Developments in Screens and Pocket Ventilation

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SUMMARY

Although the use of the screen and the pocket ventilation are not new subjects, this article has been written primarily for papermakers who either are not very conversant with them or are contemplating to introduce them on their machines. The intention has been to provide a comprehensive information. When supplemented by a papermakers' practical experience backed by an intimate knowledge of a particular machine under his charge, it would assist him to use the screen and also employ the most suitable ventilation system to obtain the best advantage and maximum economy of steam.

HISTORY

About fifteen years back due to the development of new types of permeable clothing, inovations were made in all areas of drying technology for example, ventilation, machine configuration, and condensate removal. The major breakthrough however came with the introduction of highly permeable screens. This not only gave significant economy of steam consumption but helped in profile correction of sheet moisture. It helped in minimising the over dry edges, better sheet surface for uniform conductivity drying as high tension could be employed and less rejection of paper for better reels at the end. A careful study should therefore always be made before a particular type of screen is introduced. The introduction of some recently developed products quite often proves detrimental if proper care is not taken of its prerequisites. Screens can be employed effectively in old machines with most suitable pocket ventilation. Thus the cost of drying can be brought down considerably and a better quality of paper ensured.

Even though the removal of water from the sheet by drying is the most expensive portion of papermaking process, till 1962 very little attention was paid in comparison to the wire and press section. Fairly detailed theories have been put forth to explain drainage on the wire and dewatering in the press, but the dryer section till sometime back remained an ignored area. The basic reason for this is attributable, to the fact that most of the paper machines lack the basic information on the performance of the dryers. Commonly, a pressure guage on the main steam manifold is all that the papermaker has to guide himself. Although it is useful as rough indication of general drying conditions especially when the available pressure limits production on the machine, is of little value on its own in assessing whether a substitution of new type of clothing can bring any significant improvement.

Most of the contents of this article have already appeared in various papermaking literatures, clothing manufacturers pamphlets and journals. For writing the present article, the material has been substantially revised and brought up-to-date to include the developments in the manufacture of screens and improvements in the pocket ventilation system.

INTRODUCTION

Drying of paper requires enormous expense and effort. The cost involved in removing the relatively small quantity of water in the sheet by the time it reaches the dry end of paper machines, is very high. It is for this reason that much work has been carried out in the last decade to devise efficient and economic methods of drying the paper sheet in dryer section. Speeding up of machines has aggravated the problem of drying such as inadequate condensation, non-uniform moisture profile, over dry edges and highly humid air pockets around the drying cylinders.

In the early days it was thought that endless woollen dryer felts can only be used for drying but with the progress in paper technology and improvements in machines, cotton and cotton synthetic felts, either in endless or in open ended from with clipper seam have also come into use. Today the clothing manufacturers have further revolutionised with the introduction of screens commonly known as Dry Screens or Dry Wires. Fig. 1 and Table-1 show the differences in permeability of various clothings.

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TABLE—I

Sl. No.	Type of clothing	Gsm.	Thickness m.m.	AIR PERMEABILITY, $m^3/m^2/h$ of 10 mm ws
1.	Woollen Dry	3000	6.0	200
2.	Needled Dry	1960	5.3	375
3.	Cotton Dry-3 ply	2150	3.1	900
4.	Cotton Dry-4 ply	2300	4.1	1000
5.	Dry Screen	770	8.1	8000

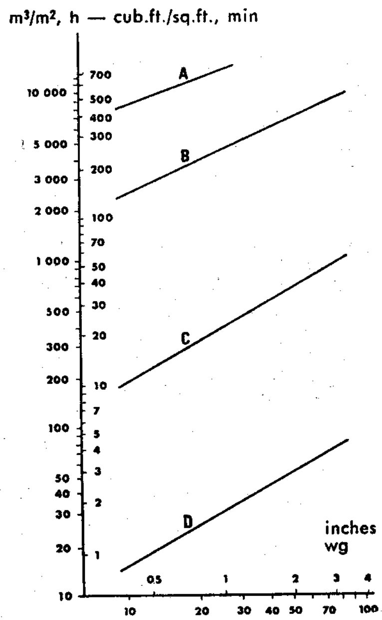

Fig. 1

A. Highly permeable dry screen.

B. Less permeable dry screen.

C. Needled dryer felt.

D. Closely woven cotton dryer felt.

To explain the progress in improved dryer clothings it is important to study the drying of a sheet on a felted cylinder.

1. DRYING ON A FELTED DRYER CYLINDER

Drying on a felted cylinder can be better explained by dividing it into four phases as shown in Fig. 2.

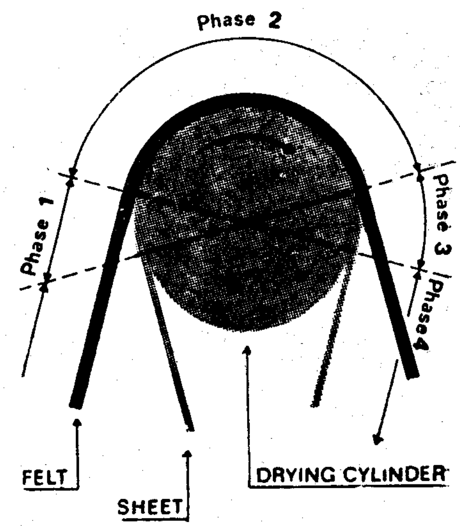

Fig. 2

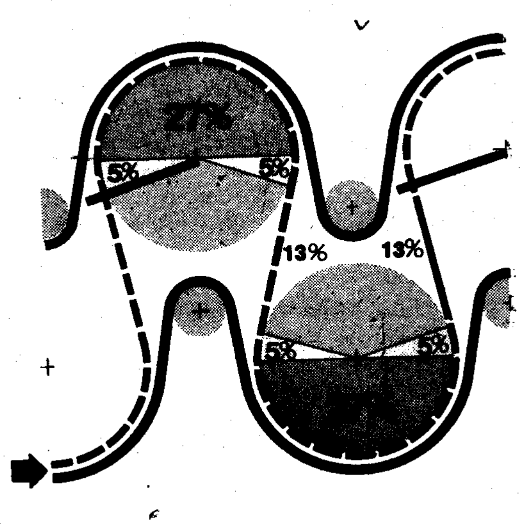

Fig. 3

Diagrams shows the approximate percentage of contact time of sheet during the cycle, lasting from contact with one top cylinder to contact with the next top cylinder.

1.1 PHASE-1

This is the section where the sheet just touches the hot cylinder but is not yet pressed by the felt. The sheet temperature begins to rise slowly but without the pressure of the felt the heat transfer is poor, and practically there is not much of evaporation. In terms of contact time, it is 5%.

1.2 PHASE-II

This phase begins when the felt starts pressing the sheet on to the cylinder and extends upto the point where the felt just leaves contact. In this phase, heating accellerates as the wet sheet is pressed firmly on the surface of the drying cylinder by the felt. The felt under tension helps to increase the conductivity between the sheet and the cylinder surface. In doing so the water contained in the sheet will first evaporate against the hot cylinder surface and then be transported to the felt side. The water inside the sheet goes by capillary action in the direction opposite to the hot cylinder surface. Depending on the temperature of the felt as well as its wetness, vapour will either condense inside felt or pass through to the surrounding atmosphere.

1.21 It is important to mention here that direct heat transfer from a metal cylinder to the paper sheet covered by a felt must be compared with heat transfer from a hot felt to the sheet and with some air in between the two. The rate of heat transfer from cylinder to sheet will be much higher than that from felt to sheet. Even though the dryer felt contacts one side of the sheet in this phase, the amount of heating of the sheet by felt is insignificant compared to the heating by the cylinders. Thus the evaporated vapour must move through the felt to the atmosphere. In terms of contact time, it is 27%.

1.3 PHASE-III

In this phase the felt just leaves contact with the sheet but the sheet continues to be in contact with the cylinder. Now, two things happen. First, the water in felt evaporates from both sides of the felt using the BTU content of the felt and lowering the felt temperature.

Secondly, the moisture escaping from the back side of the sheet now freely escapes into the triangular pocket of sheet and the felt. The balance between heat input and heat loss by evaporation is so, that the sheet begins to cool.

1.4 PHASE-IV

In this phase neither felt nor sheet has any contact with cylinder. It is better known as "Free Draw Zone". It is generally thought that most evaporation occurs in this phase within the first few centimentres after the sheet leaves the cylinder. Water freely evaporates from both sides. This "Flash-off" uses up the BTU content of the sheet, quickly dropping the sheet temperature. In terms of contact time, it is 13% before it enters Phase-1 again.

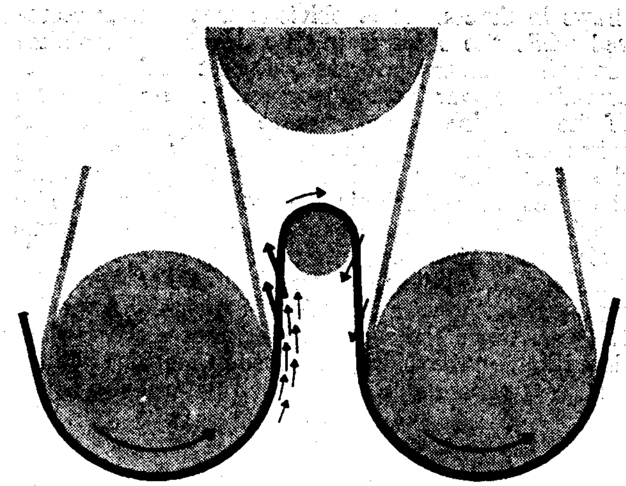

Fig. 4

The main direction of air flow.

2. CAUSES OF NON-UNIFORM DRYING

Before we postulate the prerequisites of economic and efficient drying we must look into the causes of non-uniform drying. One hardly needs to mention problems like overdry-edges causing and processing of paper, soft ridges at final reel, blackening of sheet at calenders etc. These problems have assumed a greater proportion in high speed and wider deckle machines.

We will discuss these causes briefly as they relate to the development of Dry Screens.

2.1 ACCUMULATION OF NON-CONDENSIBLES WITHIN DRYING CYLINDERS

This is one of the most common reason for retardation of drying and improper moisture profile of sheet. Even the best condensate system leaves behind some accumulation which acts as a stagnant insulator of varying depth affecting the heat-transfer to dryer shell. Although Daane has done a good deal of work by improving the condensate system and evened the steep gradient in the depth of film thickness, convenction heat transfer acts only as a weak function of film thickness. The presence of non-condensible accumulation retards the steam condensation rate, resulting in high moisture areas in the sheet.

2.2 NON-UNIFORM MOISTURE PROFILE AND OVERDRY EDGES

The insight into this cause was first provided convincingly by Daane. According to his finding non-uniform evaporation takes place in the free draws in dryers. It is obivious that vapour removed while the sheet is in free draws, must diffuse through boundary layer at the sheet surface. Thus amassing vapour in the dryer pocket near the centre of the machine. The presence of stagnant vapour raises the vapour pressure of the air surrounding the sheet, thereby stifling evaporation, except near the edges where fresh air is entrained. Therefore by the time the middle of the sheet gets dry, edges become overdry. Various work done in this direction while running conventional dryer felts under optimum tension has shown a variation of moisture from 6% to 9% between the edges and the centre of the sheet depending on the width, the speed of machine and the quality of paper made, where stock hydration is higher.

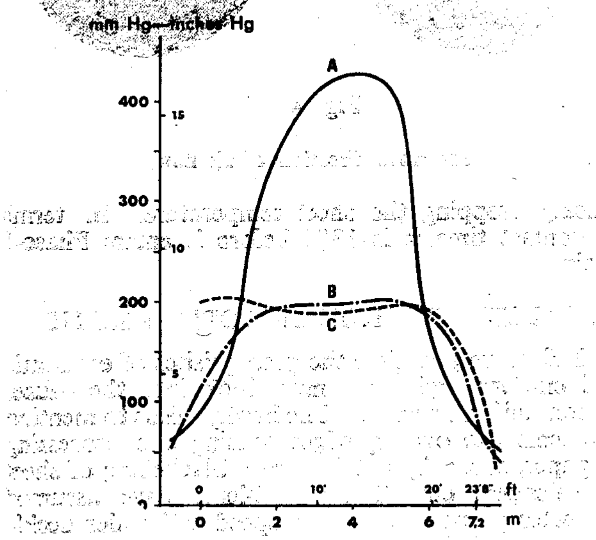

Fig. 5

Partial vapour pressure at dryer pocket.

A. Cotton Synthetic dryer felt.

B. Cotton Synthetic dryer felt with hot air blowing system.

C. Highly permeable dryer screen.

2.3 UNEVEN OR INADEQUATE CONTACT OF THE SHEET WITH THE CYLINDER SURFACE

The main function of the dryer felt is to press the sheet as closely as possible to the surface of the cylinder insulating it and thereby ensuring optimum heat transfer. The tighter the dryer felts the higher becomes the pressure holding of the paper sheet against the heated cylinder surface. This results in better heat transfer to the sheet and less heat loss for uniform conductivity drying. It has been studied that conventional dryer felts limit this tension to maximum 1.5-2.5 kg/cm. Higher tension in such felts may impair the life of the felt. The felt should also be porous to absorb the vapour and evaporate it to the atmosphere. Any inefficiency at this stage causes non-uniform moisture profile and problems like blisters and cockling of the sheet.

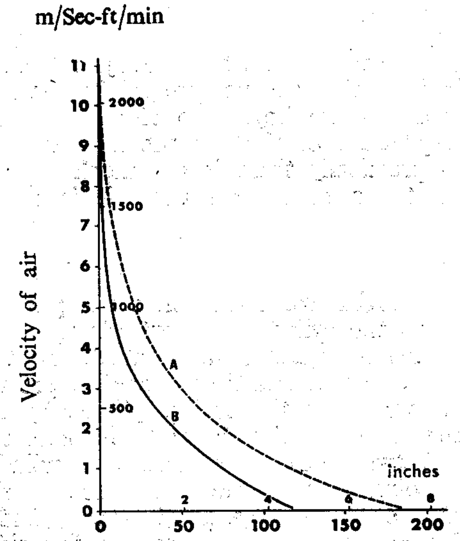

Fig. 6

Height from the dryer felt/screen surface.

A. Highly permeable screen.

B. Cotton synthetic dryer felt.

2.31 It is very important to mention here that when dryer felts are used, the evaporating moisture from the sheet is often hindered in its escape by insufficient permeability usually caused by sudden condensation of vapour entering into the felt. This is because the felt is cooler than the steam passing through it. A sudden condensation occurs in the felt because of differential temperature, particularly on the side against the sheet. This usually gives rise to humid water film on the surface of the felt thereby reducing its permeability and consequently retarding evaporation. Daane has mentioned that the moisture profile of the sheet can be improved if the differential temperature of felt and sheet is minimised. It is for this reason that special felt drying arrangements are important in order to return the felt to an acceptable condition in its cycle of run.

2.4 FORMATION OF VAPOUR POCKETS AND AIR FLOW

As mentioned earlier Daane has shown that non-uniform evaporation occurs in the free draws and vapour removed while the sheet is in free draws must diffuse through the boundary layers. This transfer is opposed by the accumulation of vapour in the dryer pocket near the centre of the cylinder.

2.5 Under normal conditions this evaporated vapour must flow out of the cylinder atmosphere. In doing so it first saturates the surrounding atmosphere before it escapes. It is however impossible to know the direction of this air flow because of factors like the width of the machines, speed, temperature and rate of evaporation which differ from machine to machine.

It has been studied that there is always a layer of air flowing just above the run of felt/screen. The velocity of this surface air depends on the speed of machine and the roughness of the felt/screen surface. The Fig. 6 shows that a screen always carries more air at higher velocity.

2.6 In U.S.A. some work has been done where they tried to establish the main direction of air flow by means of 'Pocket Simulator'. Although theoretically it is accepted that the pressure zone A and vacuum zone B (Fig. 7) will counteract at the pocket, in practice we find that most of the excess air goes out of the pocket both from the front side and the back.

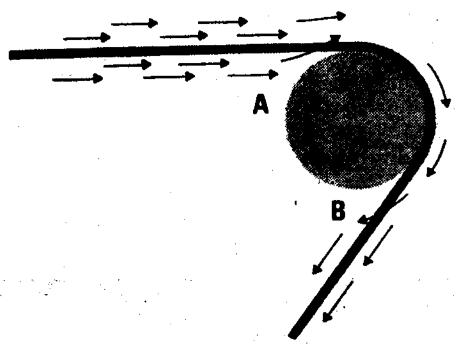

Fig. 7
Direction of air flow at a turning.

It is however established that if the speed of air flow exceeds 2 meters/second there would be sheet fluttering and the paper would break. Normally in the use of normal dryer felts, pressure does not build upto an extent as to cause such critical problems. This problem assumes a critical condition when highly permeable fabrics are used such as Dry Screens or Dry Wires. Fig. 8 shows how excess air-flow disturbs the sheet and re-enters into the pocket. If the volume of this air is not too large, adjustments of felt rolls, as shown in A, B & C of Fig. 8 can divert the air flow to counter act and avoid re-entering in the pocket.

To summarise the above points discussed we come to the conclusion that except for the condensate system, all other causes of non-uniform moisture profile can considerably be improved by use of a proper dryer clothing. The pre-requisite of this should be :

2.61 Increased permeability enabling freer evaporation.

2.62 Higher tension to improve better heat transfer.

2.63 Lower moisture absorbtion by the felt to lessen vapour condensation. This will avoid thermally inefficient process of condensation and re-evaporation.

Clothing manufacturers have developed a highly permeable material made out of monofilament to meet all the above prerequisites. Though they are marketed under various trade names, they are commonly known as Dry Screens or Dry Wires. In order to make effective use of these materials some modifications and developments are necessary in the sections where they are to be used.

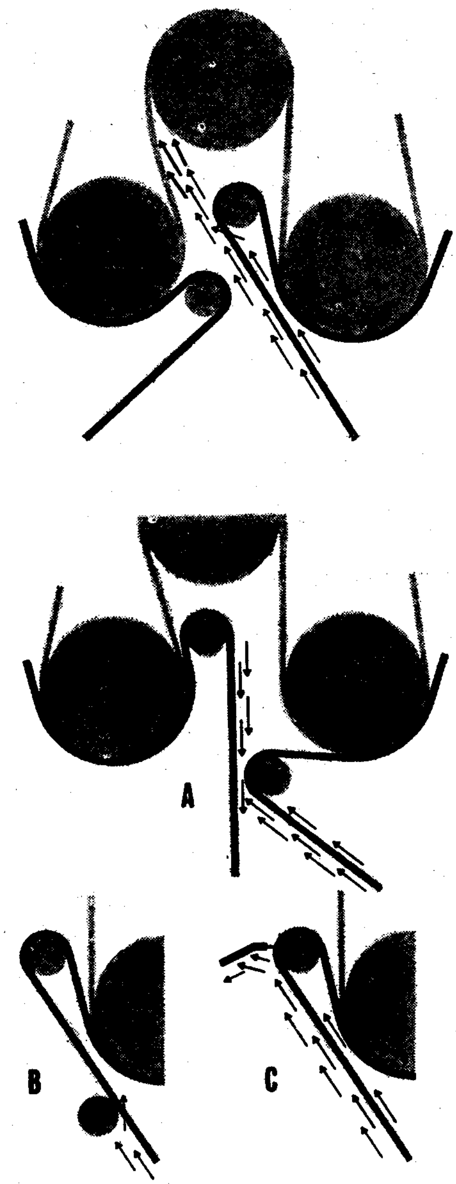

Fig. 8

3. MANUFACTURE OF SCREEN

3.1 SELECTION OF MATERIAL

On the basis of various synthetic material available and their properties, it would seem desirable to use polyester in the warp and polyamide in the weft as we know that polyester has very low extensibility and polyamide has a high abrasion resistence.

Usually, in normal manufacture however, polyamide has been chosen as it is softer and more pliable.

3.1 MONOFILAMENT

The monofilament yarn, resembling a single stiff plastic wire, is produced in endless form, usually with a diameter of 0.2—0.5 mm.

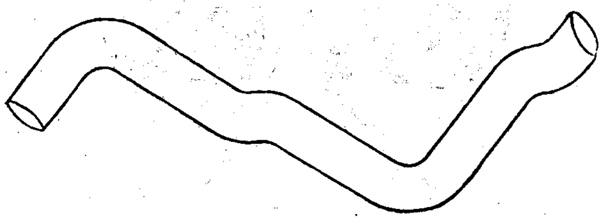

Fig. 9

A monofilament yarn

3.12 MULTIFILAMENT

The multifilament yarn is also endless but it is composed of many fine threads which are twisted together. To use it to make a screen it must be subjected to a synthetic resin coating treatment.

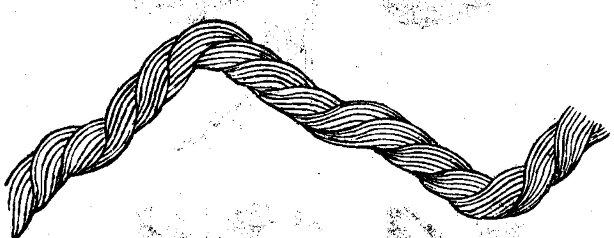

Fig. 10

A multifilament yarn.

While there is no decisive advantage in the use of either one of these over the other, the stiffness of the monofilament screen contributes greatly to its smooth running. Moreover, monofilament will always be stronger and wear resistant to multifilament, no matter whatever treatment given to it. However, multifilament is prefered in the warp as it is more pliable.

3.2 CONSTRUCTION

A dry screen can be produced in single, double or triple weave construction.

When screen was first developed it was made in plain weave single cloth. Soon it was realised that a duplex weave would be more suitable on machines running in high speed where autoguides are generally used.

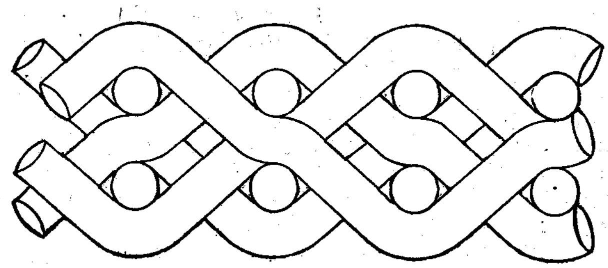

Fig. 11

End view of a duplex weave construction

3.21 The most common construction of this weave is a single warp (running direction) and a double weft (crossing yarns). The stiffness of the yarn determines the spacing which should be sufficient to ensure high permeability. It must be mentioned here that appearance of dry screen is no effective guide to its permeability or performance.

Fig. 12

A monofilament 2 ply woven screen

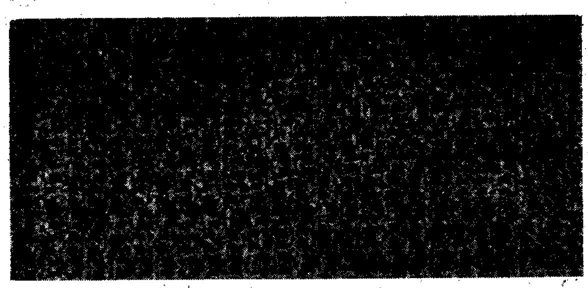

Fig. 13

Resin treated multifilament screen

3.22 On account of the stiffness of the monofilament or the resin treated multifilament yarn used in manufacture of screens it is essential to use very strong looms. They are woven as other felts and then put through various processes to ensure their dimensional stability to withstand the paper machine running conditions. After the screen has been produced it is made endless after cutting to the required length.

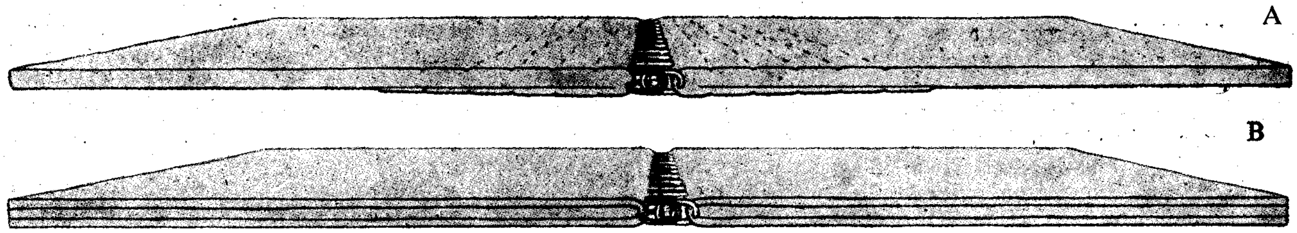

Fig. 14

A. The Tapered 'V' Spiral Seam is made possible by the 3 layer weave. Yarns are removed from the turn back area to taper the Seam making it more flexible and lighter in weight.

B. The in-line 'VS' Spiral has no turn back. webbing or stitching. The Seam thickness as the fabric and easy to join on the machine.

Screens have now been developed in triple weave (3 ply) in various forms and further development continues.

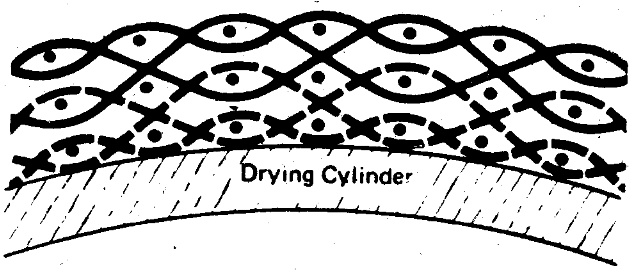

Fig. 15

Three layer screen. Only half the machine direction yarns keep contact on the paper and the hot cylinder. The back side yarns keep their strength longer.

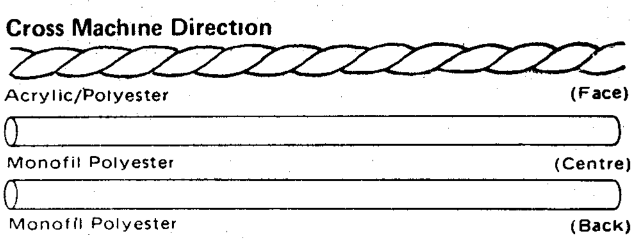

Fig. 16

3.23 At machine speeds i.e. at not less than 150 m/min. it is necessary to balance the screen permeability with the efficient removal of evaporated moisture. To reduce the evaporation rate to be compatable with the capability of exhaust removal, in some cases even 3 ply screens are employed. Our present experience is this country however convinces us that at the most a 2 ply construction would completely be adequate. The paper maker must however establish his exact requirement rather than jump over to the latest product on offer which may infact cause problems where the evaporation rate will not be in balance, and there will be sheet flutter.

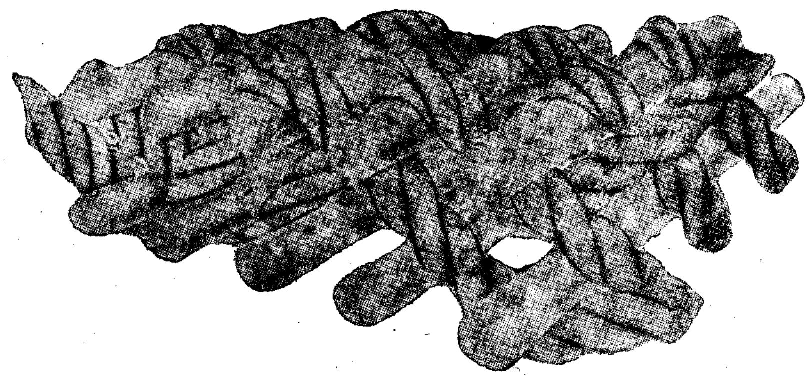

Fig. 17

Three layer screen. Top layer resin treated multifilament, cross yarns for smoother surface. Two layers below with monofilament cross yarn to ensure stability. Multifilament yarns (resin treated in machine direction for flexibility and steady running.

3.24 Screens have been developed in various ways for special purposes, using multifilament yarns in warp and monofilament in the weft and indeed incorporating conventional spun yarn also. (Fig. 18).

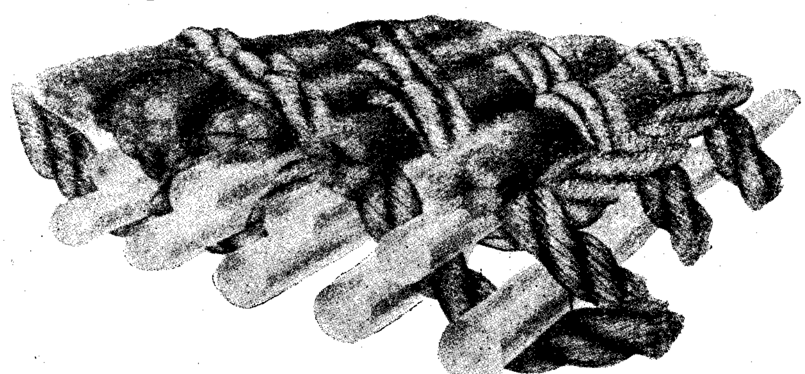

Fig. 18

Screen made of resin treated multifilament yarns in the machine direction for good wear resistance, flexibility and steady running. Two layers of monofilament ensure cross machine stability.

This kind of screens are made by using multifilament in first layer (i.e. touching the cylinder), monofilament in the second layer and resin treated multifilament made with acrylic, monofil polyester and polyester twisted together, in the third layer (i.e. on paper side). This type of screen is expected to resist wear, lower the permeability for very high speed machines. The cost of such fabric however, will be comparatively higher.

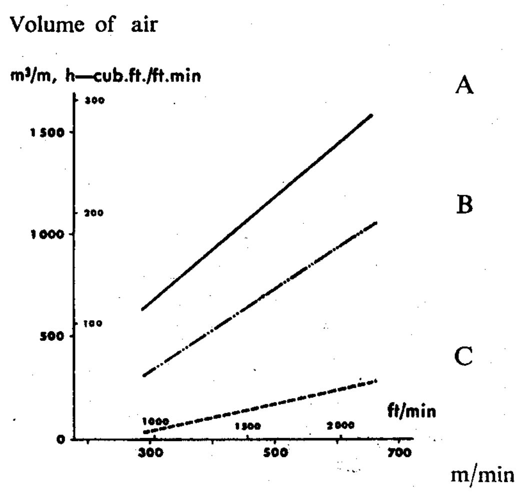

Fig. 19

A. 2 ply Monofilament screen.(Fig. 12)

B. 3 ply Multifilament (warp) Monofilament (weft) screen. (Fig. 18)

C. 3 ply Multifilament (warp) Monofilament (weft) with multifilament weft face (Fig. 17) This figure shows the increase in the volume of air in the dryer surroundings related to the machine speed and the permeability of screen.

3.25 It is important to mention here that humidity and temperature do have an effect on this kind of screen but between very narrow limits. It may also be mentioned here that since these fabrics are produced under tension and then heat-set, it is most likely that they will have a tendency to shrink slightly when first put on the machine. This shrinkage will be hardly 1%. Once the screen is set on the machine it will remain constant over a long period and only towards the end of it's life it may show signs of stretching.

NOTE : DRYER SCREENS SHOULD ALWAYS BE KEPT AT RUNNING TENSION EVEN DURING A LONG SHUT DOWN.

4. APPLICATION OF SCREEN AND VENTILATION

We have tried to explain so far the use of a Conventional Dryer felt to dry sheet on a heated cylinder and the causes of non-uniform drying. Table-II gives a typical example of a machine consisting of five groups of six dryers having 30 dryers in all. This study is based on the use of cotton synthetic dryer felts.

It is quite apparent from the table that groups II, III and IV have the maximum rate of evaporation and steam consumption. Therefore if a permeable screen is used the evaporation can be substantially improved under identical conditions alternatively better drying is achieved at lower cost.

We have already explained in (2.4) and (2.6) and (3.23) that because of increased evaporation when screen are used critical conditions develope in the surroundings and damp airpockets form in the dryers. Thus an efficient ventilation system becomes very important to maintain an optimum balance of surrounding air temperature, relative humidity and input against exhaust, while using screens. Many interesting methods have been introduced to provide the essential ventilation of damp air-pockets in modern machines where screen is used. Application of a method largely depends on the type of machine, speed, width, stock used and the space available. Some of them are explained here with their diagrams and salient features.

4.10 POCKET VENTILATION

Pocket ventilation provides an atmosphere surrounding the pockets for uniformity of sheet drying from edge to edge. It is not only intended to speed up the drying at the centre of the sheet to match the drying rate at the edges, but also accelerate the drying rate to economise the steam consumption. We have already explained about over-dry edges in (2.2), (2.3), (2.4) and Fig. 5. The methods explained here would show the progressive improvement continuing in this direction.

4.11 BLOWING HOT DRY AIR BY DUCTS INTO POCKETS

This is the most familiar and primitive method. This is commonly known as the Voith-Grewin hot air blowing system. (Fig. 20).

In this arrangement pipes are extended into the pocket ends and hot air is blown across the machine. The introduction of hot air in the pocket creates an aspirating effect thereby drawing in additional surrounding air. In order to gain sheet moisture symmetry, the ducts are usually alternated between the front and back sides. This method has the following limitations:

a. The air becomes more moisture laden as it traverses the sheet and therefore, by the time the centre of the sheet dries the sheet edges become over-dry.

TABLE—2

DRYER CYLINDER DRYER GROUPS	1–6 I	7–12 II	13–18 III	19–24 IV	25–30 V
Dryness while entering %	37	42	51	70	87
Dryness while leaving %	42	51	70	87	95
Evaporation %	14	23	33	24	6
Steam consumption %	15	20	29	26	10
Surface Temperature of °C cylinder	60–80	83–90	104	104–100	100–96

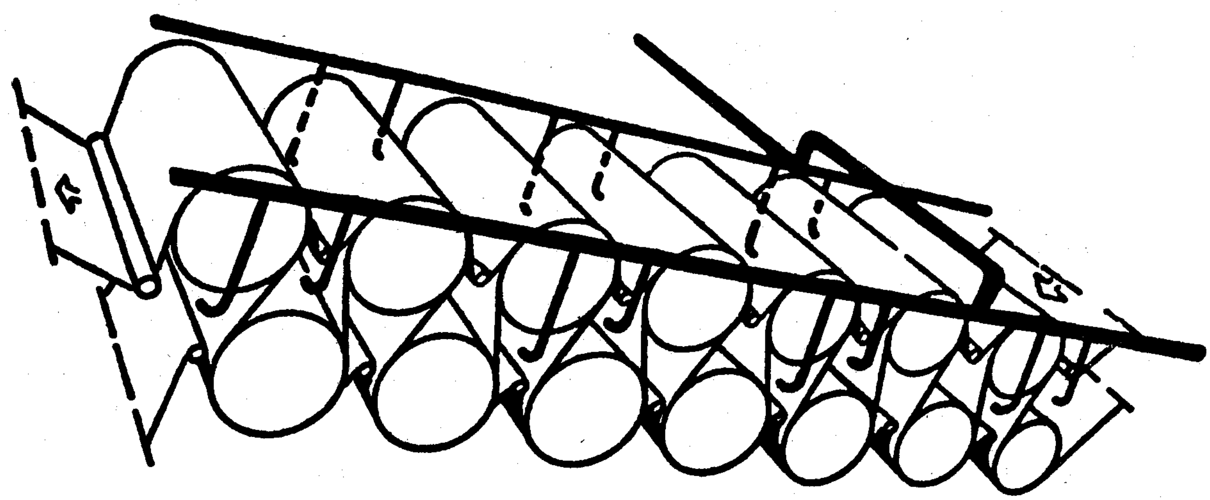

Fig. 20

b. It is not possible to supply sufficient air to absorb all the pocket vapour inspite of the aspirator effect.

c. This method has no value in lowering the moisture absorbtion of the fabric to reduce vapour condensation and re-evaporation as explained in (2.63).

d. This method becomes ineffective in wide machines. As explained in (2.6) if excessive air is inducted it will cause sheet flutter, leading to wrinkles and breaks.

4.12 DOCTOR BACK NOZZLES BLOWING FROM THE MIDDLE OF POCKET

In this method hot air is blown from the centre of the pocket. The arrangement is such that the air blows from the centre outwards, thereby purging the vapour laden air from the pockets. (Fig. 21)

It is claimed that in this method over-dry edges are considerably reduced. In this method, however the purging of moisture laden air from the center is not adequate to ensure uniform and sufficient air in the centre of the pocket. Neither is this method of any value in felt drying and conditioning.

4.13 NOZZLED CROSS PIPES BLOWING ON SHEETS IN SHEET RUN

In this method nozzled cross pipes in the sheet run have been introduced. (Fig. 22)

This method did bring some correction in the moisture profile by a combination of partial pocket ventilation and direct high velocity air impingement drying. This system has a slightly better advantage of correcting the moisture profile as pipes are equipped to block-off the air flow to selected portions of the sheet width. This system again has some disadvantages. It is not able to deliver sufficient air for complete purging of humid air from the pockets and there exists a fair amount of risk always of the sheet-run being disturbed if high velocity air is impinged. Further one or two pipes required per pocket always pose a cleaning hazard for safe operation. This method also has no provision for conditioning the felt.

4.14 NOZZLED CROSS PIPES BLOWING ON FELT IN FELT RUN

This method was employed for profile correction in view of the problems discussed in (2.31) and (2.63). (Fig. 23).

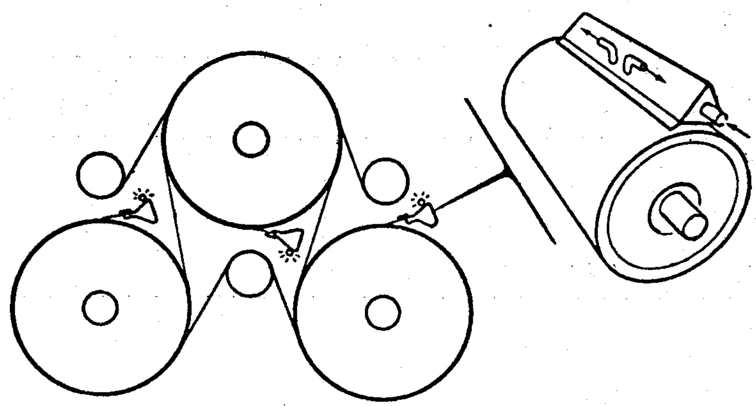

Fig. 21

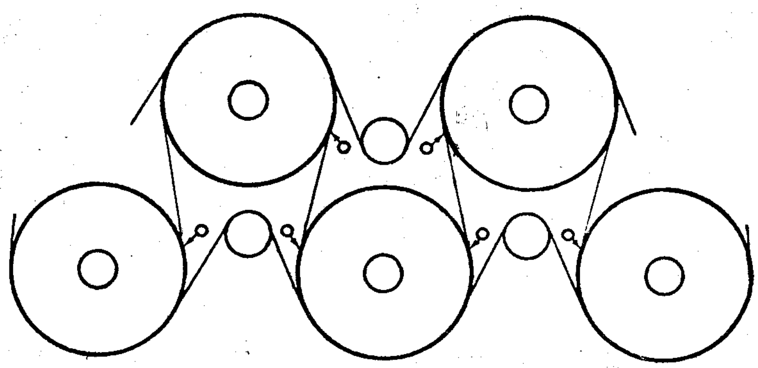

Fig. 22

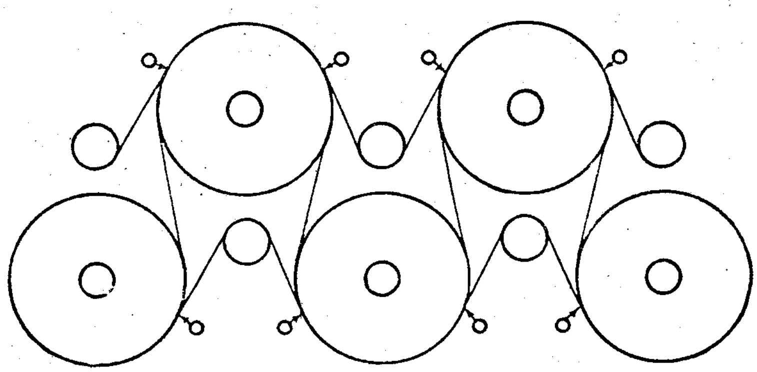

Fig. 23

Nozzled cross pipes are placed in the felt run (instead of on the sheet run) to discharge hot air on the back of the felt. This considerably avoids the problems explained in (2.31) and (2.63) and gives some correction in moisture profile. This method however does not eliminate the major cause of profile variation, which is for vapour accumulation in the pockets.

4.15 EVACUATION OF POCKET AIR ACROSS THE FELT BY SUCTION ROLL

The methods discussed so far are usually employed for less permeable felts. But as discussed and explained in (2.6) and (3.23) when a screen is used we encounter critical problems explained in (2.2), (2.31), (2.4), (2.5), (2.6) and (2.61). At this stage, we need to introduce a better method to evacuate the high humid air from the dryer pockets.

In this method suction felt rolls or suction boxes are put in between small felt rolls. The suction mainly works to suck out the humid air from the pockets and helps to give a surrounding with less humidity and thus a better and efficient evaporation to the incoming sheet, with less steam consumption. (Fig. 24).

This arrangement can give direct air impingement with an ability to preferential drying to the sheet while the sheet is on the dryer. This gives a significant cross-correction of the profile, but it is not practical to use hoods in all dryers of the entire dryer section. Also it is not much effective for conditioning the screen. The cost of such an installation in the entire dryer section is enormous. (Fig. 25).

4.17 POCKET VENTILATION DISTRIBUTOR DUCTS

This method was initially designed by Beloit especially for use with open mesh screen. (Fig. 26). It has stationary distributor ducts fixed on the back sides of the felt. These ducts supply uniformly distributed hot and dry air across, from inside the screen. The hot air passes through the screen in quantities calculated completely to evacuate the pockets of humid air. This method is more effective for sheet profile correction as :

(a) This differential temperature between the screen and the sheet could be reduced as explained in (2.63).

(b) A better balance could be attained in the surrounding [refer (3.23)] for uniformly distributed

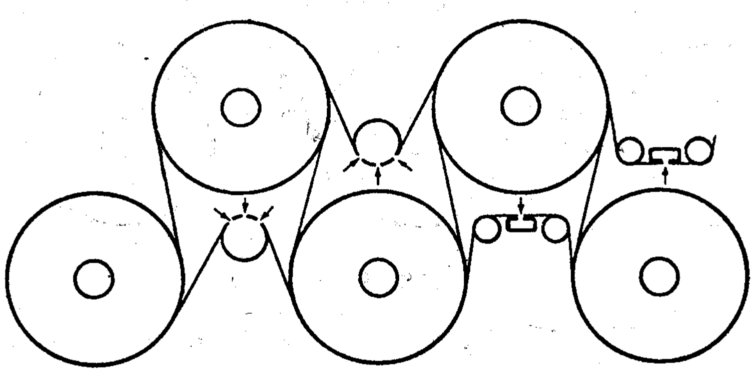

Fig. 24

This method is no doubt more efficient for drying but it became difficult to maintain a balance between the humid air exhaust and input of hot dry air as explained in (3.23). This imbalance as explained in (2.2) and (2.6) causes over-dry edges.

4.16 CROSS-CORRECTION HIGH VELOCITY HOOD

Substantial thought has been directed towards the improvement of sheet moisture profile through the application of high velocity hood designs, facilitating operation at very high humidity. The philosophy has always remained to supress the evaporation rate of the edges to equal the slower rate of drying at the centre. Therefore it became imperative to improve the slow drying zone.

hot air blowing in calculated amounts.

In order to keep static pressure low and to prevent execessive air leakage, a very open screen is required when these ducts are in use.

4.18 BELOIT POCKET VENTILATION ROLL

This method is more or less the opposite of what we discussed in (4.15) and further improvement on (4.17) (Fig. 27).

In this arrangement the rolls are perforated to blow hot air through the screen uniformly across the width. The construction of these rolls have the versatility of full or partial cross-correction of sheet moisture profile by partially blocking the air, to retard the drying rate at any desired portion.

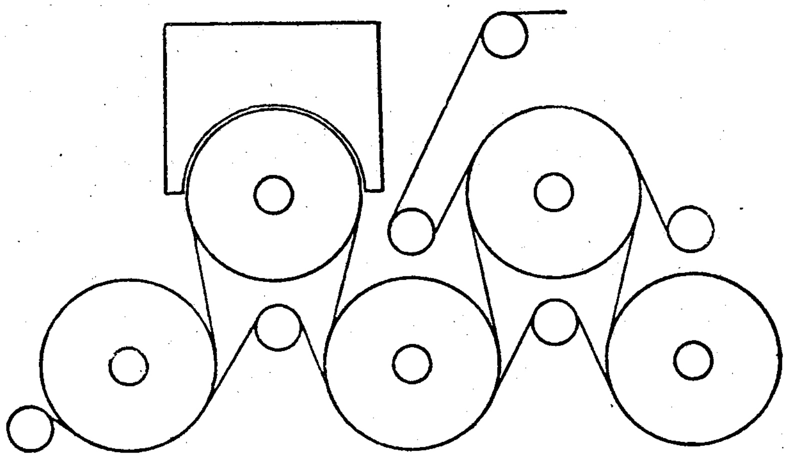

Fig. 25

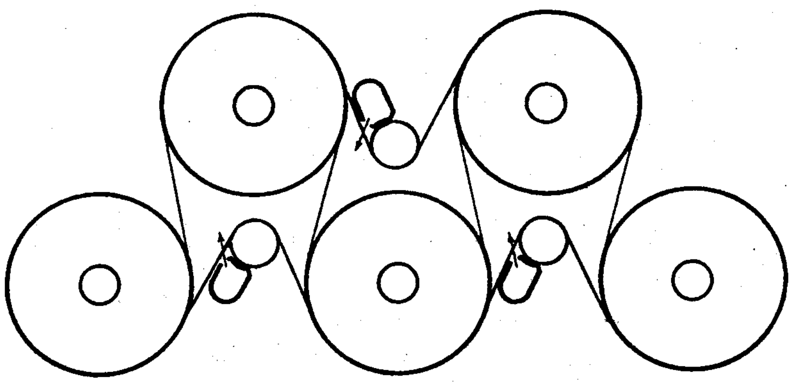

Fig. 26

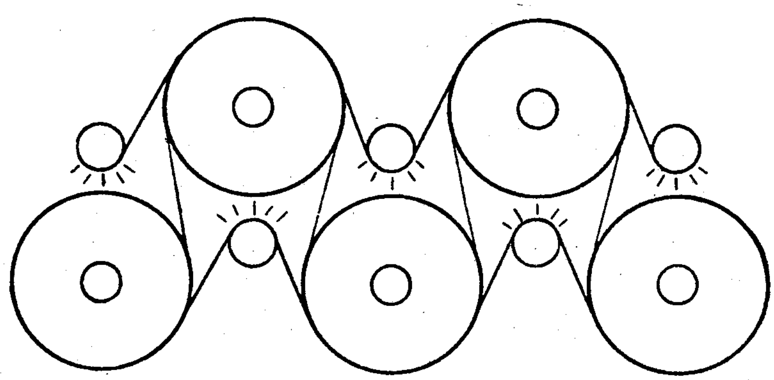

Fig. 27

This method is very effective in conditioning the screen. (Fig. 28).

4.19 BELOIT TWIN SHELL ROLL

This is one of the improved design of various rolls so far described. (Fig. 29).

It is commonly known as the twin roll as it has one inner stationary shell and over it another rotating roll. In between the outer roll and the inner shell a pair of longitudinal seals combined with appropriate circumferential seals are attached to the stationary shell. The construction is more or less the same as of a suction press roll.

The uniform distribution of air across the roll is accomplished by variation of the drilling pattern of the inner shell. The drilling pattern is engineered to balance the combination of velocity pressure, static pressure, frictional disturbances in order to achieve a uniform air flow. The large inlet of inner shell helps a continuous and abundant hot air flow.

The outer shell has uniform rectangular drilling. It is strong enough to withstand the higher tension of screen as explained in (2.62). In order to increase the open area at the roll-felt interface, the outer surface of the rotating shell is longitudinally grooved. This arrangement facilitates smooth air flow through the screen and also helps to condition it in the run. The large air inlet has ample capacity to feed enough hot air to completely purge the humid air pocket.

These rolls also have arrangements for cross-modulation of air flow to correct temporary abnormalities of drying as discussed in (4.18) and Fig. 28.

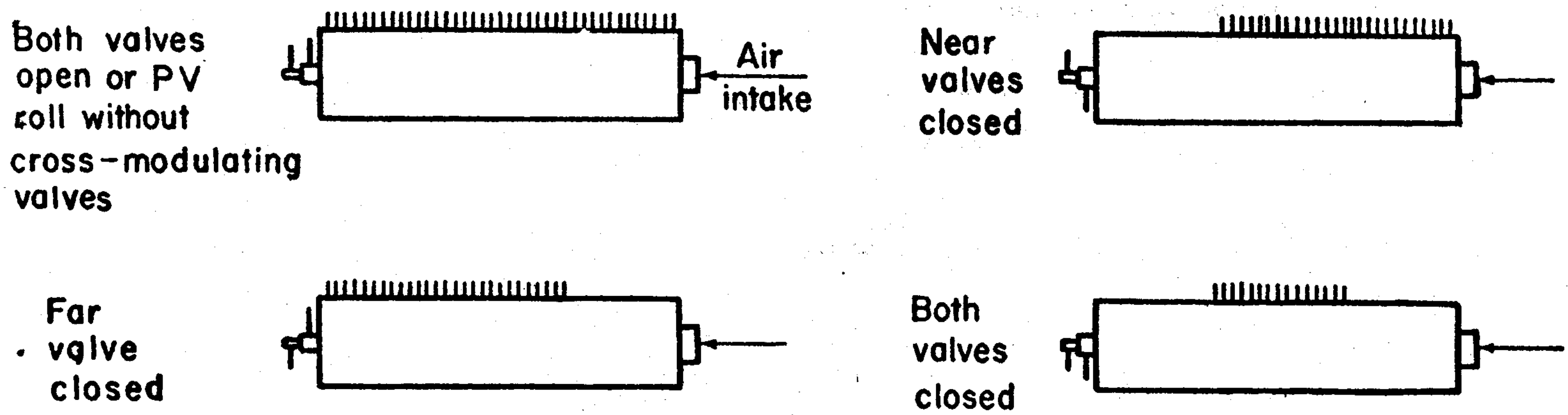

Fig. 28

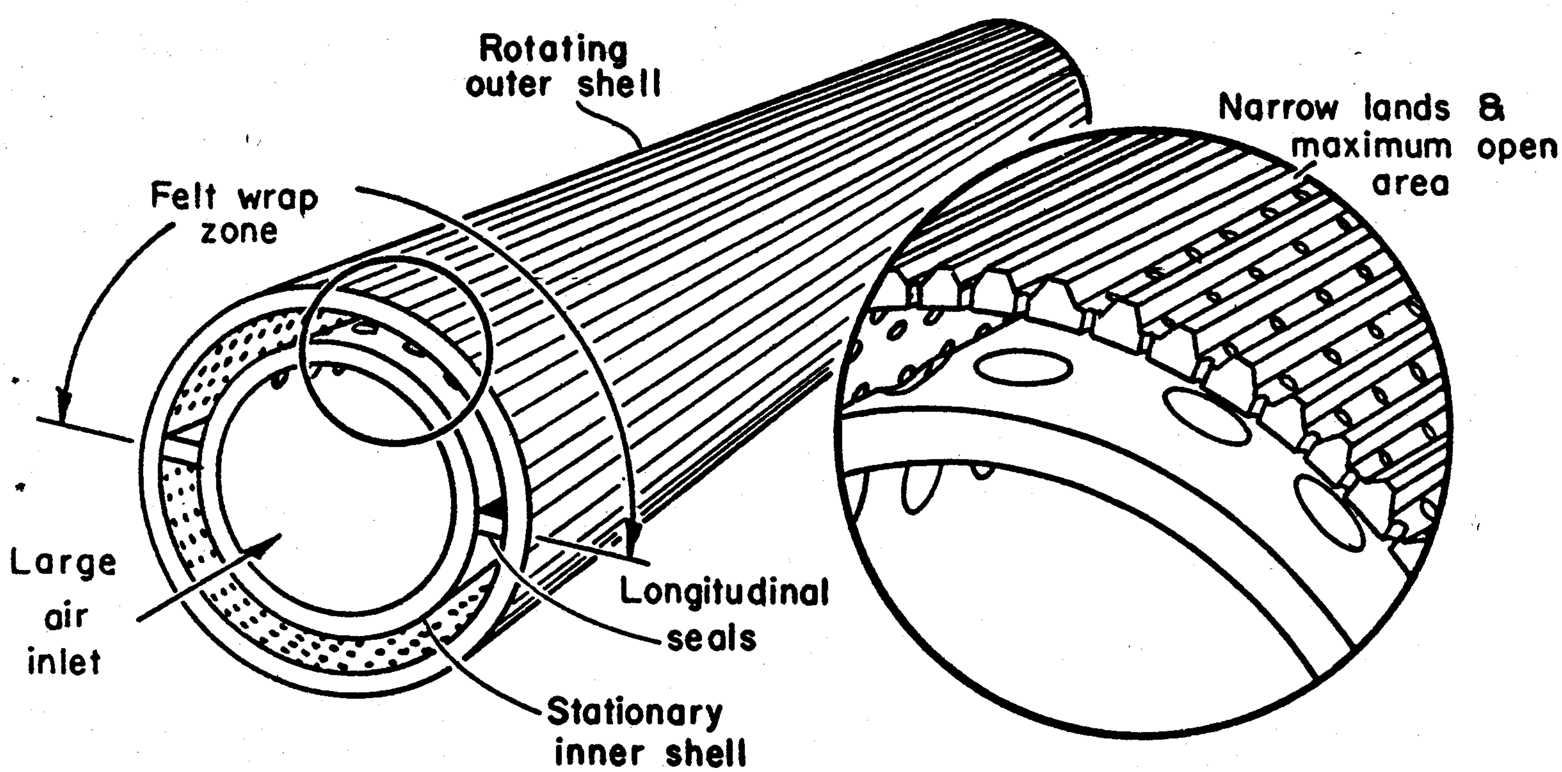

Fig. 29

CONCLUSION

The potential benefits of using a screen together with proper pocket ventilation are as follows :

1. Screen with any degree permeability can be used.
2. Width of the machine does not limit the sheet moisture profile.
3. It does not disturb the sheet run and cause sheet flutter.
4. It helps in conditioning the screen.
5. It provides maximum uniformity and control of sheet moisture profile.
6. It helps optimise operating economy based on minimum pressure drop for a given screen and hot air flow.
7. It is strong and rugged in design to withstand the hazards of running conditions.
8. Much higher tensions can be employed for better conductivity drying with better surface of the sheet.
9. Greater steam economy thereby lower cost of drying.
10. In a new machine installation less capital investment as felt dryers are avoided.
11. Some percentage of pulp can be saved for not over drying the paper.

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