April 22, 1969 R. W. RUSSELL ETAL 3,440,137

PAPERMAKING MACHINE

Filed Oct. 5, 1966 Sheet 1 of 4

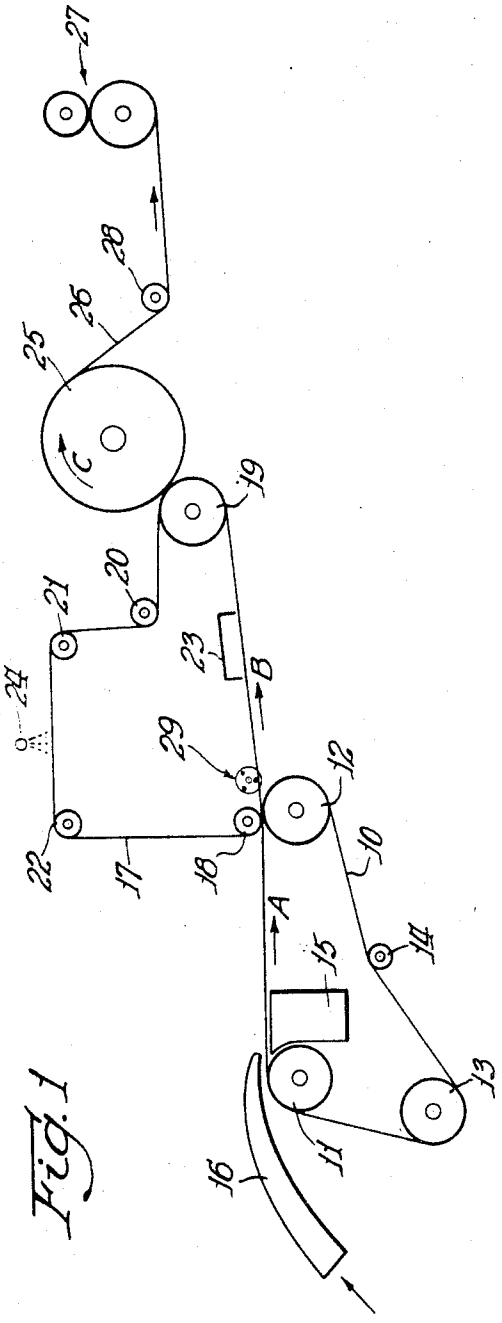


Fig. 1

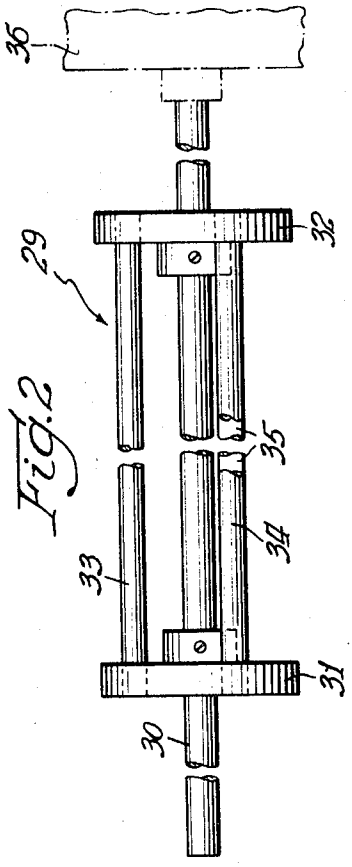


Fig. 2

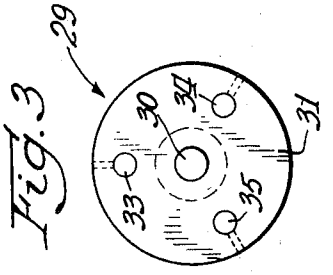


Fig. 3

Fig. 4

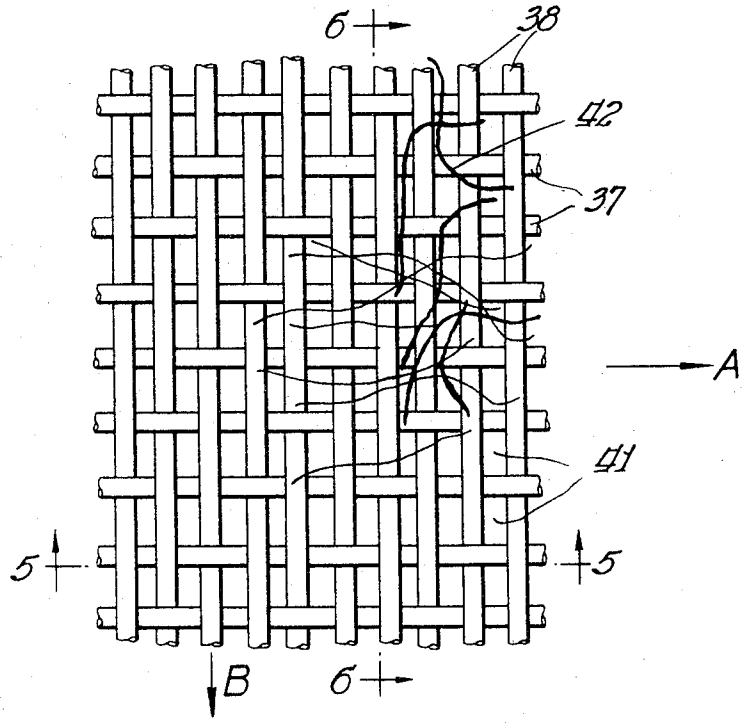


Fig. 5

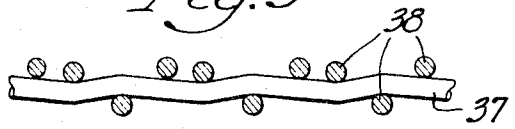


Fig. 6

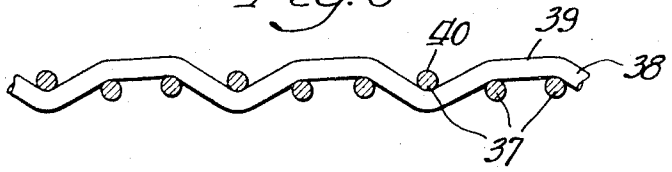


Fig. 7

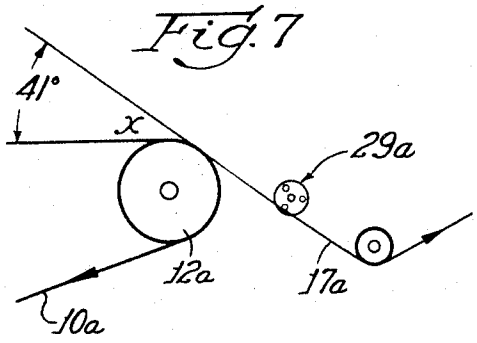


Fig. 8

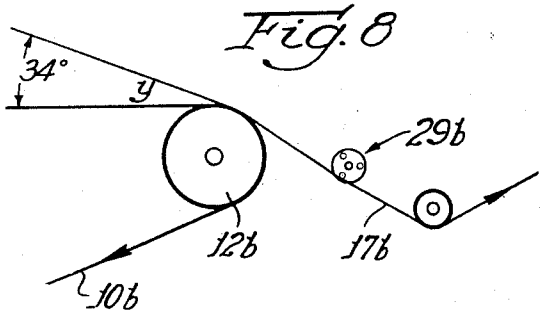


Fig. 9

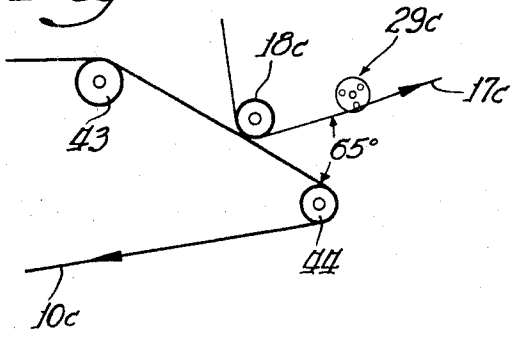


Fig. 10

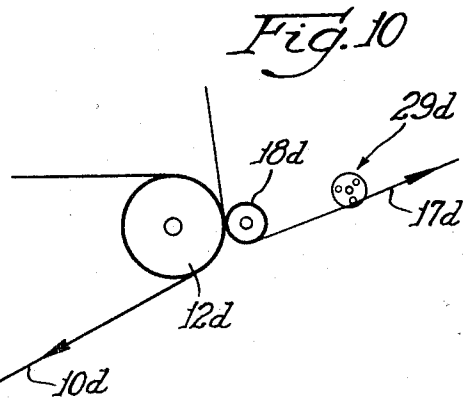


Fig. 11

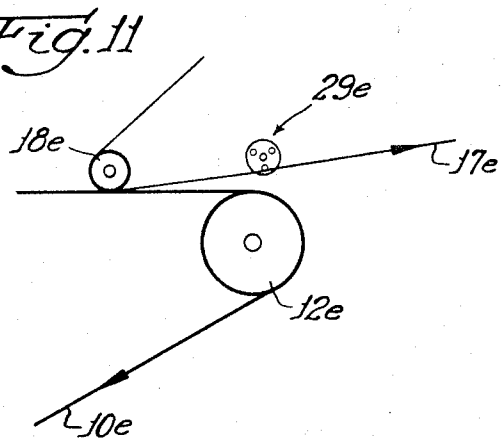


Fig. 12

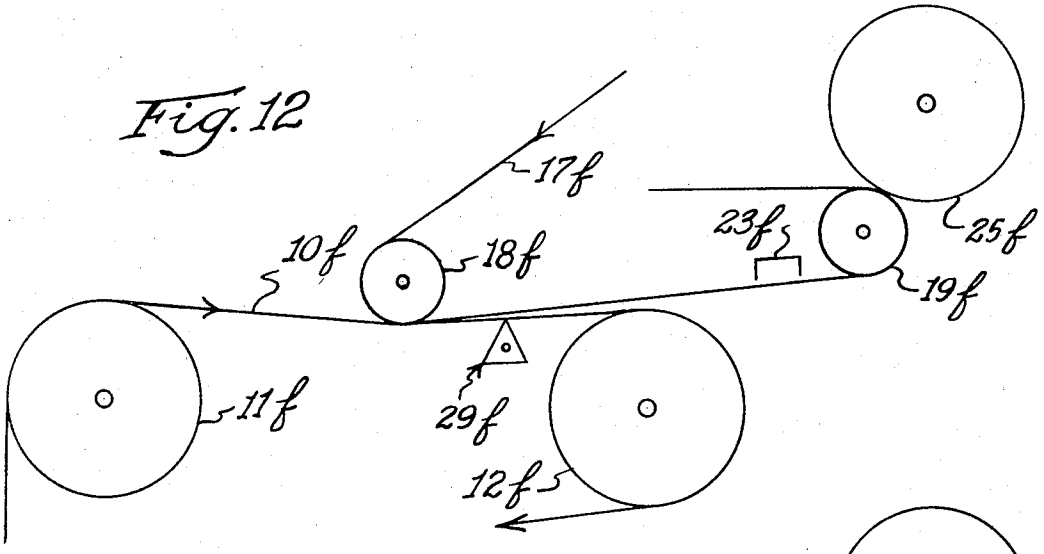


Fig. 13

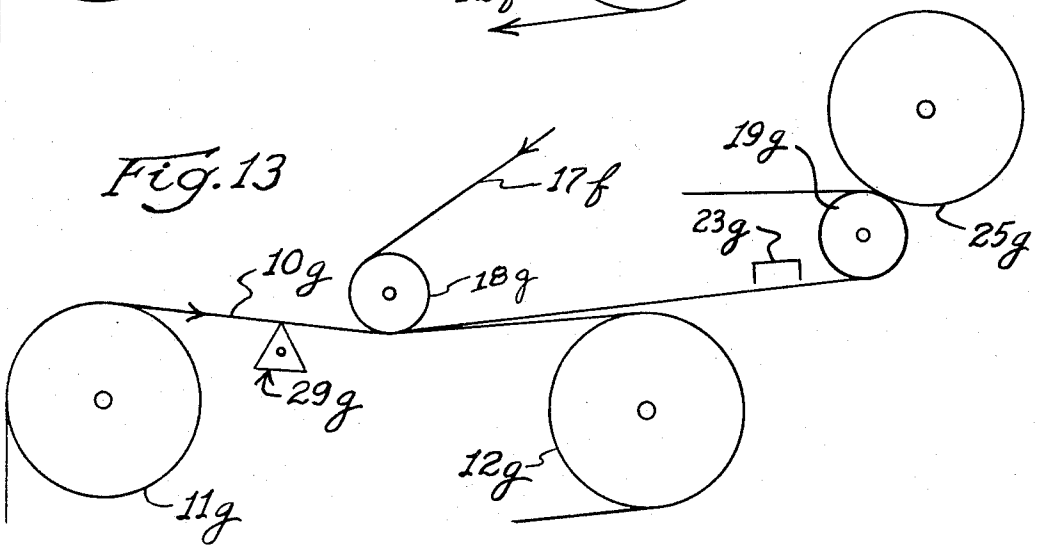
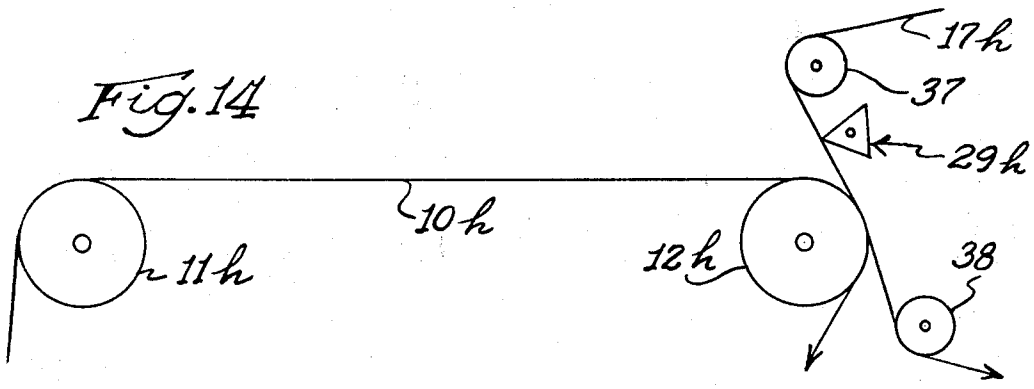


Fig. 14



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3,440,137

PAPERMAKING MACHINE

Roger W. Russell, Appleton, and Doyle L. Strong, Niagara, Wis., assignors to Kimberly-Clark Corporation, Neenah, Wis., a corporation of Delaware

Continuation-in-part of application Ser. No. 346,699, Feb. 24, 1964. This application Oct. 5, 1966, Ser. No. 584,400

Int. Cl. D21f *2/00;* B65h *17/00*

U.S. Cl. 162—306 5 Claims

ABSTRACT OF THE DISCLOSURE

A papermaking machine including a forming fabric on which paper stock is deposited for dewatering, a felt having a line of contact with the forming fabric onto which the resulting paper web transfers and a vibrator device for vibrating either the fabric or felt adjacent to the line of transfer for improving the paper web couching action from the fabric to the felt.

This application is a continuation-in-part of our copending application, Ser. No. 346,699, filed Feb. 24, 1964, now abandoned, for "Papermaking Machine."

Our invention relates to papermaking machines, and, more particularly, the invention relates to apparatus and methods for couching paper web from the endless web forming screen of a Fourdrinier papermaking machine.

It is an object of the present invention to provide an improved method and apparatus for couching a paper web from the Fourdrinier wire to the felt of a papermaking machine by means of which the web may be removed from the wire with a more perfect transfer and with less fiber remaining on the wire than would be otherwise possible and by means of which the transfer may be obtained using less moisture in the sheet and using less moisture in the pickup felt than would otherwise be possible.

In practicing the invention, we have found that if the pickup felt is vibrated in the vicinity of the line of transfer of the web to the pickup felt, such improved transfer of the web to the felt is obtained; and the invention, therefore, contemplates that the felt shall be so vibrated and contemplates the use of vibrator mechanism for acting on the felt in this manner.

Alternatively, the Fourdrinier wire may be vibrated in lieu of the felt with the same effective transfer of the paper web to the felt at the couch line. In order to obtain the benefits of the invention, it is only necessary that there be relative vibration of the wire and felt at the line of couch of the wire and felt at the outgoing side of the nip between the wire and felt.

The invention consists of the novel constructions, arrangements, devices and methods to be hereinafter described and claimed for carrying out the above stated objects, and such other objects, as will be apparent from the following description of preferred forms of the invention and method for carrying out the invention, illustrated with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic elevational view of a Fourdrinier type papermaking machine embodying the principles of the invention and including a rotatable vibrator device for the pickup felt of the machine;

FIG. 2 is a side elevational view of the rotatable vibrator device;

FIG. 3 is an end view of the vibrator device;

FIG. 4 is a fragmentary plan view of a Fourdrinier wire in connection with which the vibrator device may well be used;

FIGS. 5 and 6 are sectional views taken on lines 5—5 and 6—6, respectively, of FIG. 4; and

FIGS. 7 to 14 are diagrammatic illustrations of modified couching arrangements using the vibrator device or a modified form of the vibrator device for increasing the couching efficiency.

Like characters of reference designate like parts in the several views.

Referring now to FIG. 1, the illustrated papermaking machine may be seen to comprise an endless Fourdrinier wire or screen **10** disposed over a breast roll **11**, a couch roll **12**, and turning rolls **13** and **14**. A vacuum forming box **15** may be provided beneath the horizontal pass of the wire **10** between the rolls **11** and **12**, and a paper stock inlet **16** of any suitable type is provided for discharging paper stock onto the wire **10** in the vicinity of the breast roll **11**. In accordance with conventional practice, a vacuum producing device (not shown) is connected to the box **15** and may, for example, apply a vacuum of one inch of mercury to the box **15**.

An endless felt **17** is disposed about a pickup roll **18**, a pressure roll **19**, and turning rolls **20**, **21** and **22**. A vacuum box **23** is provided to be effective on the inner surface of the felt **17**, and a water shower **24** is provided for showering the outer surface of the felt **17**.

The roll **19** has a pressure nip with a steam heated Yankee drier drum **25**, and the web **26** that is formed by the papermaking machine travels to a conventional winder **27** over suitable guide rolls, such as the roll **28**. The wire **10** travels in the direction indicated by the arrow A; the felt travels in the direction indicated by the arrow B, and the Yankee drier **25** revolves in the direction indicated by the arrow C.

A vibrator device **29** is provided, according to the invention, to be effective on the felt **17**, particularly on the pass of the felt in the direction of travel B from the pickup roll **18**, and particularly between the vacuum box **23** and the pickup roll **18**. Referring to FIGS. 2 and 3, the vibrator device as illustrated comprises a shaft **30** having a pair of discs **31** and **32** fixed thereon. Three rods **33**, **34** and **35** extend between the discs **31** and **32**. The rods **33**, **34** and **35** are equally spaced from each other and are equally spaced from the center of the shaft **30**, as shown. A driving motor **36** of conventional construction is provided for driving the shaft **30** and thereby rotating the discs **31** and **32** and the rods **33**, **34** and **35** about the center of the shaft **30**. The shaft **30** is mounted by any suitable bearings (not shown) with respect to the felt **17** so that each of the rods **33**, **34** and **35** makes contact with the felt **17** as the shaft **30** and discs **31** and **32** rotate thereby effectively pounding, striking and vibrating the felt **17** each time one of the rods **33**, **34** and **35** makes contact with the felt **17**.

The felt **17** may be of any suitable conventional type for picking up a paper web from the Fourdrinier wire **10** and transferring it to the dried **25**. The Fourdrinier wire or screen **10** may also be of any conventional type, and the vibrator device **29** improves pickup of the paper web **26** from the wire, as will be more fully described hereinafter. The Fourdrinier screen illustrated in FIGS. 4, 5 and 6 is of a type that has long, high wire knuckles extending in the cross machine direction, and this Fourdrinier screen is disclosed and claimed in the application of Harold H. Heller and John B. Graham, Ser. No. 28,291, filed June 23, 1960. This Fourdrinier screen, due to its long, high transverse knuckles has the capacity of forming a tissue web that has an unusually large number of its fibers extending in the cross machine direction, so that the tissue is particularly strong in this direction. With such a screen, the paper web has an unusually great affinity for the screen, and the present invention is particu-

larly effective in couching off the formed paper web from such a screen.

Referring to FIGS. 4, 5 and 6, the illustrated Fourdrinier screen may be seen to comprise a plurality of warp wires **37** extending in the machine direction, that is, in the direction of travel of the screen indicated by the arrow A, and a plurality of transversely extending shute wires **38** interwoven with the wires **37**. The papermaking side of the screen is illustrated in FIG. 4; and it will be observed from FIG. 6, which is a sectional view from FIG. 4, that each of the shute wires **38** extend successively over a pair of warp wires **37** and thence under a single warp wire **37** looking on the screen from its papermaking side. Successive shute wires **38** extend under adjacent single warp wires **37** so that a semi-twill weave is formed.

The knuckles **39** of the transverse wires **38** on the papermaking side of the screen are higher than the knuckles **40** of the longitudinal wires **37**, and the longitudinal wires **37** are spaced a greater distance apart than are the transverse wires **38**. In this construction, therefore, the transversely extending wire knuckles **39** are both higher and longer than the longitudinal wire knuckles **40** on the papermaking side of the screen, and the construction also provides openings **41** between the wires which are longer transversely of the screen than longitudinally of the screen. The result of this construction is that certain paper fibers **42** tend to be moved from longitudinal positions of the screen to extend transversely of the screen, since a great flow of white water through the screen takes place parallel with the long, high transverse knuckles **39**, and the fibers tend to flow along and be directed in the same direction as the flow of white water. As is well known, with ordinary Fourdrinier screens, more paper fibers lie in the machine direction than in the cross machine direction; and the major lie of the redirected paper fibers **42** mostly in a cross machine direction is just opposite to the usual lie of paper fibers produced by a Fourdrinier machine. In view of the fact that the fibers **42** do lie along the long, high knuckles **39**, they are embedded farther into the wire and draped through the openings **41** to a greater extent than if a conventional Fourdrinier screen is used; and the resulting web is accordingly couched from the screen with more difficulty.

The Fourdrinier screen illustrated in FIGS. 4, 5 and 6, may instead be constructed to be endless in the direction indicated by arrow B, so that the Fourdrinier screen is run in this direction on the machine. Using the screen in this manner results in a greater number of fibers extending in the machine direction than would otherwise be the case and results in a web that is stronger longitudinally than otherwise. The paper fibers in this case also extend farther into the wire and drape through the openings in the wire to a greater extent than if a conventional Fourdrinier screen is used, and in this case the resulting web is couched from the screen with more difficulty.

In operation of the machine, the paper stock from the inlet **16** is deposited onto the screen **10**, and white water from the paper stock drains through the screen **10** and into the vacuum forming box **15**, so that a resulting sheet **26** is formed on the screen **10**. The sheet transfers from the wire **10** onto the lower surface of the felt **17** at the nip between the rolls **18** and **12**. The felt **17** functions to further dewater the web as the web is carried toward the Yankee drier **25**, and the web transfers onto the drier **25** at the nip of the pressure roll **19** and the drier **25**. The web is dried on the drum **25** and is removed from the drum and is wound into rolls by means of the winder **27**.

We have found that a more complete transfer of the paper web **26** is obtained from the screen **10** onto the felt **17** using the vibrator device **29** than without the use of the device **29**. The rods **33**, **34** and **35** each make impact with the inside surface of the felt **17** for each revolution of the shaft **30** and plates **31** and **32**; and, therefore, with the three rods **33**, **34** and **35**, three impacts are thus given to the felt **17** for each revolution of the shaft **30** and plates **31** and **32**. The shaft **30** and the other connected parts of the vibrator device may be rotated in either direction in order to produce these impacts on the felt **17**. The vibrator device **29** may be moved toward or away from the pickup roll **18**; however, we have found that it may well be located from two to six inches away from the nip between the rolls **12** and **18** with this improved effect on couching. The amount of impact of each of the rods **33**, **34** and **35** may be changed while still obtaining the advantages of the invention; however, we have found that very effective couching is obtained with the rods deflecting the felt $17\frac{3}{16}$ inch to $\frac{1}{4}$ inch, assuming that there is a 12-inch span, for example, between the vacuum box **23** and the pickup roll **18**. The number of impacts per linear inch of travel of the felt **17** may also be changed within wide limits while still obtaining the advantages of the invention; however, we have found that 5 to 30 impacts per linear inch of felt travel are very effective. Lighter sheets apparently should have a greater number of impacts from the vibrator device **29** than heavier sheets. For example, a sheet having a dry basis weight of 10 to 15 pounds per 3,300 square feet transfers very well with 5 impacts per linear inch of felt travel, while sheets of a basis weight of 4 to 5 pounds per 3,300 square feet couched best with about 7 impacts per linear inch of felt travel.

As is well known in the papermaking art, better couching of a paper web from a Fourdrinier wire to a felt is obtained if the web at the line of transfer is maintained relatively wet or if the felt is maintained relatively wet. Using the vibrator **29** allows the use of a drier sheet at the line of transfer to the felt and allows the use of a drier felt **17**, which may be obtained by decreasing the amount of water that is applied to the felt from the shower **24**. Some paper furnishes tend to stick to the Fourdrinier wire more than others, and we have found that the use of the vibrator device **29** makes a definite improvement in the degree of couching that is obtained using such difficult couching furnishes. As has been above pointed out, the Fourdrinier screen illustrated in FIGS. 4, 5 and 6 provides a web that is couched with difficulty from the screen due to the fact that the fibers tend to lie along the high, long transverse knuckles **39**; and we have found that couching from this type of Fourdrinier screen is much more effective utilizing the vibrator device **29** than without the use of the device **29**.

As will be observed from FIG. 1, the pickup roll **18** is disposed nearly directly above the couch roll **12**. The vibrator of the invention is effective also in many other different types of couching arrangements in which the vibrator device is located close to the line of contact of the felt and screen. A different pickup arrangement, in which a vibrator **29***a* similar to the vibrator **29** is effective, is shown in FIG. 7. In this arrangement, a Fourdrinier screen **10***a* passes around a couch roll **12***a*. A felt **17***a* is in light contact with the screen **10***a* passing over the roll **12***a*, and there is an angle *x* (which may be about 41°, for example) between the incoming passes of the screen **10***a* and felt **17***a*. The felt **17***a* lies across the roll **12***a* in substantially a flat plane, and the vibrator **29***a* is effective on the pass of the felt leaving the couch roll **12***a*. With this arrangement, it was found that with some furnishes, couching with this arrangement was possible only while using the vibrator device **29***a*.

A couching arrangement providing a tighter contact between the felt and screen is illustrated in FIG. 8. In this arrangement, the Fourdrinier screen **10***b* passes around the couch roll **12***b*, and the felt **17***b* lies over the couch roll **12***b* and the portion of the screen **10***b* carried by the couch roll; and the felt has its direction of movement changed by the couch roll. A vibrator device **29***b* is effective on the felt **17***b* as it leaves the couch roll **12***b*; and, with this arrangement also, the vibrator device materially improves couching. The felt **17***b* leaves the couch roll **12***b*

at about the same angle with respect to vertical as the felt **17***a* leaves the couch roll **12***a*; but, in the FIG. 8 arrangement, the angle *y* between the incoming passes of the Fourdrinier screen and felt is less than the angle *x* and may, for example, be about 34°.

The couching arrangement illustrated in FIG. 9 is a so-called "free wire" pickup. The Fourdrinier screen **10***c* in this arrangement passes over turning rolls **43** and **44** which are so disposed that there is a pass of the screen **10***c* between the rolls that is inclined downwardly. A pickup roll **18***c* holds the felt **17***c* in contact at a slight pressure with the pass of the screen between the rolls **43** and **44**. The vibrator device **29***c*, similar to the device **29**, is provided adjacent the pickup roll **18***c* along the pass of the felt **17***c* as it leaves the pickup roll **18***c*. With this arrangement, couching of the paper web is materially bettered using the vibrator device **29***c*.

The couching arrangement shown in FIG. 10 includes the couch roll **12***d* over which the Fourdrinier wire **10***d* passes. A pickup roll **18***d* holds the felt **17***d* in tight contact at the nip between the rolls **12***d* and **18***d*. A vibrator device **29***d* similar to the device **29** is provided adjacent the roll **18***d* along the pass of the felt **17***d* as it leaves the roll **18***d*. The vibrator **29***d* makes the pickup cleaner and more effective.

The couching arrangement illustrated in FIG. 11 utilizes a pickup roll **18***e* holding the felt **17***e* in contact with a horizontal pass of the Fourdrinier wire **10***c* supported by the couch roll **12***e*. The roll **18***e* holds the felt **17***e* in contact with the screen **10***e* along a line which is just prior to the couch roll **12***e*. A vibrator device **29***e*, similar to the device **29**, located adjacent to the roll **18***e* on the stretch of felt **17***e* leaving the roll **18***e* materially increases the couching efficiency, causing more fibers to transfer to the felt **17***e* and a cleaner Fourdrinier screen, than without the use of the vibrator device.

All of the couching arrangements previously described utilize a vibrator device effective on the pass of the felt leaving its line of couch with the Fourdrinier wire. It is not necessary that the vibrator device be effective on this pass of the felt in order for the benefits of the invention to be realized. The vibrator device can instead be used on the pass of the Fourdrinier wire leaving the line of couch, it being only necessary that there be a relative vibration between the wire and the felt at this line. A vibrator device may also be positioned on the wire at the other or inrunning side of the couch or pickup line, and sufficient vibration will be transmitted through the wire, which has substantial rigidity, to the couch line offrunning side, at which the vibration is particularly effective for the intended purpose, to materially better the pickup of the web from the wire onto the felt. Alternatively, a vibrator device may be positioned on the pass of the felt approaching the couch line, and sufficient vibration for the intended purpose may be transmitted through the felt, although the felt is much more flexible than the wire, assuming that the felt is so disposed that it makes little bend in passing across the couch line. In all of the instances, including those disclosed in FIGS. 1 and 7 to 11, the vibrator device may be positioned as close as possible to the couch line as the parts of the machine will permit, or the vibrator device may be positioned as far as desired from the couch line but between the couch line and the next adjacent roll supporting either the wire or felt, but in the latter cases the amplitude of vibration must probably be increased to provide the substantial relative vibration between the wire and felt at the couch line on the offrunning side of this line to secure the best results.

The couching arrangement illustrated in FIG. 12 is quite similar to that illustrated in FIG. 11 except that the vibrator device **29***f* is positioned to be effective on the pass of the wire leaving the couch line rather than on the pass of the felt leaving the couch line. The FIG. 12 arrangement includes a breast roll **11***f* and a couch roll **12***f* supporting the wire **10***f*. A pickup roll **18***f* and a pressure roll **19***f* support the felt **17***f*. The roll **18***f* holds the felt **17***f* in contact with the wire **10***f*, depressing the wire **10***f* to a slight extent; and the pressure roll **19***f* holds the felt **17***f* in forceful contact with the drier **25***f*. The vibrator device **29***f* is positioned beneath the wire **10***f* and between the rolls **18***f* and **12***f* and is thus effective on the pass of the wire **10***f* leaving the pickup roll **18***f* subsequent to the couch line on the periphery of the pickup roll **18***f*. The vibrator device **29***f* is substantially the same as the vibrator devices **29***a* to **29***e* except that the device **29***f* comprises an elongated tubular structure having a triangular cross section in lieu of the rods **33**. As each of the apexes of the triangular structure contacts the wire **10***f*, it produces a vibration of the wire **10***f*; and this vibration is transmitted through the wire **10***f* back to the couch line on the periphery of the roll **18***f* on the offrunning side of the couch line.

The couching arrangement illustrated in FIG. 13 is substantially the same as that illustrated in FIG. 12, except that a vibrator device **29***g* is effective on the Fourdrinier wire prior to the couch line and on the inrunning side of the couch line. The FIG. 13 arrangement comprises a breast roll **11***g* and a couch roll **12***g* supporting the Fourdrinier wire **10***g*. The felt **17***g* of the machine is supported by means of a pickup roll **18***g* and a pressure roll **19***g*, the pressure roll holding the felt **17***g* in contact with the drier **25***g*. The vibrator device **29***g* is effective on the under surface of the wire **10***g* on the pass of the wire **10***g* between the breast roll **11***g* and the pickup roll **18***g*. The line of couch of the wire **10***g* and felt **17***g* is underneath the pickup roll **18***g*, and sufficient vibration is transmitted through the wire **10***g* to the offrunning side of the pickup or couch line so that there is a material improvement in the pickup of the web from the wire **10***g* to the felt **17***g* although the pickup is not as complete as in the case in which a vibrator is disposed on either the wire or felt subsequent to the pickup or couch line, due to the fact that the pickup roll **18***g* tends to dampen out the vibrations produced by the vibrator device **29***g*.

The couching arrangement illustrated in FIG. 14 is quite similar to the couching arrangement illustrated in FIG. 7 except that the vibrator device is positioned on the pass of the felt prior to the couch or pickup line of the felt and Fourdrinier wire, rather than on the pass of the felt subsequent to this line. The FIG. 14 arrangement comprises a breast roll **11***h* and a couch roll **12***h* supporting the Fourdrinier wire **10***h*. The felt **17***h* is supported by means of two rolls **37** and **38** so positioned with respect to the couch roll **12***h* that the pass of the felt **17***h* between the rolls **37** and **38** is substantially in a flat plane with the felt having a light or kissing contact with the wire **10***h* on the periphery of the couch roll **12***h*. The vibrator device **29***h* is positioned on the pass of the felt **17***h* between the rolls **37** and **12***h*, and sufficient vibration is transmitted through the felt **17***h* to the offrunning side of the felt at its line of contact with the wire, due to the fact that the felt **17***h* is in a substantially flat plane between the rolls **37** and **38**, so that pickup of the web from the wire to the felt is materially improved.

Although the efficiency of couching and the degree of transfer of fiber to the felt from the Fourdrinier screens have by experiment proved to be materially bettered using the vibrator device of the invention, the exact theory for the cause of such betterment is not known; however, any one or all of the following theories may be the basis for this result.

It is well known in Fourdrinier papermaking machine operation that a pickup gelt picks up the web better if it is kept in relatively wet condition and if there is substantial water on the surface of the felt, so that the surface tension of the water is effective to draw off the fibers of the web from the Fourdrinier screen. It is believed that

the vibration due to the vibrator devices **29**, **29***a*, etc. may tend to provide more water on the surface of the pickup felt by driving the water from inside the felt onto the outside felt surface. Possibly the vibration breaks up the water into small droplets from inside the felt that collect on the surface of the felt. Since the felt, in accordance with this theory, has more water on its surface due to the vibration, the felt therefore picks up the web more efficiently, since, as above mentioned, a wet felt in ordinary papermaking picks up much better than a drier felt. The use of the vibrator device of the invention thus allows the use of a felt which carries less moisture than would otherwise be possible.

Another theory that may be used to explain the effective couching using our vibrator devices is that the rate of movement of the felt and wire apart is increased by the beating that our vibrator devices give to the felt. The vibrations of the felt are essentially normal to the felt; and, therefore, during the vibrations, the felt and wire move apart, not only due to the angle between the separating passes of the felt and wire as they move apart, but also due to the vibration of the felt normal to its direction of movement. This action may be compared to the action of a piece of plywood, for example, being pulled from a puddle of slurry in which some of the slurry will be pulled up from the puddle if the plywood is pulled up rapidly from the puddle, but substantially none of the slurry will be disturbed if the plywood is pulled up gradually. The adhesive force of the felt with respect to the sheet is apparently increased, due to increased surface tension effects, as the velocity of separating movement of the screen and felt is increased.

The third theory, which may be used to explain the increased couching effect provided by our vibrator devices, concerns the vacuum effects that are produced at the line of separation of the felt and Fourdrinier screen. It has previously been theorized in connection with ordinary couching arrangements that when the felt and wire are put under substantial pressure at their line of separation, the compression of the felt in the nip results in a felt that is substantially 100 percent saturated in the nip. It is assumed that the felt has previously been carrying a substantial amount of water, being about 50 percent saturated with water, for example, which is about the usual case. The voids are squeezed out of the felt in the nip due to the pressure at the nip, and the felt in leaving the screen can be expected to expand into its original thickness, and the voids that were originally in the felt will reappear therein and will tend to fill up with air. The air sucking into these voids thus creates a slight vacuum between the felt and the sheet which causes the sheet to adhere to the felt.

By vibrating the felt at a relatively fast speed, it is believed that there is a tendency to provide a void between the sheet and the felt at the line at which the felt leaves the screen, and the air rushing up beneath the web thus pushes the web against the felt and causes it to adhere to the felt.

Another theory that may be utilized to explain the effectiveness of the vibrator devices **29**, etc., is based on the theory of couching set forth in Baggalley et al. Patent 2,990,013, which is to the effect that, if water is released from the web toward the wire, it forms a film between the web and wire and that this water facilitates clean removal of the web from the wire provided that this removal is effected before the water can reabsorb into the web. Utilizing the vibrator devices **29**, etc., may cause water from the web, as the web leaves the wire, to be directed by the vibration of the web and felt to the wire and thus form such a film on the wire facilitating clean removal of the web from the wire.

A theory in connection particularly with the long, high knuckle screen illustrated in FIGS. 4, 5 and 6 is that perhaps, due to the vibration of the felt, the felt is driven down farther into the interstices of the screen and around the knuckles of the wire, particularly around the high knuckles **39** of the screen illustrated in FIGS. 4, 5 and 6, so that the felt thereby comes into contact with more of the fibers and causes them to adhere to the felt due to the high density of the felt as compared to the screen, whereby more of the fibers transfer onto the felt. As has been previously mentioned, the fibers of a paper web tend to embed themselves quite deeply in a high knuckle wire as illustrated in FIGS. 4, 5 and 6.

Therefore, in brief, our invention teaches that, by producing a relative vibration between the wire and felt at the couch nip, couching can be improved.

The couching arrangements of the invention, including the vibrators **29**, **29***a*, etc., are effective with different types of Fourdrinier screens; however, the effectiveness of the pickup arrangements of the invention is particularly noticed in connection with Fourdrinier screens in which the webs tend to adhere and interlock by means of their fibers with the screens, such as the Fourdrinier screen illustrated in FIGS. 4, 5 and 6 with the long, high knuckles **39**. The pickup arrangements of the invention are particularly effective also in connection with new felts which have not been broken in, and it has been noticed that the vibrators of the invention have about the same beneficial effect as the substitution of a much softer, thicker felt for a relatively thin, hard felt having poor pickup qualities, insofar as clean removal of the web from the Fourdrinier screen is concerned. Under couching conditions, which are poor for one reason or another, the poor couching without use of a vibrator can be improved to near perfect couching conditions using a vibrator according to the invention; and the difference in couching under the two conditions is definitely noticeable in that when the vibrator is not in use a considerable amount of fiber is left remaining on the Fourdrinier screen after the couch line, while when the vibrator is in use, practically all of the fibers are removed from the Fourdrinier screen and are transferred to the felt.

Our vibrator devices provide excellent couching even though the quality of the pickup felts is not at the desired best. Lost production time in breaking in new felts on a papermaking machine can, therefore, nearly be eliminated or at least reduced considerably. Utilizing our vibrator devices also allows a papermaking machine to be operated with less moisture in the paper web at its couch position on the Fourdrinier screen as well as with less moisture in the pickup felt itself; and, as a result, therefore, a sheet of lower total moisture content may be delivered to the steam heated drier of the paper machine. A reduction in the required drying capacity of the drier of a paper machine, or an increase in machine speed if no change is made in the capacity of the drier, can therefore be realized utilizing the felt vibrators of the invention.

Although we have illustrated rotary types of vibrators **29**, **29***a*, etc., it will be appreciated that other conventional purely mechanical or electro-mechanical vibrator devices can instead be utilized, while still obtaining the advantageous results of the invention.

We wish it to be understood that the invention is not to be limited to the specific constructions, arrangements, devices and methods shown and described, except only insofar as the claims may be so limited, as it will be understood to those skilled in the art that changes may be made without departing from the principles of the invention.

What is claimed is:

1. In a papermaking machine, a pair of endless belts, a plurality of rolls for supporting said belts in looped form so that the belts may travel about their respective rolls and have a line of contact with each other, one of said belts constituting a screen on which pulp is carried and is partly dewatered to form a continuous paper web and the other of said belts constituting a felt onto which the paper web transfers from said screen

at said line of contact, and a vibrator device for causing vibration of said felt at the off-running side of said line of contact.

2. In a papermaking machine, a pair of endless belts, a plurality of rolls for supporting said belts in looped form so that the belts may travel about their respective rolls and have a line of contact with each other, one of said belts constituting a screen on which pulp is carried and is partly dewatered to form a continuous paper web and the other of said belts constituting a felt onto which the paper web transfers from said screen at said line of contact, and means for causing vibration of one of said belts at said line of contact on the offrunning side thereof for thereby facilitating clean removal of the web from said screen as it passes onto said felt, said vibration causing means comprising a rotary device having a plurality of spaced protrusions each of which contacts and makes impact with said one belt as the device is rotated for thereby vibrating the belt.

3. In a papermaking machine as set forth in claim 1, one of said rolls for supporting said screen having a nip with one of said rolls for supporting said felt to thereby provide said line of contact.

4. In a papermaking machine as set forth in claim 1, one of said rolls for supporting said felt being so positioned as to hold said felt in contact with an area of said screen located between two of said screen supporting rolls whereby to provide said line of contact on the area of the screen between said two last named rolls.

5. In a method of removing a paper web from an endless screen belt of a Fourdrinier papermaking machine which travels over a plurality of spaced rolls and carries the web in partly dewatered condition, the steps which comprise, running an endless traveling felt belt over a plurality of spaced rolls and in a line of contact with said screen belt whereby the paper web travels from said screen belt onto said felt belt at said line of contact, and causing vibration of one of said belts at said line of contact on the offrunning side thereof for thereby facilitating clean removal of the web from said screen belt onto said felt belt, said one belt being vibrated with five to thirty vibrations per linear inch of travel.

References Cited

UNITED STATES PATENTS

2,647,619	8/1953	Green	198—230
3,207,658	9/1965	Lamb	162—203

DONALL H. SYLVESTER, *Primary Examiner.*

A. C. HODGSON, *Assistant Examiner.*

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