Oct. 28, 1958 R. C. HEYS 2,857,822

SYNCHRONIZED TAIL CUTTER AND SUCTION ROLL TRAVELLING SEALING STRIP

Filed Jan. 12, 1953 2 Sheets-Sheet 1

FIG. 1.

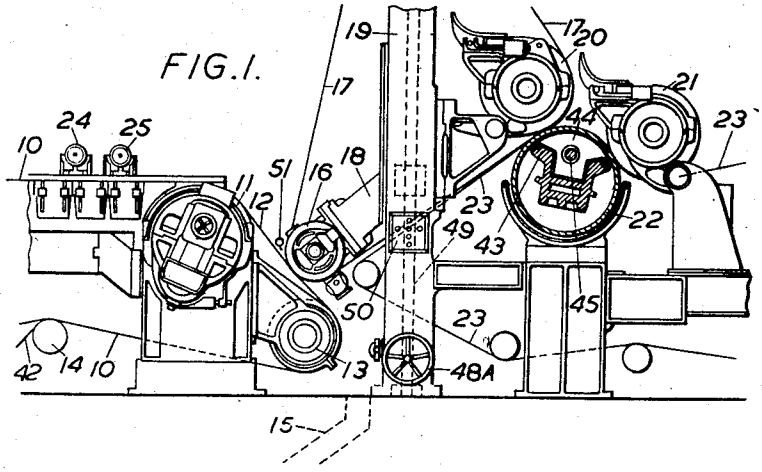

FIG. 2.

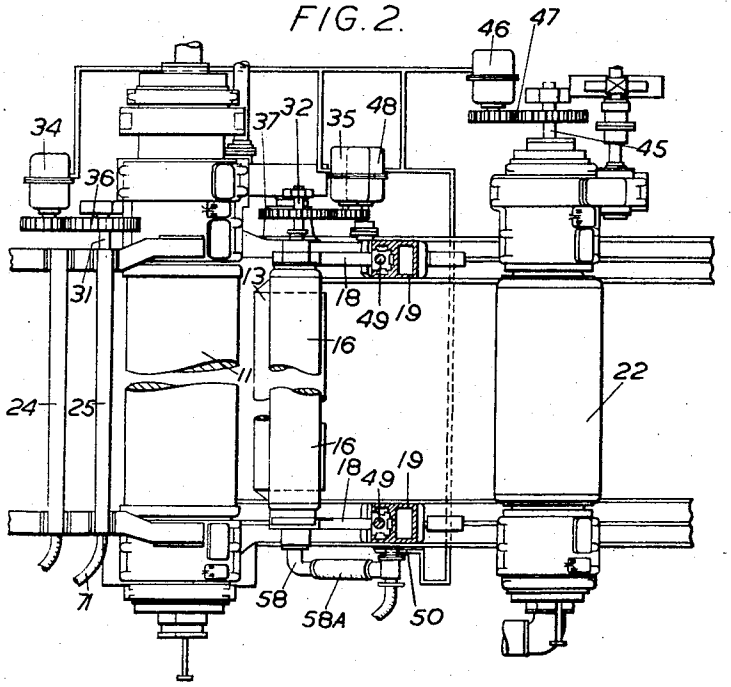

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FIG. 3A.

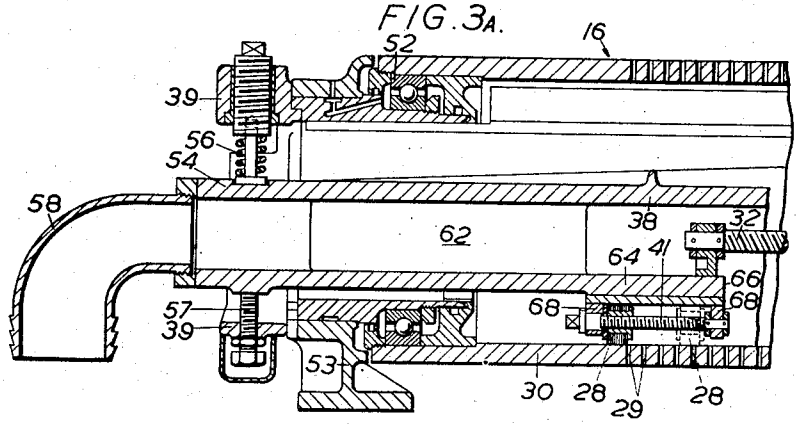


FIG. 3B.

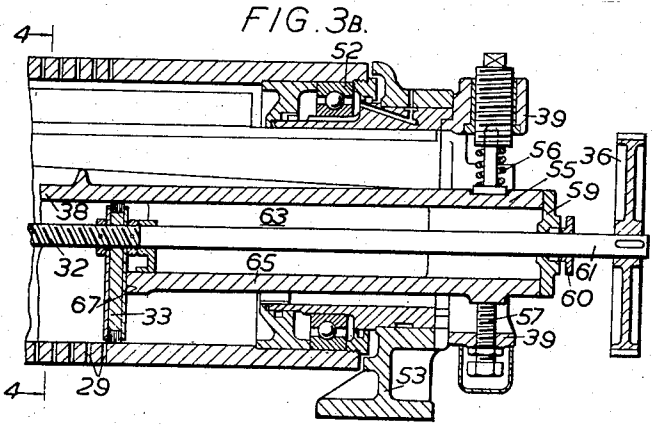


FIG. 4.

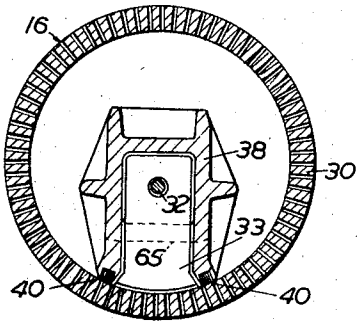


FIG. 5.

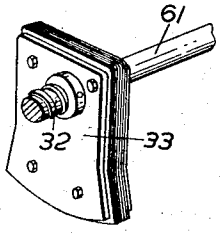
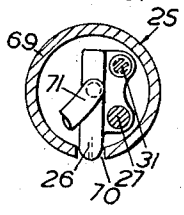


FIG. 6.



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SYNCHRONIZED TAIL CUTTER AND SUCTION ROLL TRAVELLING SEALING STRIP

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Application January 12, 1953, Serial No. 330,830

Claims priority, application Great Britain January 12, 1952

11 Claims. (Cl. 92—38)

This invention relates to the manufacture of paper and to paper-making machines, and is particularly concerned with a method of and apparatus for the rapid and convenient production of full-width paper, the substantial reduction of waste and the inconveniences resulting from excessive waste, and the efficient use of automatic pick-up mechanism for transfer of the paper web from the forming wire to the press.

In the Fourdrinier machine with automatic suction pick-up from the wire, starting up—either initially, or after a break—involves the carrying of the whole width of the sheet through the press section, with a jet cutter in advance of the couch roll severing a narrow strip (a "tail") at one side of the width (for convenience at the front side of the machine) to provide at the end of the press section next to the dryer section a strip of coherent paper capable of being transferred to the dryer section and thence to the calendar and reel; and, during this handling of the tail and its passage through and beyond the dryer section, the remaining and major width of sheet passes through the press-section, or through part of that section, to be doctored off a top press roll as "broke." With large width machines in particular, and with the higher speeds of modern machines in general, the quantity of broke formed at the press section is very great, and disposal of it interferes with the efficient operation of the machine.

Moreover, when a break occurs, broke continues to be produced at the end of the press section until a fresh tail is produced and passed through the whole machine. In the absence of automatic means for disposal of broke from the machine itself, the sheet may have to be deliberately run to waste at the couch end of the forming wire until the machine has been cleared to permit the fresh passage of a sheet and tail as described above.

In any case, broke has to be doctored off the top roll of the press section during the period required to pass the tail through the dryer section, and this substantial quantity of broke must be disposed of before the machine is again able to produce finished paper. There is thus considerable wastage of material, time, and labour, and reduced efficiency of the complex and costly assembly that goes to make the modern type of paper-making machine.

Similar difficulties arise in starting up a vacuum-forming machine by automatic pick-up.

According to the present invention, a process for the manufacture of paper as a continuous operation comprises the steps of first forming a continuous wide flow, or ribbon, of paper stock of uniform thickness, draining liquid from that flow, or ribbon, to convert the stock into a continuous web, separating the web longitudinally at a point to form a strip alongside the remainder of the main width of the web, running the remaining width away from the strip to waste, picking up the strip by vacuum applied over the width of the strip and forwarding it for continuous removal of further liquid by expression and for subsequent drying by heat to form finished paper, and then

progressively moving the separation point increasing the width of the strip until it merges into the full main width and simultaneously increasing the application of the vacuum progressively to the full width of the web to pick-up the full width, the full width then being forwarded for continuous removal of further liquid by expression and for subsequent drying by heat to form a full width sheet of finished paper.

Although the remainder of the main width of the drained web is wasted during the performance of the expressing and drying steps on the strip alone, as soon as those essential steps have been performed the progressive picking up of the full width of the web to enable a full width of paper to emerge from the last of those steps is performed with the production of no more waste than arises in the length of web over which the progressive increase from the strip width to the full width takes place.

Apparatus according to the invention comprises primarily a vacuum pick-up roll, and means movable lengthwise within the roll over substantially the whole perforated length of the roll to vary the lengthwise extent of the periphery of the roll exposed to vacuum. Used in combination with a paper-web cutting device disposed in advance of the pick-up roll and movable transversely of the machine, the pick-up roll may then have the means within it moved in step with the cutting device to pick up a width of paper corresponding to whatever width is cut by the device. In particular, means may be provided for simultaneously and progressively moving the cutting device and the means within the roll from corresponding respective positions in which the cutting device is adapted to sever a narrow strip of paper web and the roll is able to apply vacuum only to that narrow strip to corresponding respective positions in which the cutting device is clear of the full width that would be occupied by the width of paper to be produced and the roll is able to apply vacuum to the whole of that full width.

Thus, the suction-box within the pick-up roll may be provided with a deckle or sealing-plate guided to travel lengthwise of the box to make a seal with the inside of the roll shell and with the walls of the box, so that vacuum is applied only to the part of the shell between the travelling deckle and a fixed (or adjustably fixed) deckle or sealing-plate near one end of the box (conveniently the end at the front side of the machine). Progressive movement of the travelling deckle away from the fixed deckle towards the other end of the box exposes more and more of the shell to vacuum.

The travelling deckle thus permits the roll to pick-up any width of paper web from a narrow strip corresponding in width to the distance between the fixed deckle and the travelling deckle in its nearest approach to the fixed deckle, up to the full width corresponding to the maximum distance possible between the deckles.

The suction-box of the suction press roll of the press of the machine (or of the first press of a multi-press machine) may be provided with a similar travelling deckle, progressively movable lengthwise of the roll in step with the travelling deckle of the pick-up roll, so that suction is applied by the press to the width of the strip only during the running of the strip through the machine. Consequently, during this period air is not sucked through the part of the suction press roll not covered by paper web, and the applied suction is effective to bring the width of the strip into the best condition for its progression through the remaining sections of the machine.

The invention will now be described in greater detail with reference to the accompanying drawings, in which

Figure 1 is a side elevation, partly in section, of the couch end of a Fourdrinier machine and the adjoining press section;

Figure 2 is a plan corresponding to Figure 1, with the wire and felts and the top press rolls of the press section omitted;

Figures 3A and 3B are longitudinal sections of the end portions of the suction pick-up roll shown in Figures 1 and 2;

Figure 4 is a section on the line 4—4 of Figure 3B;

Figure 5 is a perspective view of the travelling deckle shown in Figures 3B and 4; and

Figure 6 is a vertical cross-section of the jet cutter shown in Figures 1 and 2.

In a Fourdrinier machine, the pick-up roll may co-operate directly with the couch roll at which the forming wire begins its idle return run to the breast roll where the paper stock is flowed on to the wire, or it may co-operate with a length of the wire extending between the couch roll and a returning roll forward, or forward and downward, of the couch roll. The arrangements shown in Figures 1 and 2 has the pick-up roll located between the couch roll and the return roll, but it should be understood that that location is not essential to all possible methods of carrying out the invention.

The forming wire **10** is shown passing over a suction couch roll **11** and thence forwardly and downwardly over a run **12** to a forward drive roll **13**, from which it passes to a wash roll **14** lying above a couch pit **15**. A suction pick-up roll **16** carries a top transfer felt **17** in contact with the paper web on the wire run **12**, and is mounted in arms **18** that are vertically slidable in the machine columns **19** to enable contact of the roll **16** to be broken. The transferred paper web is carried by the felt **17** to the press, which in the arrangement shown is of the type having two top press rolls **20**, **21** co-operating with a single bottom suction roll **22**. The felt **17** leaves the paper web on a bottom felt **23** after passing the nip of the rolls **20**, **22**, and makes its return run to the pick-up roll **16**. The paper web continues on the bottom felt **23** through the nip of the rolls **21**, **22**, the web then passing either through one or more further presses or direct to the dryer section of the machine, in the usual manner.

Some little distance before the wire **10** meets the couch roll **11**, a jet cutter **24** is mounted with the usual water nozzle (not shown) adjacent each edge of the paper web to trim the edges. A further jet cutter **25** is next encountered, this having a single water nozzle **26** (Figure 6) mounted on a guide rod **27** permitting movement of the nozzle across the whole width of the wire, with means (described below) for bringing the nozzle into position some distance (say 12") from the front edge of the wire.

As shown in Figure 3A, the pick-up roll **16** has a "fixed" deckle or sealing plate **28** disposed at one end of the perforations **29** of the roll shell **30**, and this fixed deckle is located near the front edge of the wire. A screw **31**, parallel to the guide rod **27**, forms a traversing means for the nozzle **26**, and is operable in synchronism with a traversing screw **32** (Figure 3B) for a travelling deckle or sealing plate **33** in the pick-up roll **16**.

The deckle **33** is shown in Figure 3B at the furthermost position of its travel from the "fixed" deckle **28**, i. e., at the farther end of the perforations **29**; but rotation of the screw **32** enables it to be brought to a distance (say 12") from the deckle **28** corresponding to the distance of the nozzle **26** from the front edge of the wire. The screwed rods **31**, **32** are driven by separate motors **34**, **35** synchronised to give the same traversing speeds, with suitable gearing **36**, **37**.

The travelling deckle **33** makes a seal with the inside of a suction box **38** extending through the pick-up roll **16** and carried by guides **39** at the ends of the roll, and also with the perforated shell **30** opposite the open mouth of the box **38** between the lengthwise sealing strips **40** (Figure 4), this width of perforated shell being covered by the transfer felt **17**. The "fixed" deckle **28** is mounted on a short lengthwise screw **41** to close the effective

length of the box **38**, but with liberty to have its position with respect to the front edge of the wire **10** adjusted within fairly narrow limits by rotation of the screw **41**. The endmost perforations **29** may thus be cut off from the suction, as also may the endmost perforations **29** at the other end of the roll **16** by varying the position in which the travelling deckle **33** is brought to rest. This provides for adjustment of suction to widths of paper web less than the width of the wire **10**.

Before starting up, the pick-up roll **16** is out of contact with the wire **10**, and the paper web remains with the wire until, after passing the return roll **13**, it encounters the first guide roll (or "wash roll") **14** external to the return run of the wire. The web adheres to the wash roll, and is removed by the doctor **42**, the waste falling into the couch pit **15**, and the clean wire returning to receive a fresh layer of stock. The nozzle **26** is then positioned to sever a narrow strip or tail (say 12") from one side of the web, and the travelling deckle **33** is positioned to expose only a corresponding 12" length of the pick-up roll shell **30** to vacuum.

The pick-up roll **16** is brought into contact with the wire **10** by lowering the arms **18**, and can only pick up this 12" tail, the remaining width continuing round the roll **13** to waste as before. The tail proceeds into the press section **20**, **21**, **22**, where expression of water so much improves coherence that it can be handled for transfer to the dryer section. Until the tail has passed the dryer section and the final calendar, the remaining width runs to waste, and the press section is kept clear of all but the tail.

As soon as the tail completes its passage of the machine, the nozzle **26** is traversed to increase the width of the tail gradually until the nozzle reaches the other side of the web, and the travelling deckle **33** is similarly traversed to expose a greater part of the length of the pick-up roll shell **30** until the full effective width is exposed, so that at all times the pick-up roll **16** applies vacuum to the width of web delivered to it. When the nozzle **26** is clear of the web, full-width paper is being produced, and this width passes smoothly into and through the press section, dryer section, and calendar, to the reel.

If a break occurs in the press or dryer section, (which may be announced by an alarm—sound or light), the operator traverses the nozzle **26** completely across the wire **10**, and the pick-up roll **16** is lifted clear by lifting the arms **18**. Consequently, all the paper web is directed to the pit **15**, except for the paper already in the press section and beyond, which has to be removed as broke. As soon as the machine is clear, the pick-up roll **16** is lowered, with the travelling deckle **33** already brought to tail width from the front end, and the nozzle **26** is moved to tail width from the front edge of the wire **10**. The new tail is progressed as before, until the full width is again taken into the press section.

The suction box **43** of the bottom suction roll **22** may be provided with a travelling deckle or sealing plate **44** traversed by a lengthwise screw **45** driven by a motor **46** through gearing **47**. Initially positioned at tail width from the front of the machine, the deckle **44** moves progressively along the suction roll **22** as the nozzle **26** and deckle **33** similarly move on increase of the paper web from tail width to full width; in other words, the application of suction increased progressively at the same rate that the strip width is increased to the full width of the web.

The arms **18** carrying the pick-up roll **16** are lifted and lowered by means of a motor **48** that drives screwed rods **49** threaded through the arms **18** inside the columns **19**. A hand-wheel **48A** provides for manual adjustment of the roll **16**, and may be used to lower the roll.

The motors **34**, **35**, **46**, and **48** are operated from a

control panel **50**, with motors **34**, **35**, and **46** of the synchronous type and interconnected for simultaneous operation for some of their motions. The panel **50** has four push-buttons in circuits incorporating suitable limit switches to govern the extent of motor-driven movement:

Push-button	Operation
No. 1	Emergency stop. Motor 48 lifts pick-up roll 16. Water supply to nozzle 26 turned on. Motor 34 traverses nozzle 26 completely across wire 10. Motors 35, 46 traverse deckles 33, 44 to tail-width position.
No. 2	Motor 34 traverses nozzle 26 back to tail-width position.
No. 3	Motor 48 lowers pick-up roll 16.
No. 4	Motors 34, 35, 46 traverse nozzle 26 and deckles 33, 44 progressively to full width. Water supply to nozzle 26 turned off.

Other push-buttons may provide for independent operation of any of the moving parts. Again, the return of the deckles **33**, **44** to tail-width position may be effected independently of (and later than) the return of nozzle **26** across the full width of the wire **10**.

The motors **34**, **35** for the nozzle **26** and the travelling deckle **33** may also be so interconnected with the press drive and the wire drive that when either of these latter is stopped the nozzle **26** and deckle **33** are automatically brought into position to form and pick up a tail on re-starting.

To facilitate transfer of the paper web from the wire **10** to the pick-up roll **16**, a spray **51** may be directed against the felt **17** on the roll **16** just before it reaches the wire.

Constructional details of the pick-up roll **16** and its "fixed" and travelling deckles **28**, **33** are clearly shown in Figures 3A and 3B. The roll shell **16** is freely rotatable (under the pull of the transfer felt **17**) on bearings **52** in the supporting brackets **53**. The suction box **38** has cylindrical ends **54**, **55** pressed by springs **56** against stops **57** adjusted to bring the deckles **28**, **33** and the sealing strips **40** into correct contact with the shell **30**. The end **54** carries an elbow **58** for attachment of the usual suction hose **58A** (Figure 2), and the end **55** is closed by a cover **59** having a gland **60** to seal the plain portion **61** of the screwed rod **32** where it emerges to carry one of the gears **36**.

The cylindrical ends **54**, **55** continue into rectangular sections **62**, **63**, the lower walls **64**, **65** of which end at **66**, **67** to expose the width of the box **38** to the perforated periphery of the shell **30** between the sealing strips **40**, over the whole perforated length of the shell. At the front end of the roll **16**, the screw **41**, carried in brackets **68** from the underside of the wal **64**, enables the exposed length of the shell to be adjusted in accordance with the width of the paper web laid on the wire **10**.

When brought by rotation of the screwed rod **32** into contact with the end **67** of the wall **65**, the travelling deckle **33** occupies a position at the rear end of the roll **16** corresponding to the outermost adjusted position of the deckle **28** at the front end. By setting of a limit switch in the circuit of the motor **35**, the deckle **33** may be stopped short of the wall **65** by an amount corresponding to any inward adjustment of the deckle **28**.

As shown in Figure 6, the travelling nozzle **26** and its guide rod **27** and operating screw **31** are carrier inside a tube **69** with a slot **70** for the emergence of the nozzle. The flexible hose **71** supplying the nozzle is drawn inside the tube **69**, and is thus kept clear of the wire **10**.

Trim produced by the nozzles of the trimming cutter **24** at the sides of the web may be taken from the pick-up roll by the usual trimming rollers pressed against the latter, the trim adhering to the trimming rollers and then dropping into the couch pit.

The roll **16** could be the lowest of a press taking the web direct from the wire, e. g. the well-known stacked press with say three superimposed rolls. In that case, it is not convenient to lift and lower the pick-up rolls, but

the break of contact with the web on the wire may then be effected by movement of the forward return roll, for example by means of a motor similar to the motor **48**.

In a vacuum-forming machine, the pick-up roll co-operates directly with the shorter wire passing round the vacuum-forming roll. For starting up, the pick-up roll is first held clear of the wire and the web runs with the wire to the first outside return roll for the wire, where it is doctored into a pit. The pick-up roll is then lowered and the jet cutter nozzle and travelling deckle operate to produce a tail that is automatically transferred to the press part. As soon as the tail is through the press, further operation of the cutter nozzle and travelling deckle bring the web gradually to full width.

With a stacked press used in conjunction with vacuum-forming, the wire is adjustable towards and from the bottom fixed suction press roll, which operates as the pick-up roll.

In multiple vacuum-forming installations for multi-ply paper or board, each vacuum-forming unit may be provided with similar tail-forming mechanisms, operated in synchronism.

The invention includes the use of the travelling deckle in a suction transfer roll for the transfer of first the tail and finally the full width of paper from one press to another (to a dryer section) in installations with separate press units operating in sequence in the press section, with synchronism with the jet cutter nozzle and travelling deckle at the wet end of the machine. The pick-up roll containing this travelling deckle may either be a separate roll, or one of the suction rolls of the press unit to which transfer is to be made.

The invention improves the efficiency of paper-making machines by extending "automatic" operation in starting up beyond what has previously been possible, and reduces much of the hand manipulation required before a full width of web and paper extends completely through the machine. Although hand manipulation of the tail into the dryer section may be essential, because the heavier felts of that section (wool or cotton, with or without asbestos or nylon strengthening threads) are not suitable for vacuum pick-up, the paper is generally in a suitable condition for being handled at that late part of the machine; as also is the case when the paper reaches the unfelted smoothing press used for better class papers, or a reversing press where the last contact made by the paper before entering the dryer section is with the bare top roll of the press.

What I claim is:

1. Mechanism adapted for application to a paper-making machine having a forming wire, the mechanism having in combination a vacuum pick-up roll, a sealing plate movable lengthwise within the roll to vary the lengthwise extent of the periphery of the roll exposed to vacuum, a paper-web cutting device disposed in advance of the pick-up roll and movable transversely to correspond with the lengthwise movement of the said sealing plate within the roll, and power means for simultaneously and progressively moving the cutting device and the sealing plate axially within the roll from corresponding respective positions in which the cutting device is adapted to sever a narrow strip of paper web and the roll is able to apply vacuum only to that narrow strip to corresponding respective positions in which the cutting device is clear of the full width that would be occupied by the width of paper to be produced and the roll is able to apply vacuum to the whole of that full width.

2. Mechanism adapted for application to a paper-making machine having a forming wire, the mechanism having in combination a vacuum pick-up roll, a deckle movable lengthwise within the roll to vary the lengthwise extent of the periphery of the roll exposed to vacuum, a paper-web cutting device disposed in advance of the pick-up roll and movable transversely to correspond with the lengthwise movement of the said deckle within the

roll, and motor-driven traversing mechanism to move the cutting device and the deckle within the roll simultaneously and progressively transversely of the machine.

3. A vacuum pick-up roll for a paper-making machine, said roll having a perforated shell, an internal suction box exposed to a width of the shell over the whole perforated length, a travelling cutting device, a travelling deckle within the box, and means for traversing the deckle from a position near one end of the perforated length of the shell to the other end of the perforated length of the shell.

4. A vacuum pick-up roll for a paper-making machine, said roll having a perforated shell, an internal suction box exposed to a width of the shell over the whole perforated length of the shell, a normally fixed deckle within the box disposed at one end of the perforations in said shell, means for giving a limited adjustment to that deckle with respect to one end of the perforated length of the shell, a travelling deckle within the box, and means for traversing the traveling deckle from a position near the fixed deckle to the other end of the perforated length of the shell.

5. A suction press for a paper-making machine, said press comprising a suction roll and at least one other press roll, and the suction roll having a perforated shell, an internal suction box exposed to a width of the shell over the whole perforated length of the shell, a travelling cutting device, a travelling deckle within the box, and means for traversing the deckle from a position near one end of the perforated length of the shell to the other end of the perforated length of the shell.

6. A paper-making machine having a forming wire, a vacuum pick-up roll disposed transversely of the wire, a suction press including a suction roll, a transfer felt extending from the pick-up roll to the suction roll, a paper-web cutting device disposed transversely of the wire in advance of the pick-up roll, means movable within the pick-up and suction rolls for varying the lengths of the rolls exposed to vacuum, and means for simultaneously moving in step the cutting device and the means within the rolls transversely of the machine.

7. A paper-making machine comprising a forming wire, a vacuum pick-up roll disposed transversely of the wire, a jet cutter disposed transversely of the wire in advance of the pick-up roll and including a nozzle movable across the machine, means to position the nozzle near one edge of the wire, a suction box within the pick-up roll, a deckle movable within the suction box from a position corresponding to the said position of the nozzle to a position at the other end of the roll, and means for simultaneously moving the nozzle and the deckle from their initial positions to the other side of the wire and the other end of the roll respectively.

8. A paper-making machine as in claim 7, comprising also a suction press including a suction roll, a transfer felt extending from the pick-up roll to the suction roll, a suction box within the suction roll, said sealing plate movable within the suction box from a position corresponding to the initial positions of the nozzle and the sealing plate of the pick-up roll to a position at the other end of the suction roll, and the means for moving the nozzle serving to move both sealing plates in step with itself and with each other.

9. A vacuum pick-up roll for a paper-making machine embodying a movable cutting device, said roll having within it means movable lengthwise over substantially the whole length of the roll to vary the lengthwise extent of the periphery of the roll exposed to vacuum, and means for effecting such lengthwise movement simultaneously in accordance with the movement of the cutting device.

10. In a paper-making machine of the forming wire type, the combination of a vacuum pick-up roll disposed transversely of the wire, means within the roll movable lengthwise over substantially the whole length of the roll to vary the lengthwise extent of the periphery of the roll exposed to vacuum, a paper-web cutting device disposed transversely of the wire in advance of the pick-up roll, and means for moving the cutting device progressively across the wire and varying the exposure of the roll to vacuum in step with the movement of the cutting device.

11. Mechanism adapted for application to a paper-making machine having a forming wire, the mechanism having in combination a vacuum pick-up roll, means movable lengthwise within the roll to vary the lengthwise extent of the periphery of the roll exposed to vacuum, a paper-web cutting device disposed in advance of the pick-up roll and movable transversely to correspond with the lengthwise movement of the said means within the roll, motor-driven traversing mechanism to move the cutting device and the means within the roll simultaneously and progressively transversely of the machine, and motor-driven mechanism for moving the cutting device across the whole width of the wire and lifting the pick-up roll from the wire to render the pick-up roll ineffective.

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