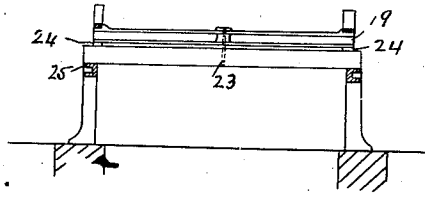


Fig. 8.



WITNESSES

Paul A. Blair.

Wallis Rose

INVENTOR

Samuel Milne

BY

Howson and Howson

ATTORNEYS

UNITED STATES PATENT OFFICE.

SAMUEL MILNE, OF EDINBURGH, SCOTLAND.

PAPER-MAKING MACHINE.

No. 840,228. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed December 3, 1904. Serial No. 235,326.

To all whom it may concern:

Be it known that I, SAMUEL MILNE, a subject of the King of Great Britain and Ireland, and a resident of Edinburgh, Scotland, have invented certain new and useful Improvements in Paper and Pulp Making Machines, of which the following is a specification.

The invention relates to improvements in paper and pulp making machines, and essentially comprises improvements and modifications on that class of machines known as the "Fourdrinier" machines.

My improvements consist mainly in combinations of Fourdrinier wires to make them suitable for making compound papers—such as duplex, triplex, and the like—so that several webs may be united to form one compound web without any of the difficulties hitherto connected with the manufacture of such papers on the machines employed for that purpose.

My improvements are chiefly connected with the manufacture of compound papers; but some of them are equally applicable to the ordinary Fourdrinier machine when used for making one thickness of paper.

Several very important advantages will result from my improvements, such as the material increase in the quality, which will equal the best Fourdrinier papers, and also an increase in output and a handiness and convenience of parts hitherto unobtainable on such machines.

In the accompanying drawings, which show diagrammatic views in elevation illustrating the various modifications of my improvements, Figure 1 shows an elevation of my improved machine with one wire-cloth. Fig. 2 shows an elevation of my improved machine with four wire-cloths and various arrangements of couch and wire rolls. Figs. 3 and 4 show elevations of machines with three wires arranged above each other, the couch-rolls being arranged in different relative positions in the two views. Fig. 5 shows an arrangement of side bars suitable for the machines shown in Figs. 1, 2, 3, and 4. Figs. 6 and 7 show other arrangements of side bars and framing, and Fig. 8 is an end elevation of part of Figs. 6 and 7.

In the construction shown in Fig. 1 I arrange a Fourdrinier wire 1 above the usual level and cause it to deliver the web of paper on the felt 2, which carries it below the wire device to the press-rolls 3 and 4. At the delivery end of the wire instead of the usual bottom or inner couch-roll I provide one, 5, of preferably larger diameter than usual to bring the wire sufficiently low down to meet the felt 2 and allow it to pass underneath.

The usual upper couch-roll may be dispensed with and the couching performed on the under side of roll 5 by the roll 6, of which there may be more than one, as shown at 6^a, 6, and 6^{ab}. Roll 5 may have a solid surface or may be perforated to allow water to pass on the upper side through the wire 1, as well as on the lower side through the felt 2. The roll 6 therefore performs the couching, and jackets may be dispensed with, as the felt 2 takes the place of the jacket, as well as acting as the press-felt. The paper leaves the wire 1 and adhering to the felt 2 is carried to the press-rolls 3 and 4, with the wire side upward, so that it comes in contact with the bare top roll, this being the exact reverse of an ordinary Fourdrinier machine, in which the wire side is down or next the felt when passing through the first press-rolls. By this arrangement the first pressure of the bare press-roll 4 is on the wire side of paper, which is the best possible condition for obliterating the wire-mark.

It will be seen that this arrangement delivers the paper at the press-rolls 3 and 4 without it requiring to be touched by hand in much better condition than it is delivered from the second set of press-rolls in an ordinary Fourdrinier machine. In the ordinary machine it must be led twice by hand to get it through the second press-rolls. All the losses incident to leading the paper from the couch-rolls to the second press-rolls in an ordinary Fourdrinier machine are therefore saved.

Although for all ordinary papers one set of press-rolls may be sufficient, more sets may be employed, the important point being that the wire side of paper comes first in contact with the bare top press-roll to remove the wire-mark.

The roll 5 instead of being of relatively large diameter, as shown in Fig. 1, may be of the usual diameter and be arranged as shown in Figs. 2, A, B, and C. The wire and felt would have all the usual accessories, and the felt may be carried up as far as necessary on

roll 5, as shown at 10 and 10ª. A tray 7 is fitted below the wire to prevent leakage onto the web of paper in its passage to press-rolls. This tray may be permanently secured to the framing of machine or may be made easily removable. It is obvious that a cloth or other lining can be led onto the roll 5, so that it may be united and pass through with the paper.

Fig. 2 shows an arrangement of four Fourdrinier wires similar to Fig. 1 to make quadruplex paper; but one or more may be used. The wires may be of any convenient length, and different arrangements of the rolls at delivery end of the wire are shown, all of them, however, delivering the paper onto a felt 2 passing underneath.

A shows a modification with the wire brought down on a roll 5 of usual diameter to bring it in contact with felt 2.

B shows a modification with two rolls 5 5 on the lower part of wire, so that the water may be allowed to pass through the wire from the paper on the upper side.

C is similar to A, with an extra roll 8 added to the upper part to make the angle less acute on roll 11, which could be used as guide-roll.

D is similar to Fig. 1 and is shown with three rolls 6 6 6, which would be very suitable for consolidating the paper and extracting as much water as possible before the paper passes to the press-rolls.

It must be distinctly understood that I do not limit myself to the arrangements illustrated of rolls 5 and 6, as it is obvious modifications can be made to suit the various papers being made.

It is also obvious that cloth or other material may be led onto either of the wires A, B, C, or D, so as to be fixed on the surface or embedded on the web of paper. The same felt 2 passes under all the wires and through the press-rolls, and each wire is provided with a water-tight tray 7 under it to prevent leakage onto the web. Figs. 3 and 4 show a modification with the wires arranged one above the other. The felt 2 passes downward, coming in contact with each wire successively in its course, and finally it passes to the press-rolls 3 and 4 underneath the bottom wire. The felt 2 may, however, be led from the bottom wire with the paper on its under side to a set of reversed press-rolls similar to ordinary second press-rolls in a Fourdrinier machine.

The wires may be arranged with their delivery ends vertically or at an angle either way, Figs. 3 and 4 showing two modifications. Rolls 5 and 6 may be arranged in different ways to suit the arrangement of wires and the paper being made.

All the wires mentioned may be of any suitable length, and provided with all the usual accessories, such as deckles 12 and vacuum-boxes 9, and the space between breast-roll 14 and vacuum-boxes 9 may be filled with the usual tube-rolls 13, Fig. 1 or Fig. 2ᴬ, to extract the water from the pulp in its passage along the wire. This space may, however, be filled with a flat plate or plates 15, Fig. 2ᴮ, instead of the tube-rolls, to prevent the water from leaving the pulp till it reaches the vacuum-box 9. This plate may be in one or several places and may be carried from the usual save-all supports or from the side bars in a manner similar to the usual tube-rolls 13. For example, the plate or plates could have supports similar to the journals or tube-rolls resting in adjustable bearings, so that they may be raised or lowered to suit the paper being made, or the space may be partly filled with a plate 15 and partly with tube-rolls 13, Fig. 2ᶜ, it being understood that the plate is of considerable length in the direction the wire travels—say not less than about one-tenth of the distance between the breast-roll 14 and vacuum-box 9.

The plate may be arranged to commence near the breast-roll and the tube-rolls near vacuum-box 9. A few tubes may be arranged near the breast-roll, followed by the plate, which may extend to the vacuum-box, or tubes may be introduced at each side of the plate, or an endless band of rubber or like material may be used, and this band may pass round the breast-roll, as shown dotted in D, Fig. 2, and tube-rolls or around separate rolls, as shown in full line at 15ª D, Fig. 2. This band may be arranged to occupy any position or proportion of the space between breast-roll and vacuum-box. The purpose of these various arrangements is to provide means for the proper settling of the fibers before the water is extracted.

At the breast-roll the pulp sometimes flows on with a rush, and the fibers are not in the best condition for forming the best paper they are capable of making. There is often also a great difference between the lineal speed of the top and bottom layers of the paper at this part of the wire, and when much water is extracted at this part the paper will be cloudy and irregularly formed.

By the means above described the fibers have time to become thoroughly interlaced and uniform and to become quiescent, or nearly so, by being carried forward on the wire to the part where the "shake" is reduced before water is extracted either by the tube-rolls 13 or vacuum-box 9, and a much superior quality of paper can be made from the same material. By arranging a few tubes near the breast-roll and before the plate or plates or band a certain quantity of water can be extracted to form the lower surface of the paper. The upper layer would then be better formed in passing over the plate or band than it would be were water continuously extracted. The means de-

scribed permit of every range of variation to suit the various kinds of paper and materials.

As previously stated, the wires may be provided with the usual shake motion; but if short they may be stationary or receive only a very small shake. The breast-board may be much wider than usual, as shown, 16ª, Fig. 5, and receives a shaking motion similar to the wire, or the whole breast-box 17 and breast-board 16 may be vibrated for the same purpose.

To provide for a shake in short wires when the delivery end is led downward to deliver the paper on top of felt 2, I arrange the shake or side bars with their ends and joints carried past the couch-rolls 5 and 6 to points coincident with arcs drawn from the point *a*, Fig. 5, where the wire leaves the upper roll, to the point B, where it meets the lower roll 5, the center of curvature of this arc being the point *a* on surface of upper roll, the arc being represented by dotted line A'.

The practical effect of this is to give the wire a gradually-reducing shake from breast-roll 14 to couch-roll 5, thus taking advantage of the full length of the wire between these points. The usual side bars terminate at or about the point C, Figs. 1 and 5.

By another modification shown in Fig. 6 the whole wire and its roll and fittings (except the bottom roll or rolls 5, which bring the wire in contact with the felt 2) are carried from two side bars 18, which are rigidly fixed to the cross-beam 19. This beam 19 is carried from a lower beam 20 by a pin or bolt in the center 23, Fig. 8. Beam 20 is stationary and is carried from the framing of machine.

The breast-roll ends of side bars are connected to the cross-bar 21, which may be placed outside the wire, as is usual, or inside, as shown in Fig. 6. The wire frame at breast-roll end is supported on the usual adjustable and movable supports 22, which may be placed under the breast-roll bearings, as shown, or under the cross-bar 21, as desired. Additional supports may be placed under the side bars, as usual, if they are of considerable length. The whole upper part of the wire frame will therefore be supported so that if the breast-roll is vibrated it will receive a motion round pin 23 as a center, the motion being a circular one instead of a parallel motion, as is obtained when the side bars are carried on two centers at the couch-roll ends, as is usual.

The practical result of this arrangement is that the breast-roll and the wire receive a shake without the wire being strained, as all the upper parts move as one piece. If the wire is led downward vertically, as shown in Fig. 6, the ends of roll 8 would move in an arc drawn from point B, where the wire meets roll 5 as a center, to a point *a*, where the wire leaves roll 8, which is the nearest possible to a horizontal line when the very small extent of motion is taken into consideration. It follows, therefore, that with the arrangement shown in Fig. 6 the beam 19 may be supported at its outer ends by pieces 24, Fig. 8, to insure a horizontal motion.

When the wire is led downward from roll 8 at an angle, as shown in Fig. 7, roll 8 while moving by the action of the shake in an arc of a circle the center of which is pin 23 will also receive a motion at its ends corresponding to an arc drawn from point B as a center to point *a*, as shown by arc *a'*. The ends of roll 8 while having a horizontal motion as the result of the shake will also have a small vertical motion as a result of its position in relation to roll 5, these motions being reverse at each end of roll—that is to say, when the front end of roll 8 is moved toward the left hand it will also drop a little, while the back end will be moved to the right hand and rise a little. This vertical motion in practice is very slight and may be provided for by leaving the ends of beam 19 free by removing supporting-pieces 24, Fig. 8, and allowing the wire-cloth by its tension to adjust beam and roll to suit, or it may be provided for by arranging the supports 24 of such a shape as to give the desired motion in accordance with arc *a'*. Instead of these supports 24 this motion may be provided for by using connecting links or rods the centers of which would coincide with the points B and *a*. The whole object of these various arrangements is to maintain a uniform tension on the wire-cloth between the rolls 8 and 5.

In Fourdrinier wire frames the framing has hitherto been so arranged that it is necessary when changing wires to take out all the rolls which are inside the wire, the save-alls, and the other parts, excepting the inner couch-rolls, which entails a considerable amount of work and time. To enable the wires to be changed more quickly, I arrange the framing and supports for the rolls and parts which are inside the wire so that they come within the path of the wire. The cross-bar instead of being placed outside the wire, as is usual, is placed inside, as shown at 21, Figs. 6 and 7.

The usual supports at breast-roll end may be placed under the breast-roll bearings, as shown in Fig. 6, or they may be under the cross-bar 21, the front supports being arranged to be easily removed. The couch-roll ends of side bars are carried from cross-beam 20, and the couch-roll 5 may be carried from the beam or from adjacent framing. A part of the framing 25 is made easily removable to allow the wire to be slipped on. The supports 22 may have tapered or spherical-shaped ends resting in suitably-shaped recesses top and bottom, so that they are easily removed when the frame 25 is withdrawn after the bolts are removed in the

usual manner. To put on a new wire, the breast-roll end is supported by suitable means and front support 22 removed.

The whole of the wire frame, excepting the roll 5, is carried on the beam 20 and supports 22. The roll 5 may also be supported from the beam 20. In the following explanation it is supposed to be so: If the wire is one hundred inches wide, the supports used must have a clear length of one hundred inches outside the framing. In the case of the breast-roll it would be a long rod or pipe slipped on the end of the spindle, which is always left long for this purpose. For the beam 20 any suitable bar would do, the beam being preferably made hollow to admit it. This bar should also be long enough to hold the full width of the wire. Suppose these two supports are in position and the wire over them. Then the breast-roll is lifted up and support 22 removed, a temporary one being put on at the outer end beyond the wire. The beam 20 is then lifted and supported at the outer end of the bar in the same manner. Roll 26 is then taken out of its bearings and lowered and the frame 25 removed. It will be seen that the way is entirely clear for slipping the wire over the rolls, after which the permanent supports are put in and the temporary ones removed, as described. If it is borne in mind that the lifting appliances project far enough outward to suit the full width of wire, the description will be readily understood.

It will thus be seen that when beam 20 and cross-bar 21 are arranged inside the wire and carrying the rolls and other parts which are inside the wire these parts do not require to be removed when changing wires and also that this system, although only shown in Figs. 6 and 7, is applicable to all Fourdrinier wire frames.

It will be understood that I can use any number of wires in conjunction to form any desired number of plies in the finished paper and that I may use any number of deckle-straps on each wire, as also any number of vacuum-boxes.

I claim as my invention—

1. A paper-making machine, having Fourdrinier wires in combination with a single felt passing below said wires, the wires coming in contact with the felt so as to deliver their webs onto the felt.

2. A paper-making machine, having Fourdrinier wires, in combination with a single felt passing below said wires, one or more inner couch-rolls so arranged that the under side of wire is brought sufficiently low down to meet the felt passing underneath.

3. A paper-making machine, having Fourdrinier wires, in combination with a felt having couch-rolls under the wire and inside the felt, the wire being in contact with the felt at the roll, whereby the paper is transferred directly to the upper side of the felt.

4. A paper-making machine, having Fourdrinier wires, in combination with a felt having couch-rolls under the wire and inside the felt to deliver the paper from the under side of the wire direct to the upper side of the felt with the wire side uppermost to come first in contact with the top press-roll.

5. A paper-making machine having Fourdrinier wires, in combination with a felt and press rolls, arranged whereby the paper passes under the wire directly onto the felt, with the wire side upward, the paper being supported and carried by the felt from the wires to the press-rolls.

6. In paper-making machines of the Fourdrinier class, beams 19 and 21 and side bars rigidly fixed thereto, and a pin mounted in the center of said beam 19, in combination with movable supports carrying the breast-roll end so that the wire frame is capable of receiving a swinging motion round pin 23.

7. In paper-making machines of the Fourdrinier class, a cross-beam 20 and a bar 21 arranged inside the wire in combination with and carrying side bars and other parts which come within the part of the wire from said beam 20 and bar 21 placed inside the wire, whereby a wire can be slipped on without removing these parts.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

SAMUEL MILNE. [L. S.]

Witnesses:
ROBERT F. SCOTT,
JAMES GARDNER.