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(54) **Single tier drying section**

Einsieb-Trockenpartie

Section de séchage à étage unique

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a single tier drying section of a paper making machine.

[0002] More specifically, the present invention relates to a looped felt which extends around a plurality of dryer cylinders of a single tier drying section.

INFORMATION DISCLOSURE STATEMENT

[0003] In the papermaking art, a pressed web is transferred to a drying section of a paper machine so that water remaining in the web is driven therefrom by passing the web around a plurality of dryer cylinders disposed in a single tier.

[0004] More specifically, with the advent of the BelChamp type drying section, drying speeds have greatly increased.

[0005] More specifically, U.S. Patent No. 4,934,067 assigned to Beloit Technologies, Inc., disclosed a BelChamp type dryer of the single tier type and envisioned that drying speeds of 3048 m/min (10,000 feet per minute) could be attainable. Already machine speeds of 2438 m/min (8,000 feet per minute) are being attained on a single tier pilot machine.

[0006] In CA-A-2 216 048 there is described a single tier dryer section of a papermaking machine according to the preamble of claim 1. More specifically, in CA-A-2 216 048, the single dryer section has dryer rolls with a reversing vacuum roll positioned between each pair to transfer and wrap the dryer felt and paper web against the next dryer roll. A vacuum box is positioned between adjacent dryer rolls and over the vacuum roll to hold the web on the dryer felt by vacuum, and the dryer felt has a permeability of between 2134 and 15240 $cm^3/min/cm2$ (70 and 500 cubic feet per minute per square foot).

[0007] WO-A-97 455 88 discloses a dryer section having one or two vacuum reversing rolls in a vacuum box, wherein the rolls are wrapped by a dryer felt having a permeability of between 12192-36576 $cm^3/min/cm^2$ 400-1200 cfm.

[0008] However, in the aforementioned arrangements even when a vacuum roll is disposed in close proximity with adjacent drying cylinders, there exists a tendency for the sheet to blow away from the supporting dryer felt or fabric when the web is moving from the dryer towards the vacuum roll.

[0009] The present invention overcomes the aforementioned problem of sheet blowing by the provision of a looped dryer felt having a high permeability. The high permeability tends to permit the vacuum within the vacuum roll to generate a negative pressure on the opposite side of the felt run relative to the web during transit of the web from the dryer to the vacuum roll.

[0010] Therefore, it is the primary objective of the present invention to provide a dryer felt device which overcomes the aforementioned problems associated with the prior art arrangements and which make a considerable contribution to the art of drying a web.

[0011] To achieve this, the single tier dryer section of the invention is characterized by the features claimed in the characterizing part of claim 1.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a side elevational view partially in section of a drying cylinder and an adjacent vacuum roll showing the web blowing away from the drying fabric.

Fig. 2 is a side elevational view similar to that shown in Fig. 1 but with the vacuum roll disposed in close proximity to the adjacent dryer.

Fig. 3 is a similar view to that shown in Fig. 2 but includes a dryer fabric which has a high permeability according to the present invention.

Fig. 4 is a side elevational view of a first dryer section of a single tier drying section of a paper machine according to the present invention.

[0013] Similar reference characters refer to similar parts throughout the various views of the drawings.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0014] Fig. 1 is a side elevation view of part of a prior art single tier drying section generally designated 10 having a drying cylinder 12 and an adjacent vacuum roll 14. A dryer fabric or felt 16 extends between the drying cylinder 12 and

the vacuum roll 14 and the web W is shown being blow away from the supporting fabric 16 during transit between the drying cylinder 12 and the vacuum roll 14.

[0015] Fig. 2 is a similar view to that shown in Fig. 1 but it shows the vacuum roll 14 disposed in close proximity relative to the dryer 12.

[0016] Fig. 3 is a similar view to that shown in Fig. 1 but shows the vacuum roll 14A disposed in closer proximity to the adjacent drying cylinder 12A and a felt having a high permeability according to the present invention.

[0017] Fig. 4 is a side elevation view of a first dryer section 18 of a drying section of a papermaking machine.

[0018] More specifically, as shown in Fig. 3, a dryer felt device 16A supports a web WA which extends through a single tier drying section 18 of a papermaking machine. The device 16A includes a looped felt 16A having a high permeability.

[0019] According to the present invention, the permeability of the dryer felt is at least 18288 $cm^3/min/cm^2$ (600 cfm).

[0020] In the prior art BelChamp type dryer sections, the dryer felt 16 has typically had a permeability of less than 2743.2 $cm^3/min/cm^2$ (90 cfm). The aforementioned low permeability fabrics tend to clog easily and they are difficult to clean.

[0021] Additionally, another problem with the use of low permeability fabrics or felts is that the application of an effective vacuum at the paper surface as the paper passes over the vacuum roll is reduced.

[0022] Also, low permeability or closed fabrics are more likely to lower the drying rate of the paper web.

[0023] The present invention includes the employment of an open fabric or dryer felt having a high permeability. Additionally, trials on a pilot single tier BelChamp type dryer section have shown that an open fabric having a high permeability of 18288 $cm^3/min/cm^2$ (600 cfm) can be used without blowing the sheet in the pocket areas.

[0024] Furthermore, such open fabrics are easier to clean and there is the potential for increasing the drying rate.

[0025] An additional advantage of using a high permeability fabric is that the cost of production thereof may be reduced.

[0026] Clearly, the advantages of using a high permeability fabric include improved machine runnability since the fabric stays open and is easy to clean thereby increasing the drying capacity of the drying section.

[0027] The present invention also envisages use of the aforementioned high permeability fabric which is capable of withstanding high temperatures such as is present in those machines incorporating an air cap for blowing heated air through the aforementioned fabric onto the web disposed between the fabric and the dryer cylinder.

[0028] The advantage of the aforementioned air cap type drying section is that the length of the dryer section can be reduced thus resulting in capital savings.

[0029] Furthermore, the dryer capacity is variable which may be important for future multigrade machines.

[0030] Also, drying on both sides of the sheet using air caps provides better curl control and the potential for eliminating any bottom felted sections.

[0031] The felt according to the present invention is preferably of the type having an open structure and having a permeability of 18288 $cm^3/min/cm^2$ (600 cfm) while being of a lower caliper.

[0032] The aforementioned fabric according to the present invention is utilized in a single tier drying section having vacuum rolls which may be of the stationary type or pivoting vacuum rolls.

[0033] Also, the fabric according to the present invention is utilized in a single tier drying section having passive vacuum boxes which generate a negative pressure due to their proximity to adjacent vacuum rolls.

[0034] During trials using a high permeability fabric according to the present invention, the web ran well in all pockets at 914 m/min (3,000 feet per minute). Also at 1067 m/min (3,500 feet per minute) the web ran well in pockets incorporating passive vacuum boxes of the aforementioned type.

[0035] As shown in Fig. 4, vacuum boxes 20 and 22 were disposed in the pockets between the second and third dryers 24 and 26 and the third dryer 26 and fourth dryer 28, respectively.

[0036] The vacuum box 22 in the third pocket had felt seals of a simple design due to the fixed geometry. The center shaft and seals in the second and third vacuum rolls 30 and 32 respectively were rotated counterclockwise 10.16 cm (4 inches) and 6.35 cm (2.5 inches) respectively, to provide more vacuum in the box 22. The trial plan included comparing conventional BelChamp type fabric having a permeability of 2743.2 $cm^3/min/cm^2$ (90 cfm) with an open fabric having a permeability of 18288 $cm^3/min/cm^2$ (600 cfm). The trial included the following criteria.

- Run conventional BelChamp 2743.2 $cm^3/min/cm^2$ (90 cfm) fabric.
- Draw: 50 (2^{nd} press) - 60 (sample felt) - 10 (1^{st} press) fpm
-

Pocket/vacuum roll #	Gap between dryer and VFR	Vacuum in the roll
2 (passive box)	5.1 cm (2")	2485 Pa (10" water column)
3 (passive box with felt seals)	7.6 cm (3")	2485 Pa (10" water column)
4	5.1 cm (2")	2485 Pa (10" water column)
5	7.6 cm (3")	2485 Pa (10" water column)

(continued)

Pocket/vacuum roll #	Gap between dryer and VFR	Vacuum in the roll
6-7	1.3 cm (0.5")	2485 Pa (10" water column)

- Machine speed 914 m/min (3000 fpm) or higher
- Change following conditions 30 min. prior to shut down

Draw: 40 (2nd press) - 45 (sample felt) - 10 (1st press) fpm
Lower VFR 6 and 7 to 7.6 cm (3")

- Run open 18288 $cm^3/min/cm^2$ (600 cfm) fabric
- Run same conditions as above
- In case of threading or runnability problems:

Increase the vacuum in the rolls
Move the VFRs (4 - 7) closer to the dryer while threading/running
Reduce machine speed

[0037] From the above trials, it became apparent that conventional BelChamp fabrics having a permeability of 2743.2 $cm^3/min/cm^2$ (90 cfm) were causing serious sheet blowing problems without the vacuum boxes at 914 m/min (3,000 feet per minute). However, as shown in Fig. 1, as the gap between the dryer 12 and the vacuum roll 14 increased, the sheet flutter and blowing problem became worse.

[0038] Even for the closed gap arrangement shown in Fig. 2, having a gap of .5 inches between the dryer 12 and the vacuum roll 14, the sheet W became slightly separated from the fabric 16 and had a tendency to follow the dryer 12. However, the sheet in the second and third pocket ran very well and stuck to the fabric 16A due to the passive vacuum boxes 20 and 22 even when the vacuum in such boxes 20 and 22 was very low. The vacuum in the second and third roll 30 and 32 was varied to observe the effect of low vacuum in the boxes on runnability. Even for zero vacuum in the rolls 30 and 32 there was some negative pressure in the boxes 20 and 22 which was enough to hold the sheet WA against the fabric 16A. Such was thought to be due to the foil effect of the cross machine seal. The vacuum levels in the rolls 30 and 32 and the boxes 20 and 22 are given in Table 1. The vacuum in the third pocket box 22 was higher than the second pocket box 20 due to better sealing. The vacuum level in the boxes 20 and 22 had no effect on runnability. Therefore, center shaft and seal rotation are not necessary to obtain more vacuum in the boxes. The change in draw had no significant effect on runnability.

[0039] For the open fabric 16A, the sheet WA ran better than with the closed fabric at 914 m/min (3,000 feet per minute) machine speed. Threading with vacuum rolls in an open position that is with a three inch gap between the dryer and the vacuum roll, was as good as threading with vacuum rolls in the closed position that is the 1.27 cm (5 inch) gap. The sheet WA separated from the fabric 16A in pockets 34, 36, 38 and 40 by approximate 0.95 cm (3/8 inch) but was stable and without flutter. Accordingly, it became apparent that the openness, that is the permeability or cfm value, had a major influence on sheet flutter causing the reduction thereof. The sheet ran very well in the second and third pocket and sheet marking was reduced by decreasing the vacuum level and felt tension.

Table 1

Vacuum in the Rolls and Boxes

Pocket	Vacuum in the roll, Pa (in. of water column)		Vacuum in the box, Pa, (in. of water column)	
	Bel-Champ Fabric	Open fabric	Bel-Champ fabric	Open fabric
2	2435 (9.8)	2559 (10.3)	184 (0.74)	117 (0.47)
	745 (3)	745 (3)	67 (0.27)	45 (0.18)
	0 (0)	298 (1.2)	7.4 (0.03)	20 (0.08)
3	2535 (10.2)	2485 (10)	311 (1.25)	169 (0.68)
	745 (3)	375 (1.51)	117 (0.47)	37 (0.15)
	0 (0)		14.9 (0.06)	

[0040] To study the effect of machine speed, 30 minutes prior to shut down, the speed was increased to 914 m/min (3,500 feet per minute).

[0041] The sheet blowing and flutter increased significantly in non-passive vacuum box pockets with increase in speed. Runnability in the passive vacuum box pockets was not affected by speed.

[0042] Accordingly, it was concluded that the use of open fabrics in existing BelChamp or single tier designs will greatly

increase the speed at which such dryer sections can be operated.

Claims

1. A single tier dryer section (18) of a papermaking machine comprising :

a group of dryer cylinders (12A;24,26,28), wherein each dryer cylinder (12A;24,26,28) of the group has a portion wrapped by a dryer felt device (16A) for supporting a web (WA) through the single tier drying section (18),
vacuum rolls (14A; 30, 32) between adjacent dryer cylinders (12A;24,26,28) of the group,
wherein said dryer felt device (16A) includes a looped felt (16A) which extends successively around each of said dryer cylinders (12A;24,26,28) and each of said vacuum rolls (14A; 30, 32), and
passive vacuum boxes (20, 22) disposed in the pockets above said vacuum rolls (14A; 30, 32) between adjacent dryer cylinders (24,26,28) of the group,
characterized in that
the passive vacuum boxes (20, 22) are only diposed in the second and third pockets between the second and third dryer cylinders (24, 26) and between the third and fourth dryer cylinders (26, 28) of the group, respectively,
said looped felt (16A) has a high permeability which is at least 18288 $cm^3/min/cm^2$ (600 cfm) so that the vacuum within each vacuum roll (14A; 30, 32) generates a negative pressure on the opposite side of the felt run relative to the web (WA) during transit of the web (WA) from each dryer cylinder (12A;24,26,28) to each vacuum roll (14A; 30, 32) of said single tier dryer section, and
the negative pressure generated in said passive vacuum boxes (20, 22) holds the web (WA) against the high permeability felt (16A).

Patentansprüche

1. Einreihiger Trocknerabschnitt (18) einer Papierherstellungsmaschine, umfassend:

eine Gruppe von Trocknerzylindern (12A; 24, 26, 28), wobei jeder Trocknerzylinder (12A; 24, 26, 28) der Gruppe einen Teil hat, der von einer Trocknerfilzvorrichtung (16A) zum Stützen einer Papierbahn (WA) durch den einreihigen Trockenabschnitt (18) gewickelt wird,
Vakuumwalzen (14A; 30 32) zwischen benachbarten Trocknerzylindern (12A; 24, 26, 28) der Gruppe,
wobei die Trocknerfilzvorrichtung (16A) einen verschleiften Filz (16A) aufweist, der sich nacheinander um jeden der Trocknerzylinder (12A; 24, 26, 28) und jede der Vakuumwalzen (14A; 30, 32) erstreckt, und
passive Vakuumgehäuse (20, 22), die in den Taschen über den Vakuumwalzen (14A; 30, 32) zwischen benachbarten Trockenzylindern (24, 26, 28) der Gruppe angeordnet sind,
dadurch gekennzeichnet,
dass die passiven Vakuumgehäuse (20, 22) nur in der zweiten und dritten Tasche zwischen dem zweiten und dem dritten Trocknerzylinder (24, 26) und zwischen dem dritten und dem vierten Zylinder (26, 28) der Gruppe angeordnet sind,
dass der verschleifte Filz (16A) eine hohe Durchlässigkeit hat, die mindestens 18.288 $cm^3/Min./cm^2$ (600 cfm) beträgt, so dass das Vakuum zwischen jeder Vakuumwalze (14A; 30, 32) einen Unterdruck auf der entgegen gesetzten Seite des Filzes erzeugt, der in Bezug zu der Papierbahn (WA) während des Übergangs der Papierbahn (WA) von jedem Trockenzylinder (12A; 24, 26, 28) auf jede Vakuumwalze (14A; 30, 32) des einreihigen Trocknerabschnitts läuft, und
dass der Unterdruck, der in den passiven Vakuumgehäusen (20, 22) erzeugt wird, die Papierbahn (WA) gegen den hochdurchlässigen Filz (16A) hält.

Revendications

1. Section de séchoir à un seul niveau (18) d'une machine de fabrication de papier comprenant:

un groupe de cylindres de séchoir (12A; 24, 26, 28), dans lequel chaque cylindre de séchoir (12A; 24, 26, 28) du groupe a une portion enroulée par un dispositif de feutre de séchoir (16A) pour supporter une toile (WA) à travers la section de séchage à un seul niveau (18),
des rouleaux de dépression (14A ; 30, 32) entre des cylindres de séchoir adjacents (12A ; 24, 26, 28) du groupe,

dans lequel ledit dispositif de feutre de séchoir (16A) comprend un feutre en boucle (16A) qui s'étend successivement autour de chacun desdits cylindres de séchoir (12A; 24, 26, 28) et de chacun desdits rouleaux de dépression (14A; 30, 32), et

des boîtiers de dépression passifs (20, 22) disposés dans les poches au-dessus desdits rouleaux de dépression (14A; 30, 32) entre les cylindres de séchoir adjacents (24, 26, 28) du groupe,

caractérisée en ce que

les boîtiers de dépression passifs (20, 22) sont uniquement disposés dans la deuxième poche et dans la troisième poche respectivement entre le deuxième cylindre de séchoir (24) et le troisième cylindre de séchoir (26) et entre le troisième cylindre de séchoir (26) et le quatrième cylindre de séchoir (28) du groupe,

ledit feutre en boucle (16A) a une grande perméabilité qui est d'au moins 18 288 $cm^3/mn/cm^2$ (600 cfm) de manière à ce que la dépression à l'intérieur de chaque rouleau de dépression (14A; 30, 32) génère une pression négative sur le côté opposé du passage de feutre par rapport à la toile (WA) pendant le transit de la toile (WA) de chaque cylindre de séchoir (12A; 24, 26, 28) à chaque rouleau de dépression (14A ; 30, 32) de ladite section de séchoir à un seul niveau, et la pression négative générée dans lesdits boîtiers de dépression passifs (20, 22) maintient la toile (WA) contre le feutre de grande perméabilité (16A).

PRIOR ART

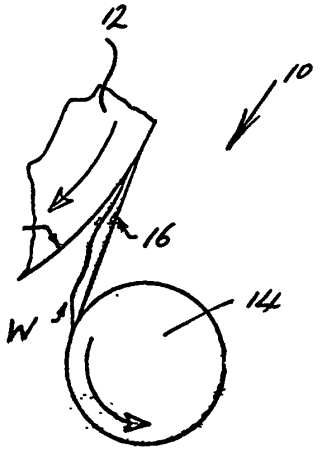

FIG 1

PRIOR ART

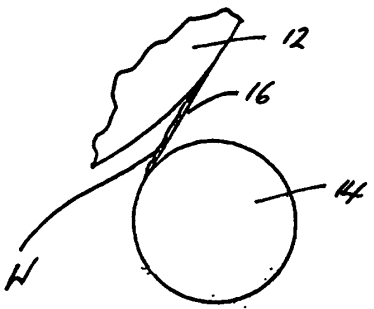

FIG 2

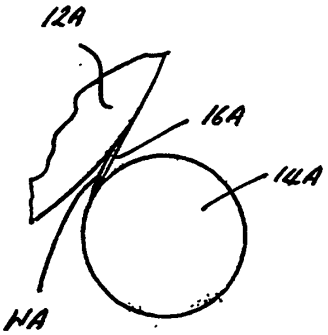

FIG 3.

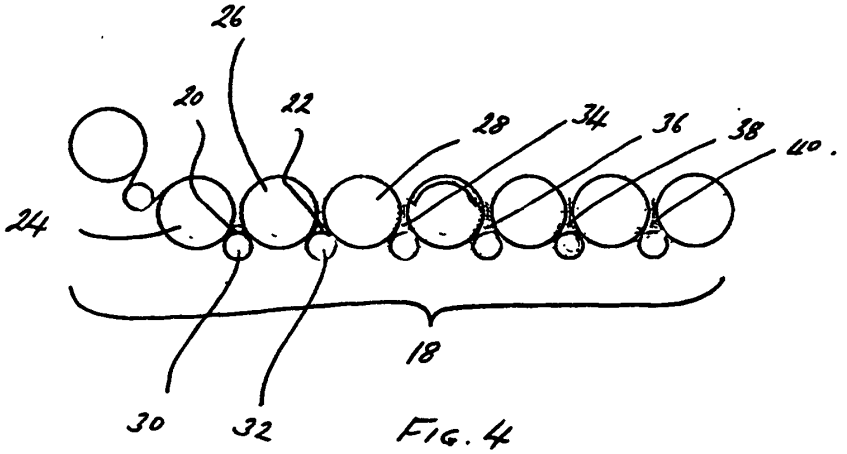

FIG. 4