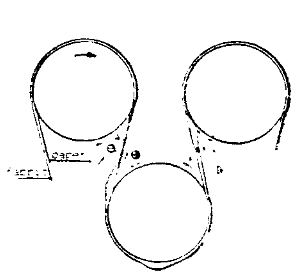
Transfering the Sheet on High Speed Machines

With increasing machine speeds, reduction in gramweights, changes in sheet composition and resulting dryness variations, problems start to appear. Generally speaking, they concern the transportation of the sheet with loss of adhesion or draw (fig. No. 1) or when transfering e.g. between last press and the dryers or between 2 groups.

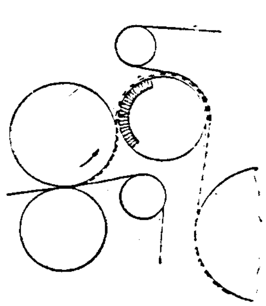


We are going to discuss these problems and their solutions : in the case of groups with single fabric run. and in the case of transfer between groups.

1.— GROUPS WITH SINGLE FABRIC RUN.

1.1.— Transfer between press and dryer part.

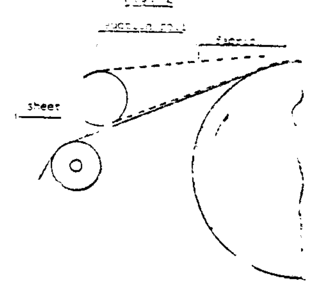
It is sometimes helped by using a big suction roll which replaces the conventional sheet roll (e g. BELOIT on different paper machines) (fig. No. 1 bis).



But we find generally 2 other systems to ensure a good sheet transfer to a dryer fabric.

1.1.1.— Suction rolls :

Put in the place of the first felt roll of the single fabric run, mainly on rebuilt machine (fig. N° 2).



The effect is generally positive when the sheet is going up because it has no arc of contact with the roll.

On the other hand, it could be negative with a thick fabric when the sheet is going down on this roll, beacuse the arc of contact of the sheet on it produces, by means of the fabric and high suction, an overspeed of t! e sheet, which disappears after wards in the straight path, but which can provoke a loss of adhesion between sheet and fabric.

1.1 2.— Stabilization boxes :

These are placed between the first fabric roll (often grooved in that case) and the first drying cylinder.

A depression is created on the back side of the fabric, thus pulling the sheet on to it. This is made by :

— the foil effect (transfer box of VOITH – fig. No 3).
  To be efficient, these boxes must be working very near to the fabric, which is a risk for the seam.

— the suction; the sheet is sticking to the fabric, but steam (due to evaporation) is also sucked in, which improves the yield of the installation.

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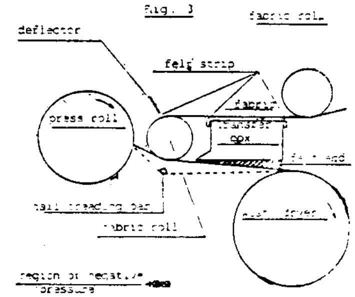
Fig. 3



— the foil effect + blowing (e.g. BELOIT).

— blowing (Press run blow boxes of VALMET). There are 2 conventional configurations :

1) — Sheet is going up after the press : e.g some machines with 3 presses and the machines with 4 presses, SYMPRESS II type (fig. No 4). It is the easier case because there is no overspeed of the sheet when it is taken by the single fabric.

2) — Sheet is going down after the press e.g. conventional SYMPRESS (fig. No 5).

Fig. 4

TWINVER Press with separate 3rd. Press

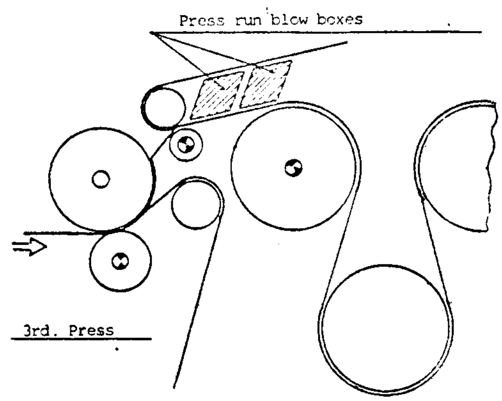
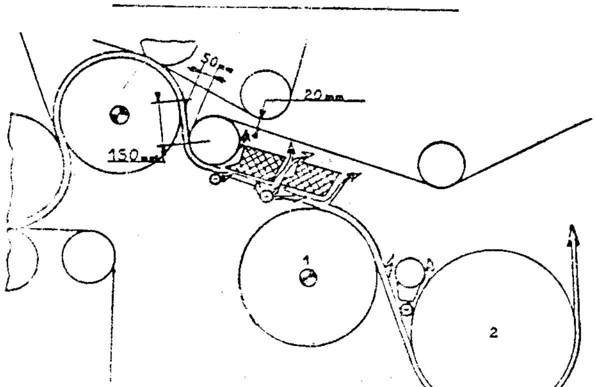


Fig. 5



The felt of the 3rd press is coming very close to the return run of the single fabric in order to limit the perturbations due to the air carried by the fabric (15 to 20 mm).

The length of the sheet between the 3rd press and the contact with the single fabric was rcduced to 150 mm (distance 3rd press felt roll 40 to 50 mm).

Moreover, it is possible to regulate the efficiency of press run blow boxes by inclining the boxes as a roof.

Remarks :

When boxes are working by blowing, the fabric is carrying an extra air quantity which may unstick the sheet between dryer cylinders

It is necessary to put sheet stabilizers between cylinders or to increase their effect. In this last case, the tendency is to use long boxes acting on all the length of the upstream free path between top and bottom cylinder.

1.1 3 — Clothing characteristics :

Fabrics with an average permeability of 1200 to 1500 m3/m2/h (75 to 90 CFM) are used. If the permeability is lower, there is the risk to suck in the fabric and to wear it by abrasion, and to hold the sheet badly which has a tendency to become unstuck, mainly on the edges. On the other hand, a higher permeability has no bad effect on the running of boxes, but may create sheet transfer problems downstream.

These fabrics are thin to avoid draw variations in the same group.

In the configuration No 2, there is an overspeed of the speed around the roll (see fig. No 5).

This inconvenience does' not exist when the speed is going upwards.

"In line" seams are necessary, without over thickness and without permeability variations to avoid the risk of catching against the boxes, and to get marking or sheet breaks by excess of suction at the seam zone.

1.1.4.— Transfer without box, by means of a small auxiliary fabric in bottom position,

This solution is used e.g. by BELOIT with long transfer (2 to 3 m) between press and first dryer cylinder. The small botton fabric is running against the top fabric, which guarantees a good sheet transportation. It is possible to use a relatively high permeability for this small fabric.

1.2.— Transportation between cylinders.

1.2.1.— Conventional configuration of a single fabric with same top and bottom cylinders and, almost always, heated :

Note that the interest to heat bottom cylinders is not always evident, because if they are shut, there is not necessarily a loss of capacity. Generally, when bottom cylinders are heated, there is an increase of the risk to lose adhesion because of the slight resulting evaporation.

The stabilization boxes are put upstream, or sometimes upstream and downstream of the bottom cylinder.
There are different types, e.g.

VOITH type with top flap touching the fabric and blowing from underneath (fig N_o 6).

BELOIT type with flap underneath and blowing from above, sucking air by the lower part.

Unofoil of SVENSKA FLAKT, double boxes, acting upwards and downwards of each cylinder (fig. N_o7).

Uno run blow boxes of VALMET. There are 3 types :

- Type 1, short, the oldest used. (Fig. N_o 8 and 9).

Fig. 6

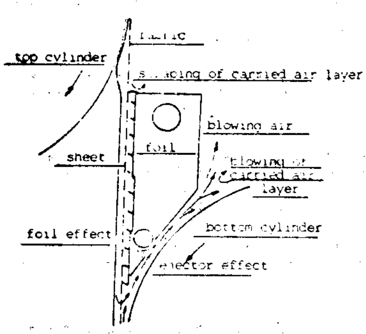


Fig. 7

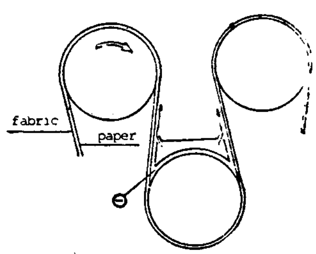


Fig. 8

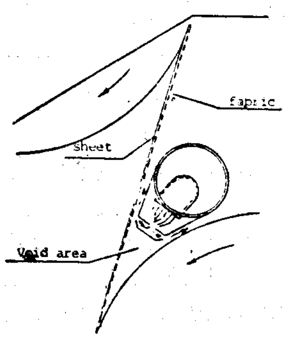
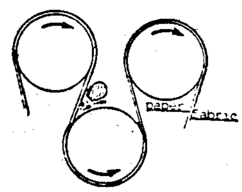


Fig. 9



- Type 2, as Type 1, but with an additional box on the edge for tailing and sheet edges (Fig. N_o 10).
- Type 3, acting on all the length of the free path between bottom and top cylinder (Fig. N_o 11).

Fig. 10

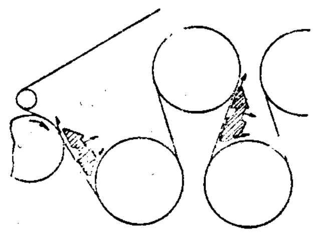
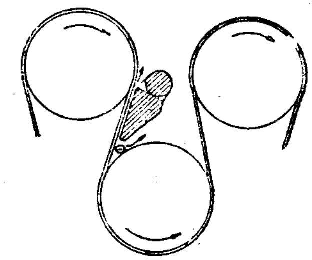


Fig. 11



The minimum air flows in these boxes are from 800 m3/m/h for the type 1 to 1000 m3/m/h for the type 3, with pressure of 150 mm of water.

The tendency is to use more and more of the type 3 on single fabrics of 1st. group. With these big size boxes, the permeability is not so critical for the adhesion of the sheet. On the other hand, these boxes, by sucking effect eliminating the steam, improve the evaporation conditions, which allows the use of single fabrics downstream, without loss of drying capacity (up to 2/3 of the dry part).

Some machine builders, such as BELOIT, have an edge box, working with large boxes, which blows air transversely, allowing the sheet, which has more tendency to become unstuck, to adhere well on the edges.

The types 1 aud 2 are used downstream on the machine.

Clothing characteristics :

More the stabilizer is holding the sheet on a longer length of the free path between top and bottom cylinders (type 3), more it is possible to increase the permeability of the clothing.

On first group, it is about 1200 to 1500 m3/m2/h (75 to 90 CFM) when press run blow boxes are used; it could be reduced if there is no stabilizers at the entrance of the dry part.

On second group, it is from 800 to 1500 m3/m2/h (50 to 90 CFM) depending if stabilizers are short or long.

More the stabilizers are efficient, better the sheet is held, and it is thus less necessary to use fabrics with a fibrous surface to avoid slipping, loss of adhesion of the sheet, and formation of crease.

Inversely, less the stabilizers are efficient, more it is necessary to avoid the bad effects of the boundary layer of carried air, by finding fabrics carrying the minimum possible air on the back side.

In that case, the optimum is obtained with fabrics all monofilament on the back side, without fibres, and notably with flat monofilaments.

See comparative curves of carried air for different types of fabrics (Appendix 1).

Thin fabrics are recommended to reduce the importance of the negative draw at the exit of the sheet between bottom and top cylinders. They will have also a smooth under side to reduce air carrying.

In some cases of loss of adhesion of the sheet on the bottom cylinder, a little thicker felt is sometimes used to fill the voids between the cylinder surface and the sheet, and thus avoiding the formation of creases. But, that seems to be in relation with the stabilizers's efficiency.

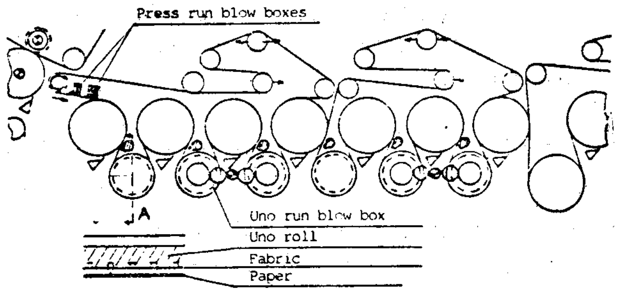
1.2.2 —Two level configuration : Conventional top cylinders (heated) and bottom rolls (not heated).

1.2.2.1.—Uno roll type of VALMET.

The bottom cylinders are replaced by grooved rolls of ϕ 1500. Only the last two rolls of each group are driven (fig. N$_o$ 12).

Fig. 12

VALMET Uno Run Dryer Concept



Stabilizers Uno run blow boxes, type 3, create a suction, even in the grooves (5mm width—3mm depth) which helps the sheet to adhere beneath the bottom rolls. These rolls, made of welded sheet iron have a large diameter to decrease the bad effect of centrifugal force, and increase the length of the free paths, i. e. evaporation between 2 consecutive heated cylinders.

This configuration is used for example on new VALMET machines.

1.2.2.2.—Bel-run system of BELOIT.

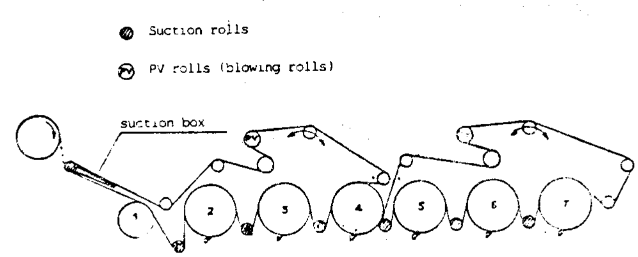
It consists of doing away with bottom cylinders and using big suction felt rolls (Φ 700). The suction sector is working beyond the tangential points felt/roll (15° more of each side) to absorb the air boundary layer carried by the back side of the fabric

The suction rolls are about 8 cm (3″) distance from the drying cylinders. The free draw between cylinder and roll is also reduced to about 45cm (17″).

The suction is much more important than in stabilizers. The sheet is better stuck than with conventional single fabric and gives more safety at high speeds. Because of the good contact between sheet/fabric, there is no tendency for the sheet to stretch and it is possible to work with a reduced draw i.e. with longer groups using single fabrics.

This system could be associated with stabilizers acting upstream of suction rolls, to avoid risks of unsticking the sheet.

Fig. 13



2.—TRANSFER BETWEEN GROUPS.

We discuss successively the 3 cases :

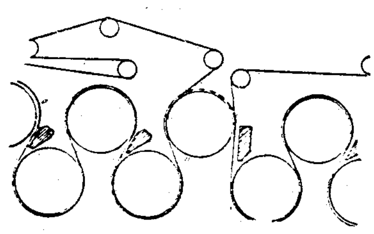
* between 2 single fabric runs
* between 1 single fabric run and 1 conventional group.
* between 2 conventional groups.

2.1. Transfer between 2 single fabric runs :

A "lick-down" technique is used—fig. No 14.

There is a slight arc of contact to allow a certain draw between the 2 groups.

Fig. 14



The length of the free path is longer, because of the distance between the groups, which increases the risk of unsticking.

It is necessary to use stabilization boxes, sometimes longer than those used upstream.

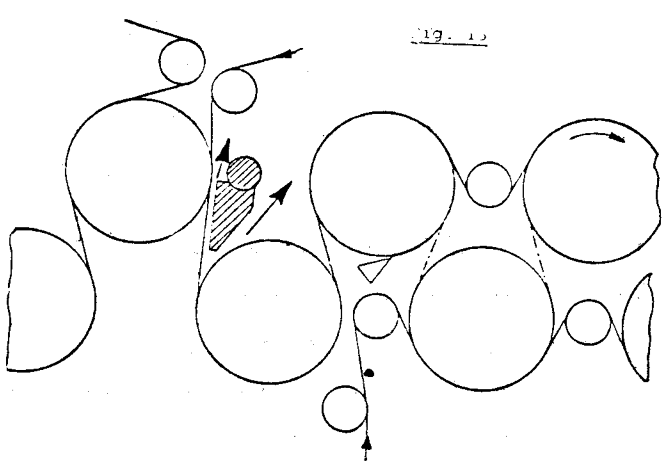
2 2 Transfer between 1 single fabric run and 1 conventional group :

In this paragraph, there are two systems, but we shall discuss only the first because the second is also applicable and discussed in the transfer between 2 contional groups.

2.2 1. "Pistol grip" system (fig. No 15) :

The top fabric, after having touched the last top cylinder of the previous group, is wrapping the 1st. bottom cylinder and then continues in a conventional circuit.

Fig. 15



The bottom fabric therefore does not cover the 1st. bottom cylinder and begins only on the 2nd. bottom cylinder.

This system can run like this if the permeability of the top fabric is reduced, to avoid the loss of sticking of the sheet during the changeover from one group to the next (near to that of the preceeding single fabric).

Inconveniences :—Different sizes of fabrics for top and bottom dryers, i.e. more fabrics in stock.

—Limitation of the ventilation in half of the pockets of the group, i.e. the drying capacity.

To solve this problem, it is necessary to put a large stabilizer on the draw between the two groups, which allows the use of fabrics with normal permeability for a conventional group.

To limit the quantity of air entering the pocket low permeabilites are used for the bottom fabric (1500 m3/m2/h-about 90-100 CFM) with paper and back side surfaces as smooth as possible.

The choice of the clothing is critical (see Appenpix 1)

Moreover, the bottom fabric has generally a roll on the return patch to break the air bounday layer and reduce the air knocking the sheet This configuration is running at speeds below 1000 m min. Above, there are troubles for the sheet which are often unbearable. It is necessary to close the bottom pocket with a flap fixed on the doctor of the 1st. top cylinder.

In spite of that, problems still remain during the tailing of the sheet. This needs the doctor not to be in contact with the cylinder and to blow air from the tending side to the back side. In effect one has to fight against the air carried by the bottom fabric, because it is pushing the tail towards the outside. This comes-about by the fact that the pocket, having a reduced size, the entering air comes out on the edges at an excessive speed.

2.3.- Transfer between 2 conventional groups and also between single fabric run and conventional group

2.3.1:- Decreasing the length of the felt free path between the 2 groups (fig. 16)

This system is more and more used.

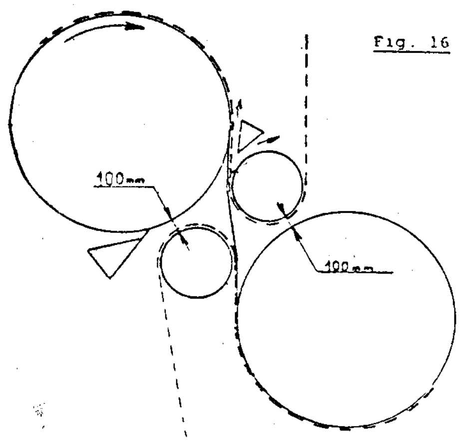
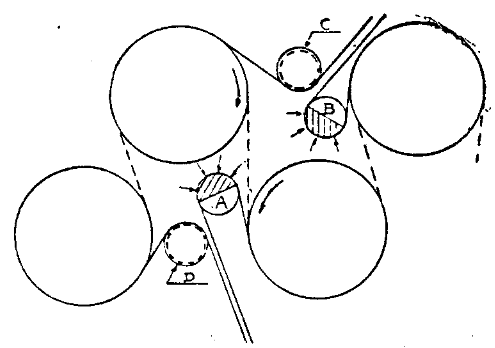


Fig. 16

Fig. 17



A and B = suction rolls
C and D = grooved rolls

This last felt roll of top fabric is set down and thefirst bottom felt roll is set up, so as to be, each one, about 10 cms from drying cylinders. To decrease still more the length of the free patch of the sheet, the rolls are displaced upstream and downstream, to create a broken path of the fabric. This displacement, compared with the tangential line bottom cylinder / top cylinder, is about 20 to 50 m.m.

A stabilization box is necessary at high speeds only in top position. In bootom position, a felt roll is put in contact with the return path (in the case of single fabric run/conventional group). Between two conventional qroups, we find again 2 parallel paths, distant by a few centimetres.

This system is running in newsprint magazine, coating base and in writings-printings.

This system is growing rapidly because it improves the passing of the tail, allows the draw between groups to be reduced, reduces breaks and does' nt need the use of different felts in size or permeability

2.3.2.—Use of suction rolls (Fig. No. 17)

Two suction rolls used, sometimes in association with grooved rolls, e.g. some new BELOIT machines.

These rolls avoid air going laterally out of the pockets, and thus the risk of sheet fluttering.

NB.— This solution is also applicable for transfer from a single fabric run to a conventional group.

3.— SHEET TRANSPORTATION ON CONVENTIONAL GROUPS :

With the increase in speed, the permeability needs are not as important as was thought. It is possible to use less open fabrics without altering the drying capacity. But, this concerns above all newsprint–magazine and comes from :

Improvement of sheet dryness entering drying part.

More and more efficient conditioning of the pockets (blowing rolls or boxes), e.g. VALMET Uniflow boxes working with permeabilities of about 2500 m3/m2/h (150 CFM).

The reduction of permeability decreased sheet fluttering problems which allowed speed to be increased. Here too, the orientation is towards smooth fabrics on paper and back side, to limit sheet troubles, notably when entering a group.

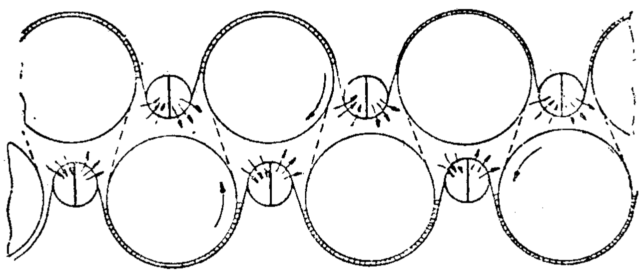
For the bottom groups immediately after the last single fabric, the permeability will be lower than the one used on top group to avoid troubles due to the air entering the pocket (supercalendered batt on mesh fabric or monofilament fabric with smooth surface with flat monofilaments).

This difference could be reduced by a better position of felt rolls between groups (See S 2.3.1.).

Suction/Blowing rolls (e.g. BELOIT Belvent rolls).
Fig. No 18

Each roll sucks air upstream of the pocket and blows it downstream.

Fig. 1B



. The interest is to suppress transversal air streams in the pockets, responsible for problems with sheet fluttering and passage of the tail.

Air blown at 90–100°C. There is no interest to blow hotter.

This technique seems interesting for groups with high evaporation rate (medium groups often situated immediately after single fabric groups).

With conventional ventilation techniques, there is often incompatibility between the necessity to have an open fabric for pocket conditioning and the risk that this presents for sheet fluttering.

APPENDIX—1

Study of air carrying with dryer fabrics for fast paper machines

This study was made at speeds from 1000 to 1500 m/min. on our pilot machine, 1 m. wide.

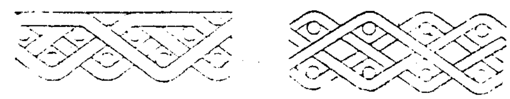
We worked on the permeabilities' range from 500 to 3500m3/m2/h (30 to 200 CFM).

For a given machine speed, we measure the speed of the carried air as a function of the distance from the fabric, till a distance H_1 corresponding to a speed of zero and to the thickness of the carried air layer. We calculate the air flow as a function of the distance from the fabric, and the total flowQ_1 in m3/min./m. width (curve 1).

The studied products were :

1.—Teflon film, said to be the ideal fabric.
2.—Monafilament fabric., flat mono, long floats in warp
3.— „ „ round mono, „ „ „ „
4.— „ „ „ „ , Conventional symetrical weave
5.— „ „ „ „ , with fibrous paper side.
6.— „ „ „ „ , needled paper side. (without impregnation).
7. bis.— „ „ „ „ , needled paper side, (with impregnation).

Long floats Conventional



1.—Results :

Each product is characterized by the height H_1 of its boundary layer. This height is independent of the speed, and is situated on average at 200mm with an ideal value of 150 mm.

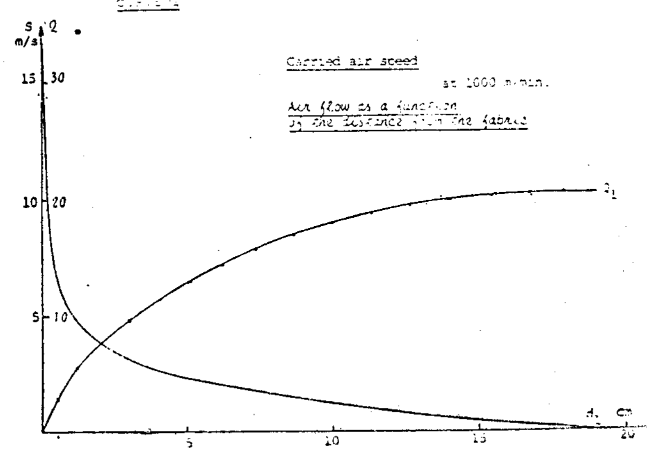
Generally, more H_1 is high, more the flow of carried air is important.

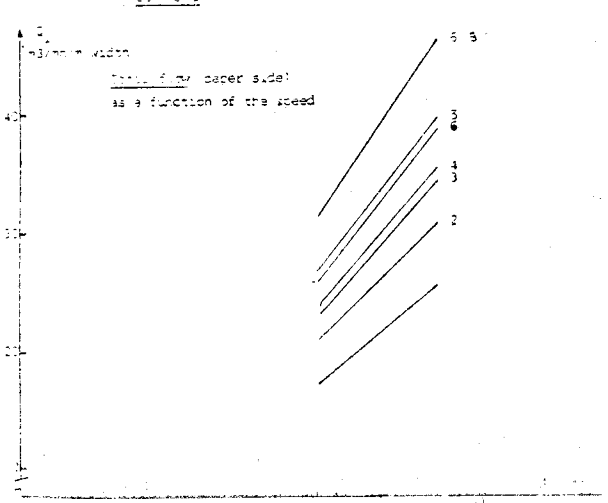
The quantity of air carried is proportional to the speed, in the range of speeds studied.

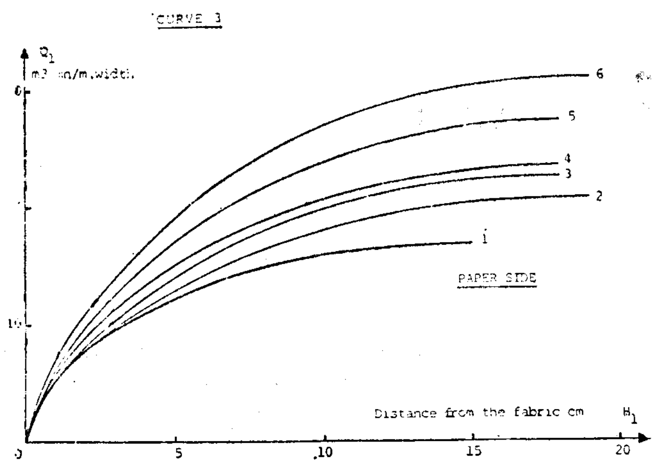
The increase of the flow goes down rapidly as a function of the distance from the fabric. Thus, irrespective of product type, we have about :

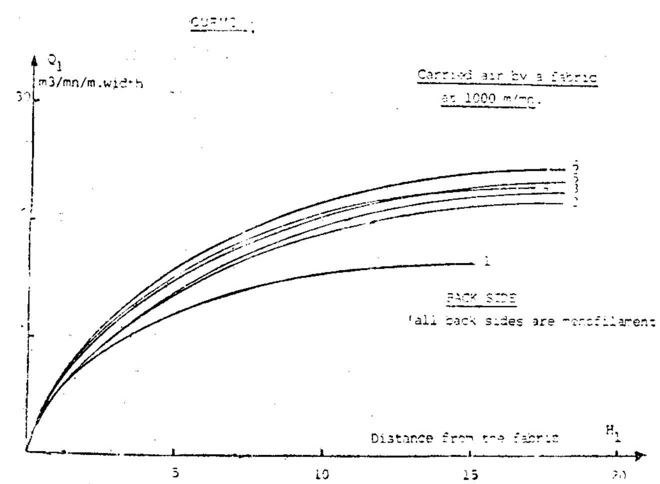
. 40% of the totol volume at 10% of H_1 (2 cm).
. 57% „ „ „ „ at 20% „ „ (4 cm).
. 67% „ „ „ „ as 30% „ „ (6 cm).

(Curve 1) .









Consequently, doctor or brush—to destroy the boundary layer must be situated very near to the ıfabic (5 mm).

2. Conclusion :

The following classification was obtained (increasing values of air carrying) :

—Monofilament fabrics :

- Flat mono, long floats in warp —fabric 2.
- „ „ , conventional design — „ 2. (back side)
- Round mono, long floats in wrarp— „ 3.
- „ „ conventional design— „ 4.

—Fabrics with fibrous paper side :

- Round mono, fibrous paper side —fabric 5.
- „ „ needled „ „ (with impregnation)— „ 6 A.
- „ „ needled paper side (without impregnation)— „ 6 B.

We can see that 100% monofilament fabrics, using long floats pattern on paper side and made with flat mono, give the lower air carrying figures.

The quantity of air carried decreases when yarn density increases.

The fabrics with a fibrous surface carry more air than 100% monofilament fabrics, but the quantity of carried air may be reduced by impregnation and/or calandering curve 2, 6 A versus 6 B).

In spite of everything, the surface of the 100% monofilament fabrics stays in better condition over time than the surface of the fibrous fabrics which is sensitive to abrasion and degradation.