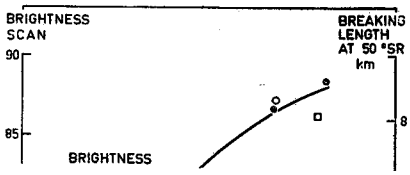

peroxide treatment, or a reducing hydrosulphite bleach. Our own investigations of peroxide bleaching have disclosed that at very high yields, and also in the yield region of chemical pulps,

newsprint instead of acid sulphite pulp, or they may be especially suitable in a specific end product by reason of their special characteristics, as in the case of hardwood NSSC-pulp in fluting.

Board and Paper Machines for Diversified Fibre Blends

G. LAGACHERIE

GENERAL

More and more intricate blends of raw materials are used nowadays in the manufacture of Paper and Boards.

It is now becoming normal practice to blend the stock delivered on the machine from the following components:

— Bleached or unbleached chemical cellulose fibres of various lengths obtained from softwoods or hardwoods and even certain monocotyledon plants such as bamboo, bagasse, etc.

— Semi-delignified fibres such as semi?chemical or high yield pulps, whether they be obtained from softwoods, hardwoods or from the same monocotyledon plants as above.

– Non-delignified fibres such as various mechanical wood pulps and hardwood or softwood species.

Similarly, mineral or chemical fillers are now used in so many varieties and in such quantities that they must be taken into account for the design of both the equipment and the approach circuits.

The aim of this paper is to describe the incidence of the stock composition on the machine design.

The field of this subject is a very wide one, and, as a consequence, a certain number of typical cases have been purposely chosen in certain chapters.

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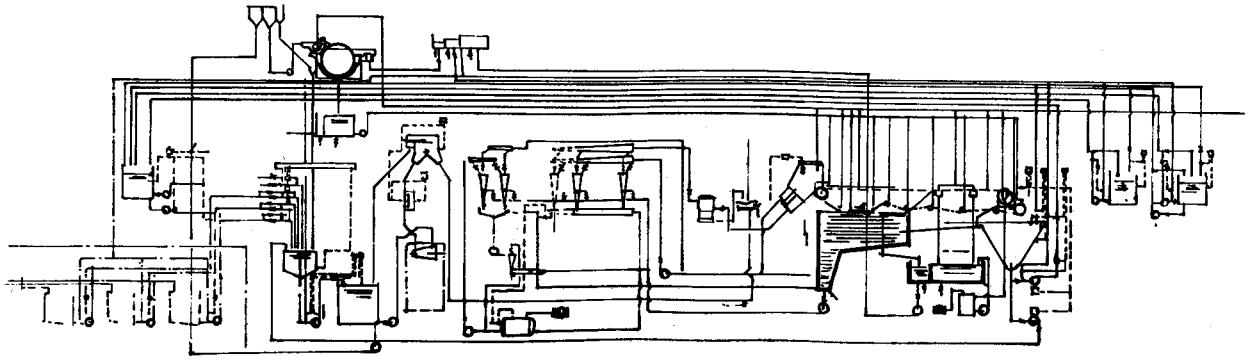

Fig. 1

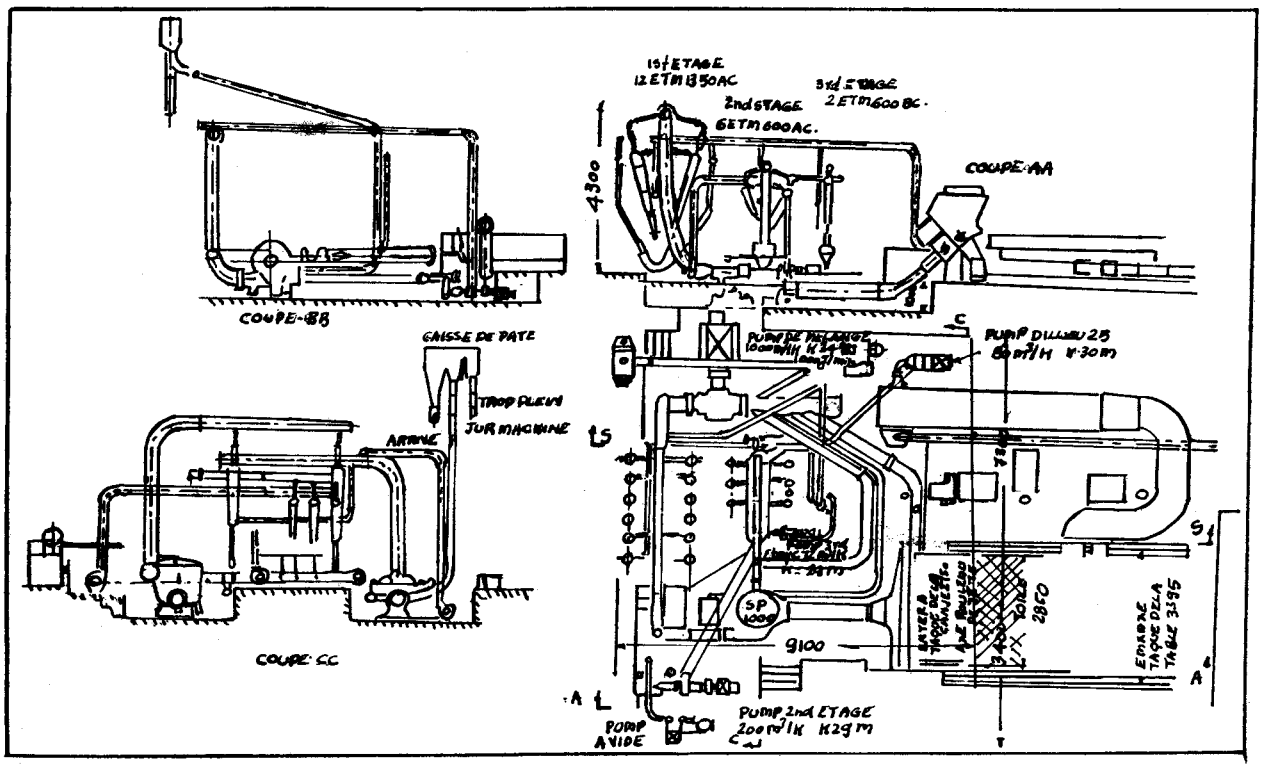

Fig. 2

Moreover, after having examined section by section the case of a single ply machine, it will be found advisable to stress the particular interest of multi-ply formation systems when using high yield pulps.

SHEET FORMATION

As a general rule, the single ply sheet forming system will always be referred to for the manufacture of all grades such as:

- very light and technical papers,
- writing-printing papers,
- basic paper for coating,
- all wrapping paper varieties,
- box boards,
- folding box boards.

It is obvious that the composition of a given grade must comply with the mechanical or physical characteristics which are required in the use of the considered grade. There is, in this respect, a great diversity of cases, for instance:

- newsprint with its high proportion of mechanical pulp,

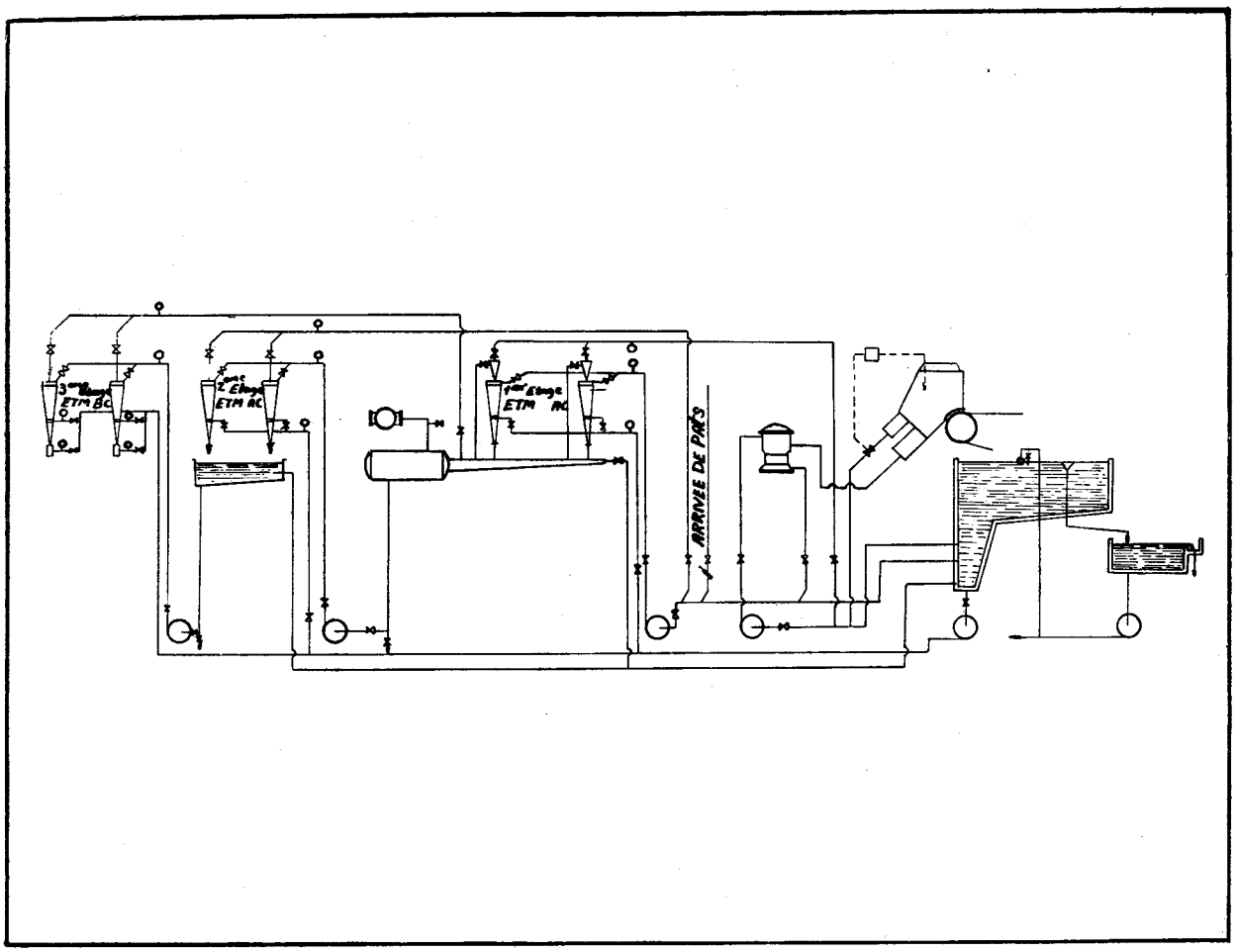

Fig. 3

- wrapping paper with its high percentage of long Kraft fibres.

The problem becomes still more intricate when the paper is to be submitted to special treatments after its formation.

Some other qualities are required such as look-through, smoothness, porosity, opacity. All these factors have a definite influence on printing, on all coating processes on pasting, etc.

It is therefore imperative that the components of the paper machine, starting from the head circuits, be designed to account for these requirements.

HEAD CIRCUITS

Although it is not intended in this paper to deal with refining,

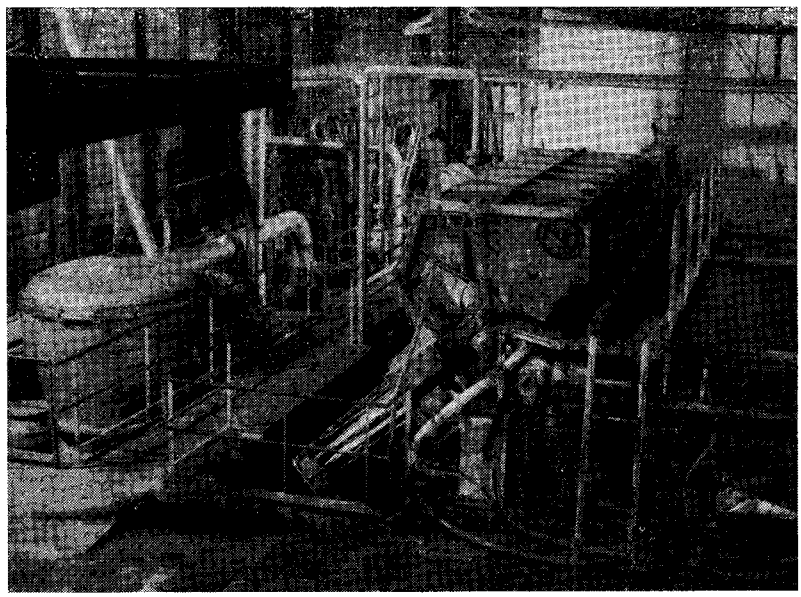

Fig. 4

it is generally agreed that treatment of fibres such as hydration, deflaking, screening, etc. must be effected in separate lines for each sort of fibres which will form the final blend.

On account of the increasing dimensions and daily production of modern machines, open type circuits and screening appliances have gradually been eliminated for blending the stock and delivering it to the machine.

This results in shorter and more direct circuits, with a decreasing storage capacity which even tends to disappear completely.

It is obvious that, if in this type of circuit a correct stability and repeatability is desired, it will require a more extensive use of instruments.

Fig. 1 shows a typical circuit designed to blend three different brands of pulp, machine brokes and all required fillers.

This type of circuit is now normally adopted when very homogeneous stock is required; it has a low time lag which enables to correct or change the proportions, pH, colour etc. with a very quick observation of the changes in the various parameters. Its operations requires mainly a well designed control panel grouping all controls, indicators and recorders of the various appliances of the circuit. With this arrangement, it is possible to check all parameters, and more particularly to reproduce easily the operating conditions for a given quality, by simply repeating the parameters previously recorded.

These records are also very valuable for the laboratory which can easily compare the characteristics of the considered product in terms of the operating parameters.

The most recent blending plants are equipped with small computers which are all the more justified that the components are in greater number.

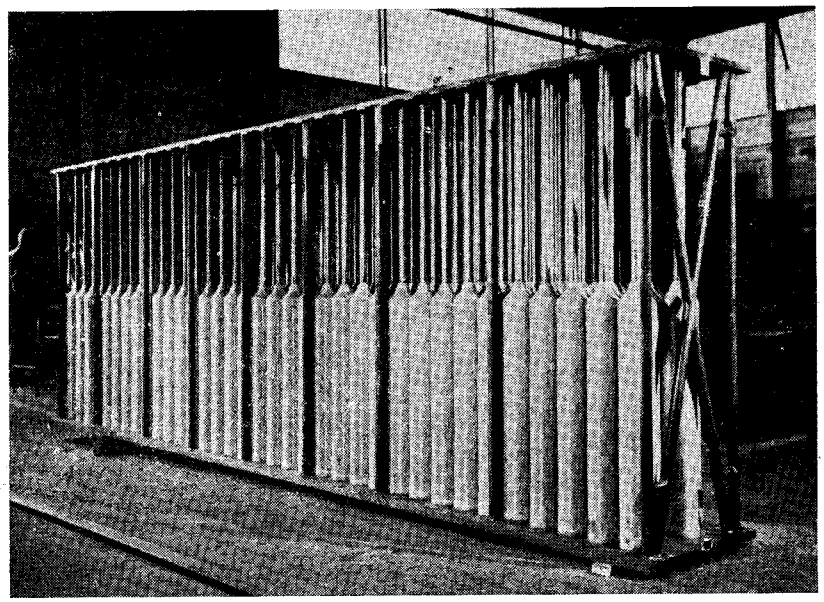

Fig. 5

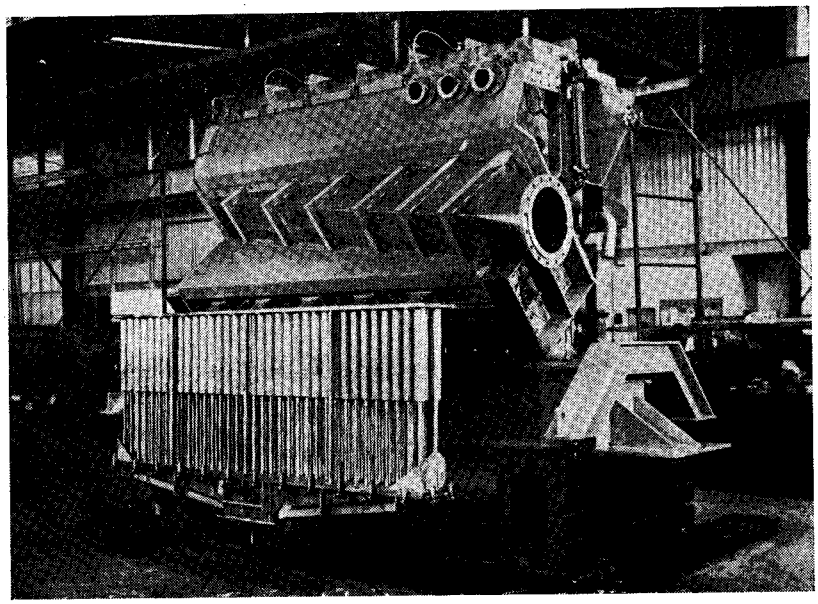

Fig. 6

It is also essential to maintain the consistency as constant as possible and, in order to obtain from the consistency regulators the best efficiency, the two following points should always be kept in mind;

— The consistency regulators should be arranged in subsequent stages with small variations from one dilution to another ,

— They should operate without dynamic interferences caused for instance by a too close proximity of valves or pumps situated upstream.

The circuit shown is designed for writing-printing paper. The range of basis weights is varied frequently, and the stock consistency can vary for instance from 5 g/1 to 12 g|1. In this

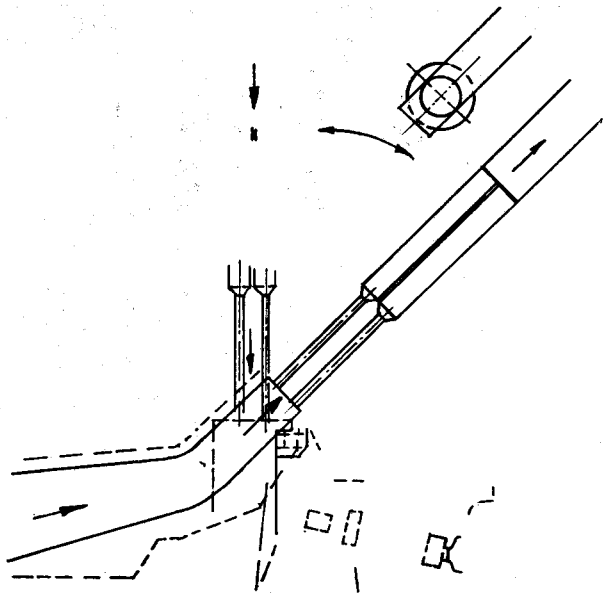

Fig. 7

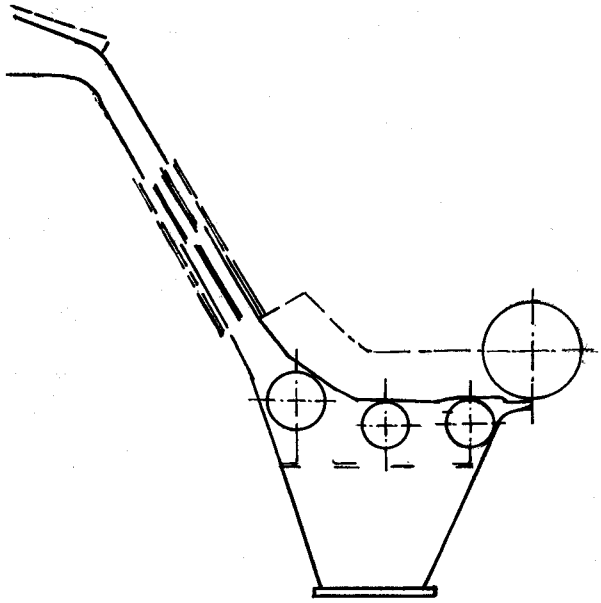

Fig. 8

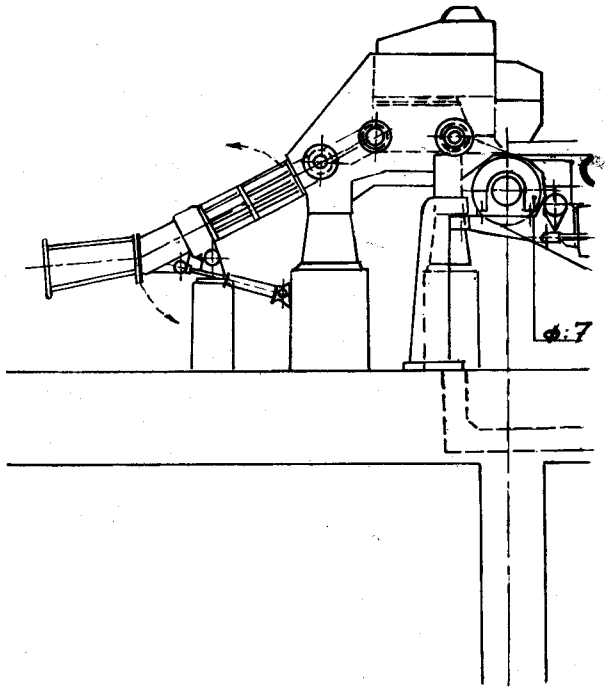

Fig. 9

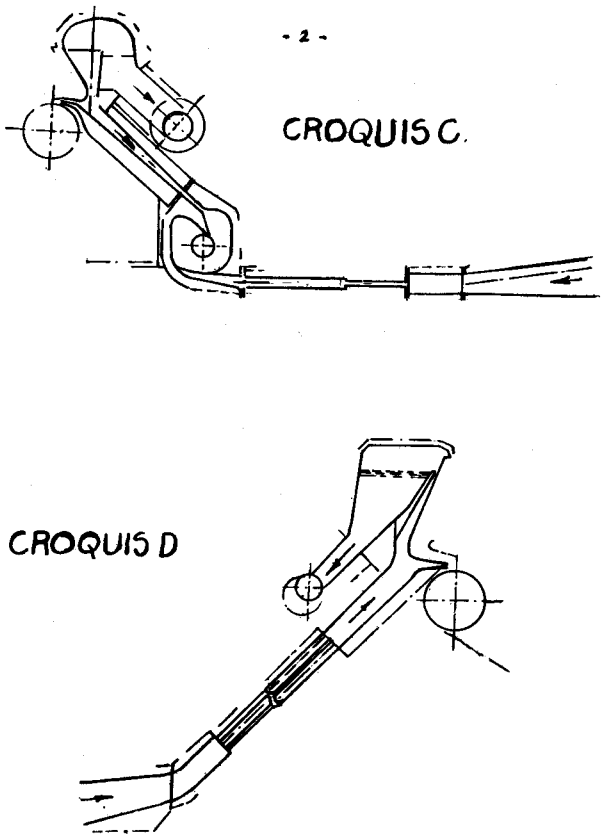

Fig. 10

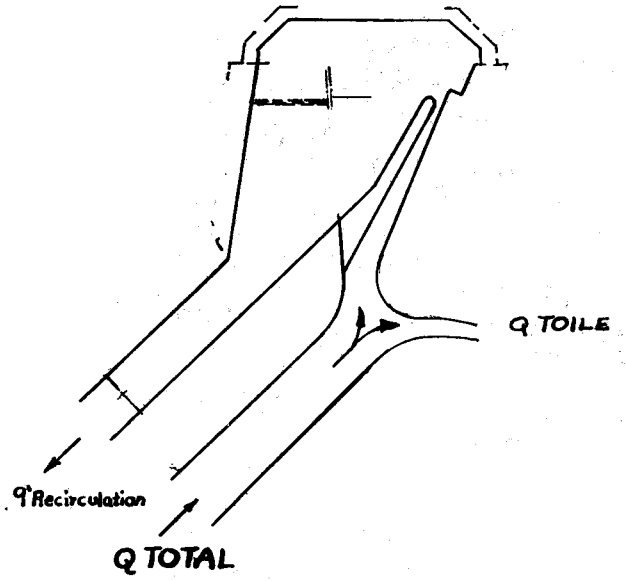

Fig. 11

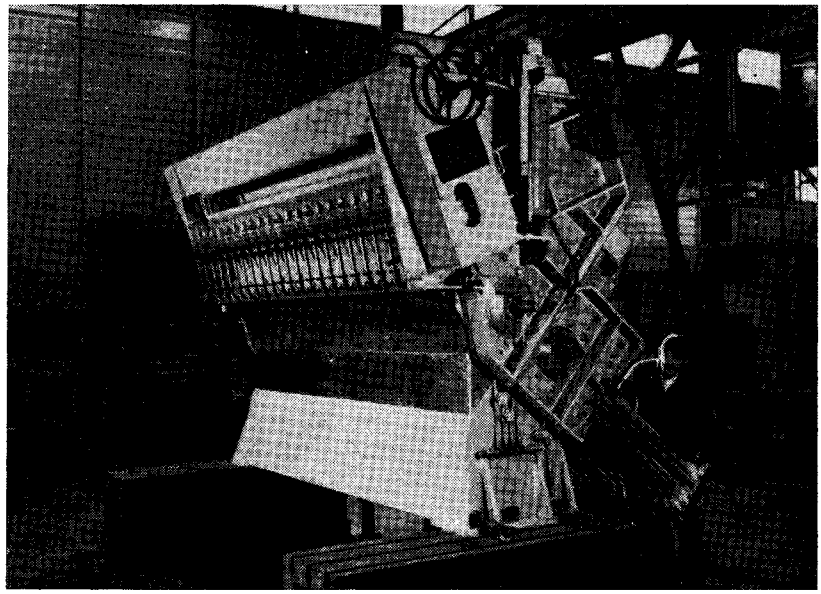

Fig. 12

case, it is preferable to design a single dilution circuit in which the fan pump will take care of mixing the final product delivered by the machine wire.

This mixture will be delivered to the first stage of cyclone cleaners, the accepted stock being sent to the pressure screen and thence to the machine headbox.

The following actual tendencies should also be pointed out:

— Firstly, the dimension of the first stage cyclone cleaners should be suitably chosen in order to avoid extensive sorting of fibres and fillers.

— The cyclones are more and more designed to operate under vacuum in order to deal with the free air carried by the pulp and white waters. This enables to remove this air from the stock before spreading the latter on the wire. It is now proved that a substantial amount of irregular "trails" which are observed in the paper are caused by an excess of air in the machine headbox.

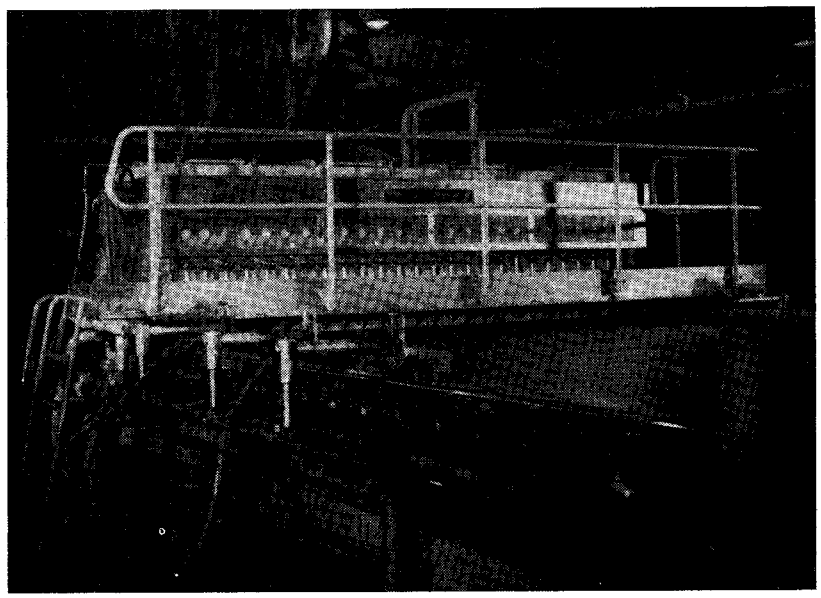

Fig. 13

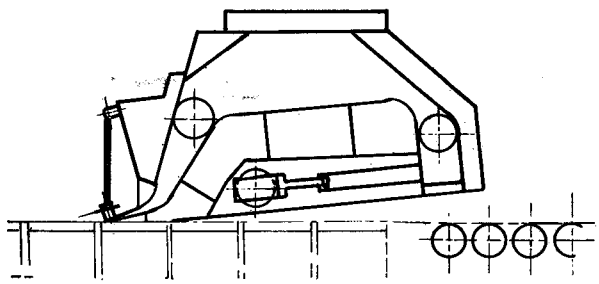

Fig. 14

Fig. 2 shows the lay-uot of a three-stage cyclone head circuit derived from the above considerations. The first stage is under vacuum, and the circuit includes a single dilution pump and a pressure screen.

In order to obtain a correct pressure stability of such a circuit, special care should be taken in the choice of the pump, in the position of the valves and in the location of the various tappings.

These precautions will reduce to a minimum the basis weight variations of the paper in the length-wise direction.

The use of diversified fibre blends requires in particular multi-vane type fan pumps capable of ho-

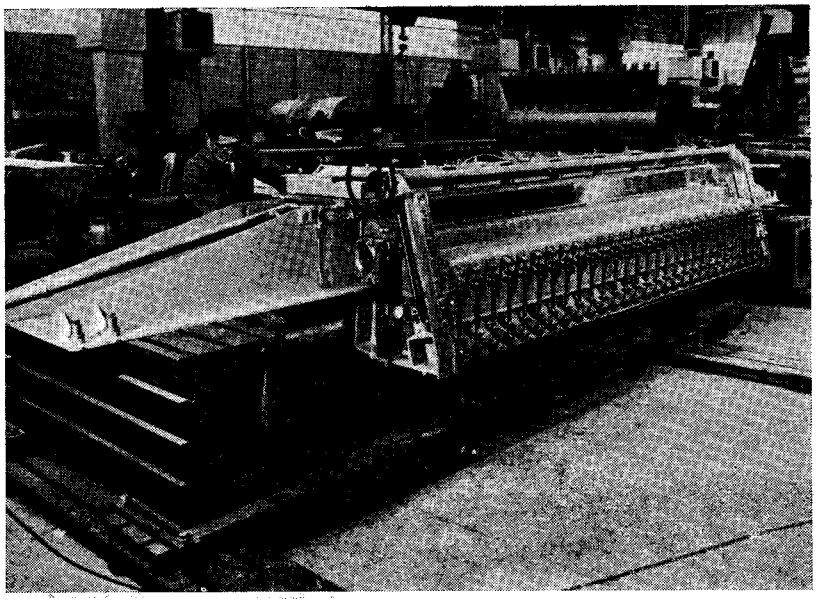

Fig. 15

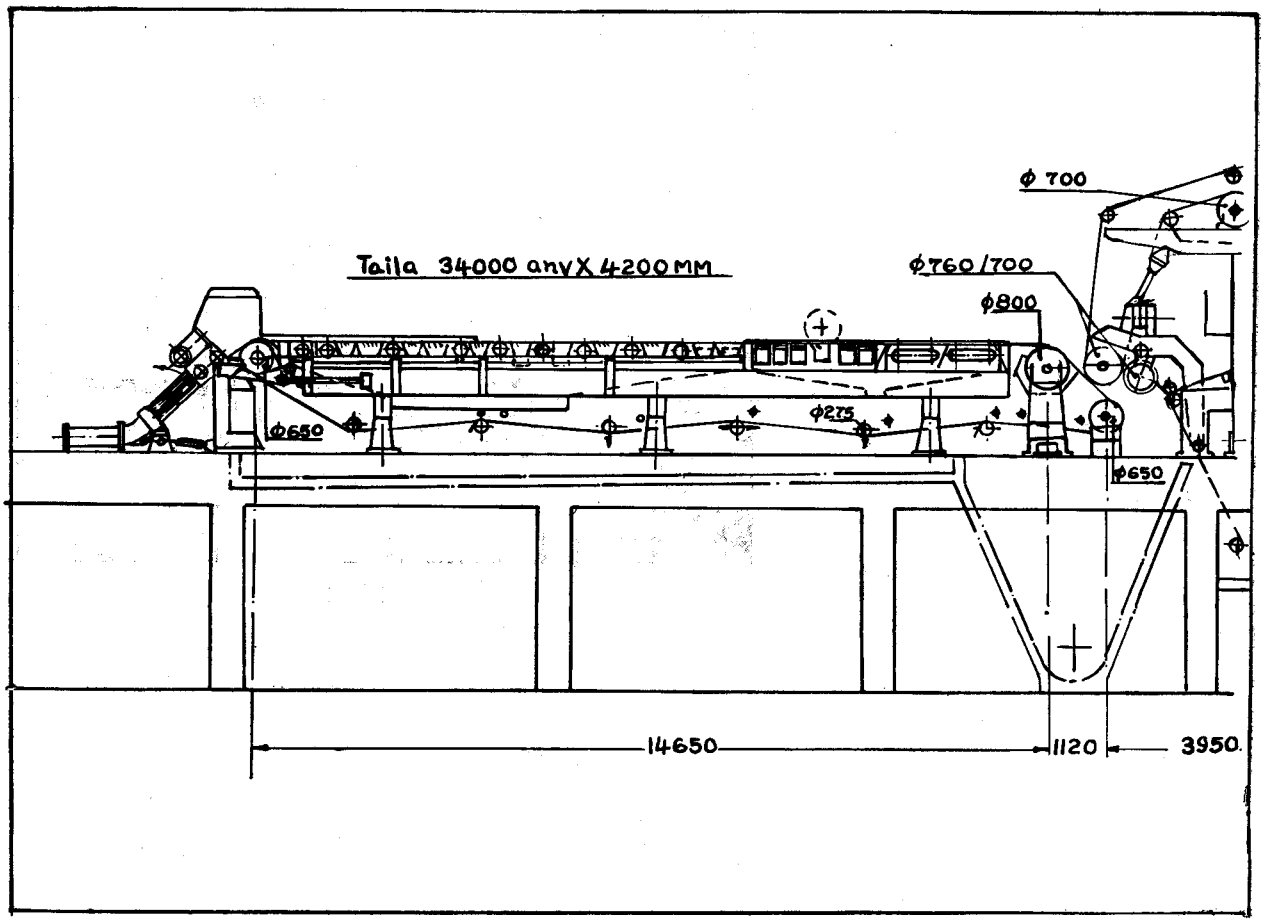

Fig. 16

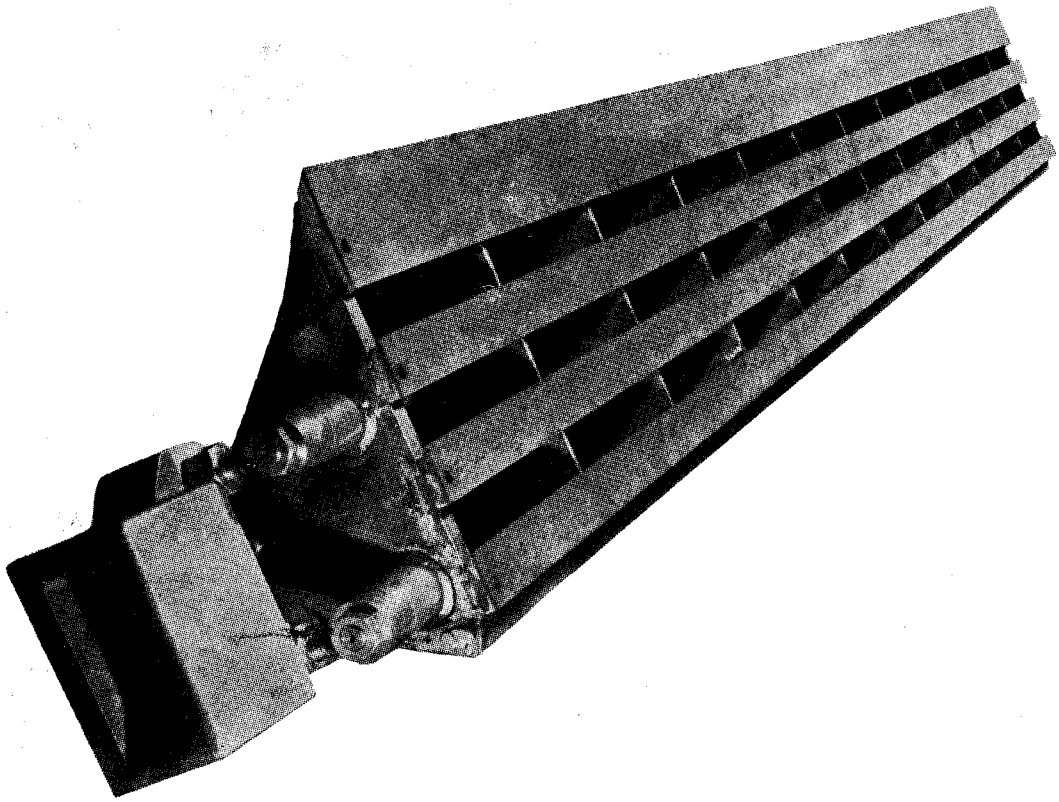

Fig. 17

mogenizing the stock under the best conditions.

As regards now the pressure screens they have several important functions :

- homogenizing the stock before delivering it to the headbox.
- screening of the pulp to remove impurities, such as shives, which the cyclones would not have retained, and re-circulating them to the cyclones through their reject circuit,
- reducing to a minimum the sorting of fibres of different qualities,
- accepting the loads without diverting them to their reject circuit,
- avoiding detrimental pressure pulsations which would impair the operation of the headbox.

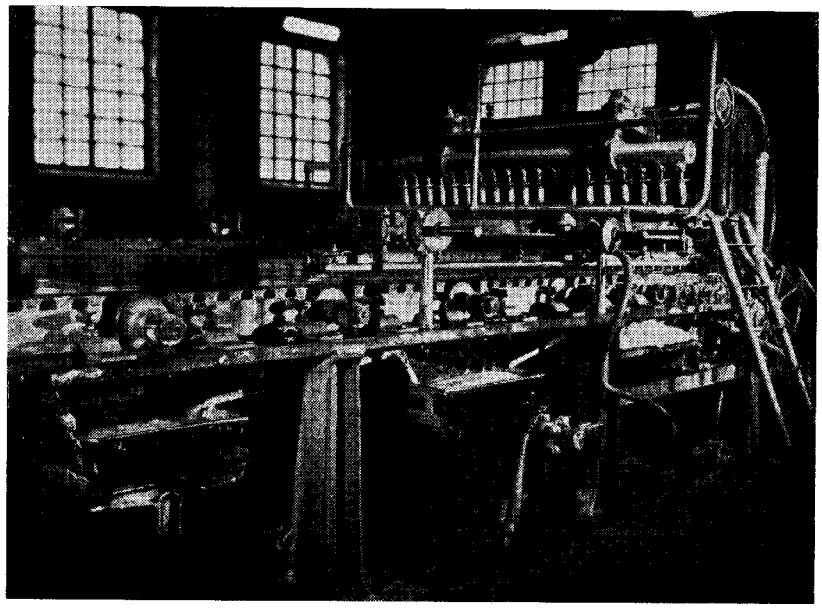

Fig. 18

It is therefore essential to design the pressure screens as carefully as possible, both as regards the diameter and void ratio of the basket holes.

Fig. 3 shows a double dilution circuit which is more commonly used in paper machines manufacturing wrapping papers at much lower consistencies ranging from 2 to 6 g/l. The precautions to be taken in the design of this type of circuits are the same as those mentioned above for a single dilution circuit. It should however be noted that the double dilution is chosen for economic reasons, in order to reduce the number of cyclone cleaners, and to adjust as closely as possible the output of the dilution pumps. This output is shared between the two pumps.

- with a limited flow and high delivery head for the first dilution pump, and
- with the full machine flow and a low delivery head for the second dilution pump.

It is essential, in this case, to draw white water with each of the pumps, which means that a positive extraction balance must be maintained in each of the circuits. This will prevent some pulp from being returned to the white waters, which always has the effect of creating important variations of the basis weights in the lengthwise direction.

Fig. 4 shows an arrangement of such a circuit when there is no machine basement.

To conclude this paragraph, it should be also pointed out that consistency regulators, cyclone cleaners and pressure screens have different behaviours, according to the blends which are used, and to their relative proportions of long and short fibres. For instance, it is well known that the cyclone cleaners have a better efficiency when treating a stock composed of only one brand of pulp, and that pressure screens have a tendency to clog their baskets when using long fibres if the voids ratio is too low.

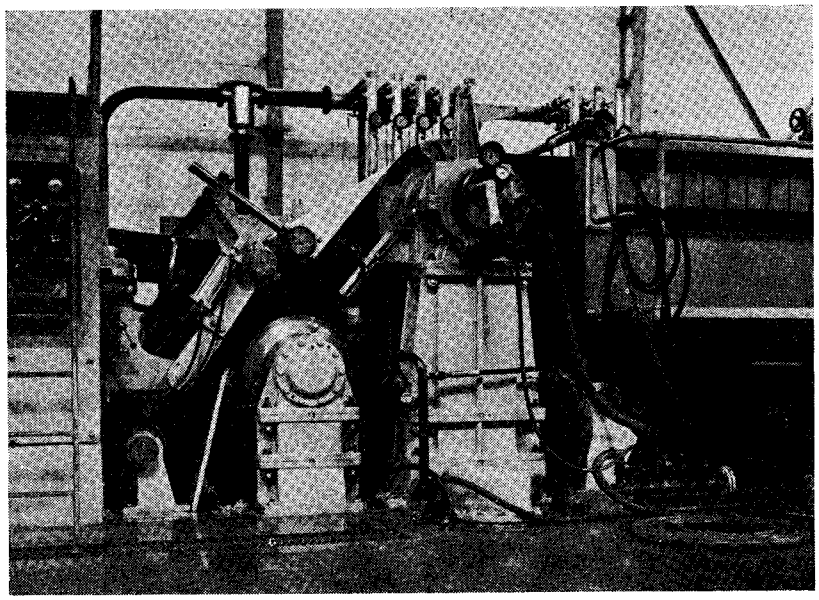

Fig. 19

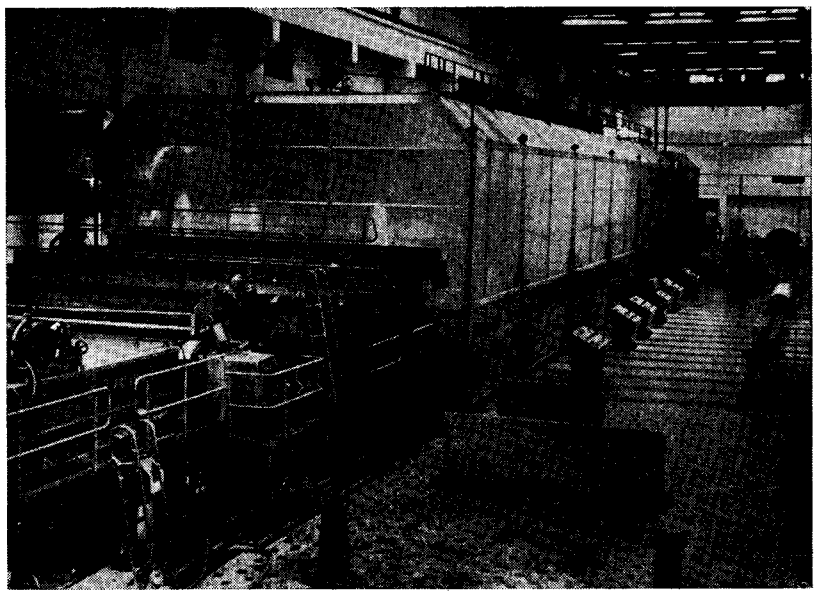

Fig. 20

THE MACHINE HEADBOX

Three different types can be distinguished :

- headboxes designed for comparatively narrow ranges of grades, basic weights and pulp blends, which is the case, for instance, of newsprint or super magazine, basic paper for coated magazine, sacks, corrugated board, etc. In fact, for the above grades, the basis weights and machine

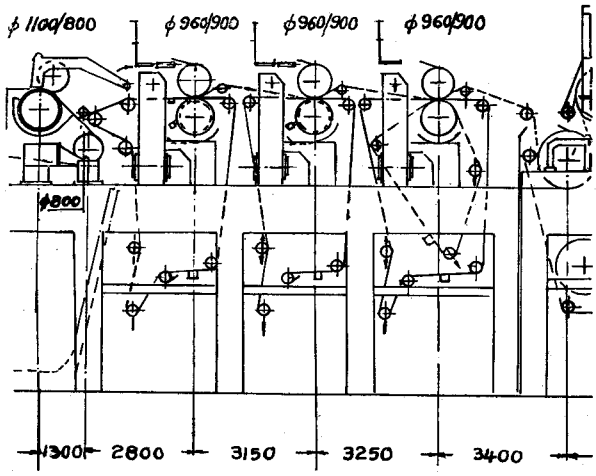

Fig. 21

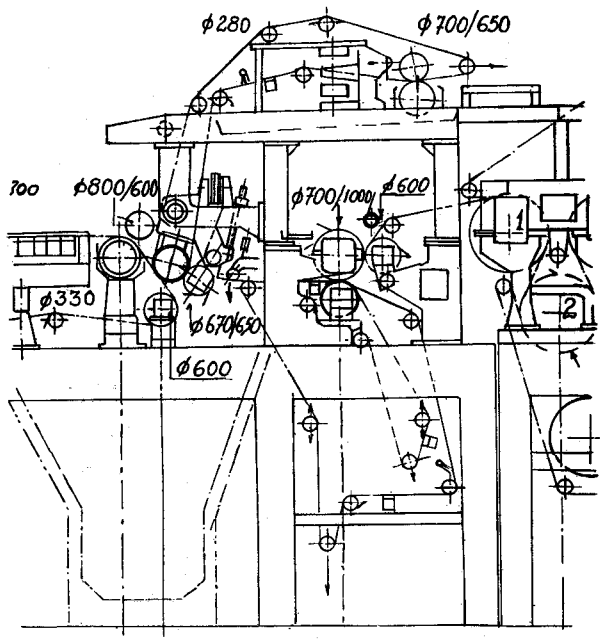

Fig. 22

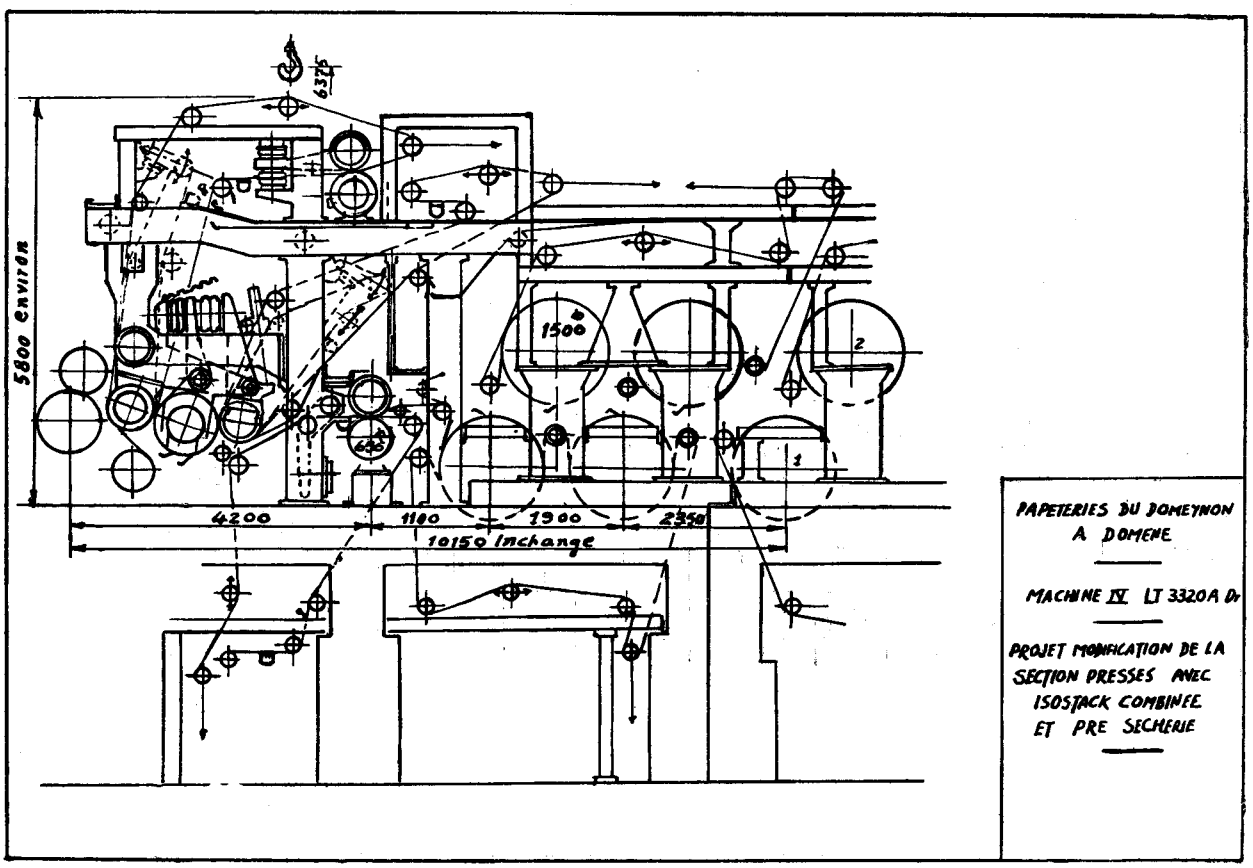

Fig. 23

speeds are almost constant and the headboxes producing them are referred to as "quasi constant characteristics" type.

— headboxes designed for large varieties of grades, wide ranges of basis weight in the same grades, or very diversified blends for single or multi-ply wrapping papers, writing-printing papers, high quality basic papers for coating, etc. These headboxes are referred to as "multivalent characteristics" types,

— secondary headboxes, the purpose of which is to lay a second ply on a primary

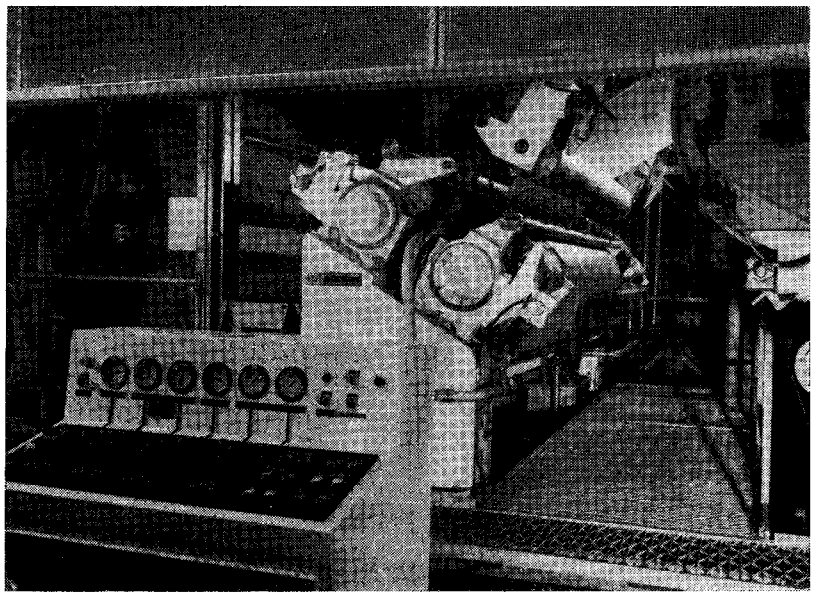

Fig. 24

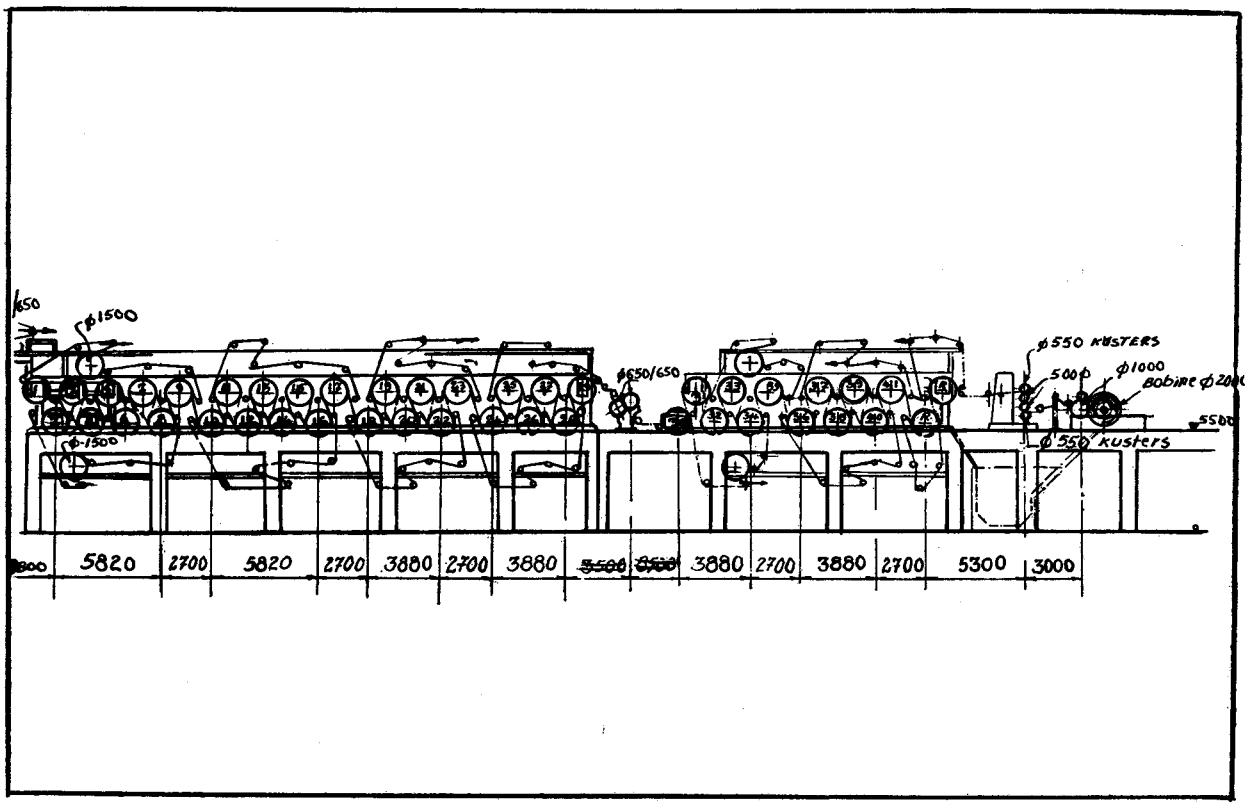

Fig. 25

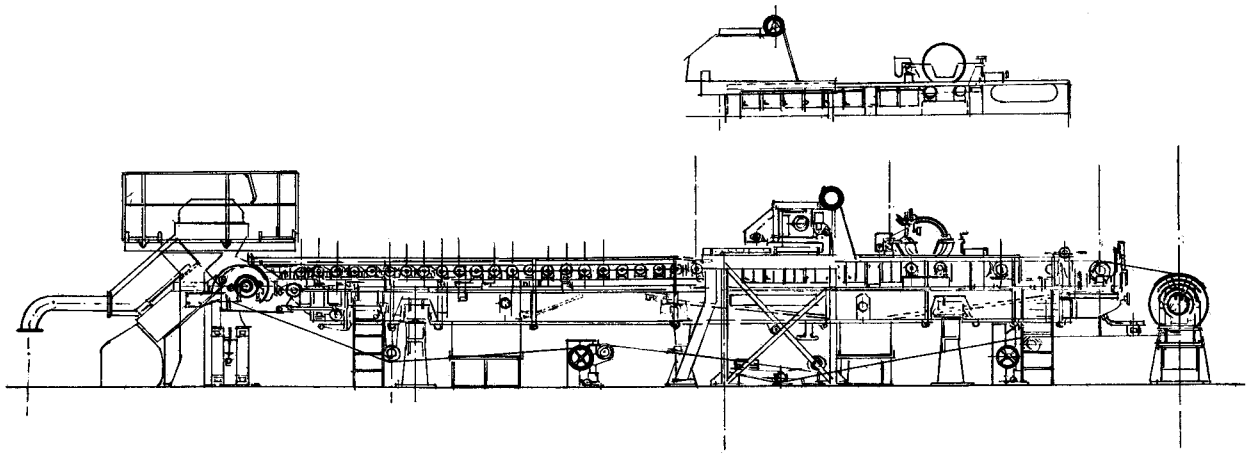

Fig. 26

ply formed by one of the two above mentioned types.

MANIFOLDS

As far as we are concerned in this paper, these three headboxes have a common component which is a multi-tubular manifold with a loss of head of approximately 5 m of water.

This manifold has been designed in view of distributing the fibres, loads and fillers, as finely as possible. It must maintain at the same time within the flow of the diluted pulp a high degree of micro turbulence remaining well above the floculation limit of the bres, without producing however in the headbox exagerated turbulences or swells, which would be impossible to eliminate completely.

The various applications of this manifold are illustrated in the sketches and photographs. **Fig. 5, 6 and 7.**

The specific power input required to maintain the desired micro turbulence has been determined by extensive laboratory tests, covering different types and compositions of pulps and also various temperatures and consistencies.

From the data obtained in these laboratory tests, these data being in fact very different from one particular case to another. it has been possible to study this type of manifold on a scale model and then to develop industrial prototypes during the last three years.

HEADBOXES PROPER

A "Quasi constant characteristics" type headbox is shown on **Fig. 8 and 9,** and two typical examples are given. The first one refers to a medium production headbox, and the second to a high production headbox.

The main feature which is common to the two alternatives, is that headbox operates at a constant pond level which is obtained by means of a skimming weir with a small overflow.

The overflow weir has been studied with paper pulp on a sectional type scale model. It allows for a good sharing of the flow between the machine wire and the re-circulation circuit.

Besides the advantages of this design, as regards elimination of foam and removal of entrained air, the overflow system permits an adjustment of the inlet flow to the headbox as a function of the level in the overflow tank. Changes of dilution are then obtained automatically, as soon as the slice lip opening is varied. by acting on the regulating valve placed on the fan pump delivery pipe. This type of headbox embodies obviously a variable pressure air cushion to adjust the total head to the jet velocity on the machine wire.

The hydraulic design described above is well adapted to maintain, by means of perforated holly rolls, the micro turbulences developed in the manifold without creating at the same time macro turbulences which could impair the crosswise and lengthwise regularity of the paper.

We shall now study the case of "multivalent characteristics" type headboxes. Their design has been based on a production of varied grades and basis weights composed of several qualities of fibres.

To solve this problem, the Isoflo headbox has been hydraulically designed for a constant inlet flow, in which the partition between the flow delivered to the wire and the overflow has been located as close as possible to the slice lips. This arrangement is governed by the relationship.

Q Constant = q Wire + q Overflow. It is obvious that qw and qo can vary according to the demand of stock on the machine

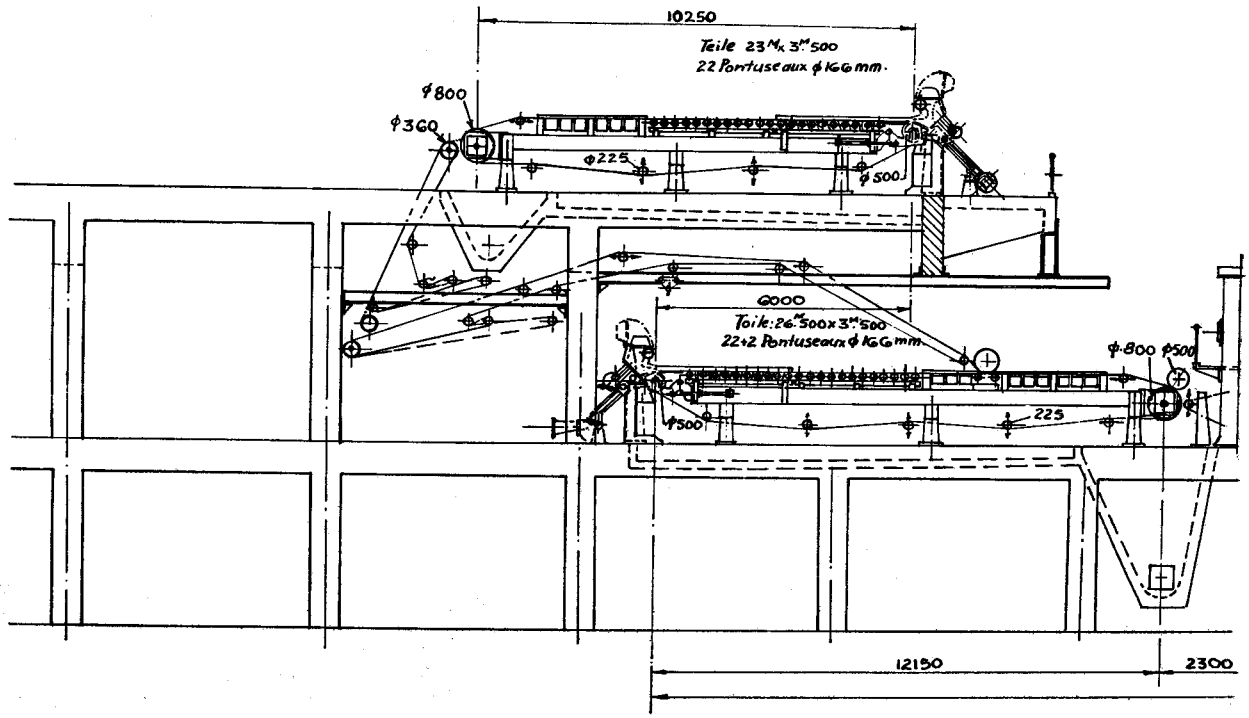

Fig. 27

wire as shown on **fig. 10, 11, 12 and 13.**

A multicell overflow weir, having a great developed crest length, allows, for important recirculated flows without substantially changing the pond level in the headbox.

Finally, a consatnt pond level has the advantage described above of changing automatically the dilution, by controlling the flow through the recirculation valve. No action takes place on the delivery line of the fan pump, as the latter is operating at constant flow; dilution is varied by action on the re-circulated flow and on the quantity of white water drawn at the suction at the suction of the fan pump.

ISOFLO headboxes have proved their interest when spreading on the wire diversified fibre blends, and this is mainly due to the fact that a higher degree of microtubulence is maintained from the headbox inlet manifold to the slice lips.

When the above described designs, it has been possible to solve fabrication problems embodying very long fibres (rags, linters, softwoods), diversified blends (mixtures of more or less delignified lon gor short fibres with or without wood pulp), very high freeness pulps (glassine or ppaline) etc.... Each problem has been solved by an adequate design adapted to each particular case, but in all cases, the main principle of the controled flow has always been adhered to.

It should once more be insisted on the fact that this type of headbox is particularly adapted to handle mixtures composed of various pulps prepared by distinct processes.

As regards secondary headboxes, the aim has also been to maintain the pulp in deflaked condition in order to obtain the best hiding power, and a typical design is illustrated in **fig. 14 and 15** which shows all the interest brought to obtain the results described above.

To close this chapter, the following points require a particular attention :

- it is of the greatest importance that the regulation of the headbox be as simple as possible in order to avoid detrimental interaction of different regulators,
- it is essential that, when shifting from one production to another, the operating parameters may be easily restored with the help of statistical records and by observation of repeatable qualities. This can be obtained for instance in terms of :
- the slice lips opening which governs the correct dilution and therefore the

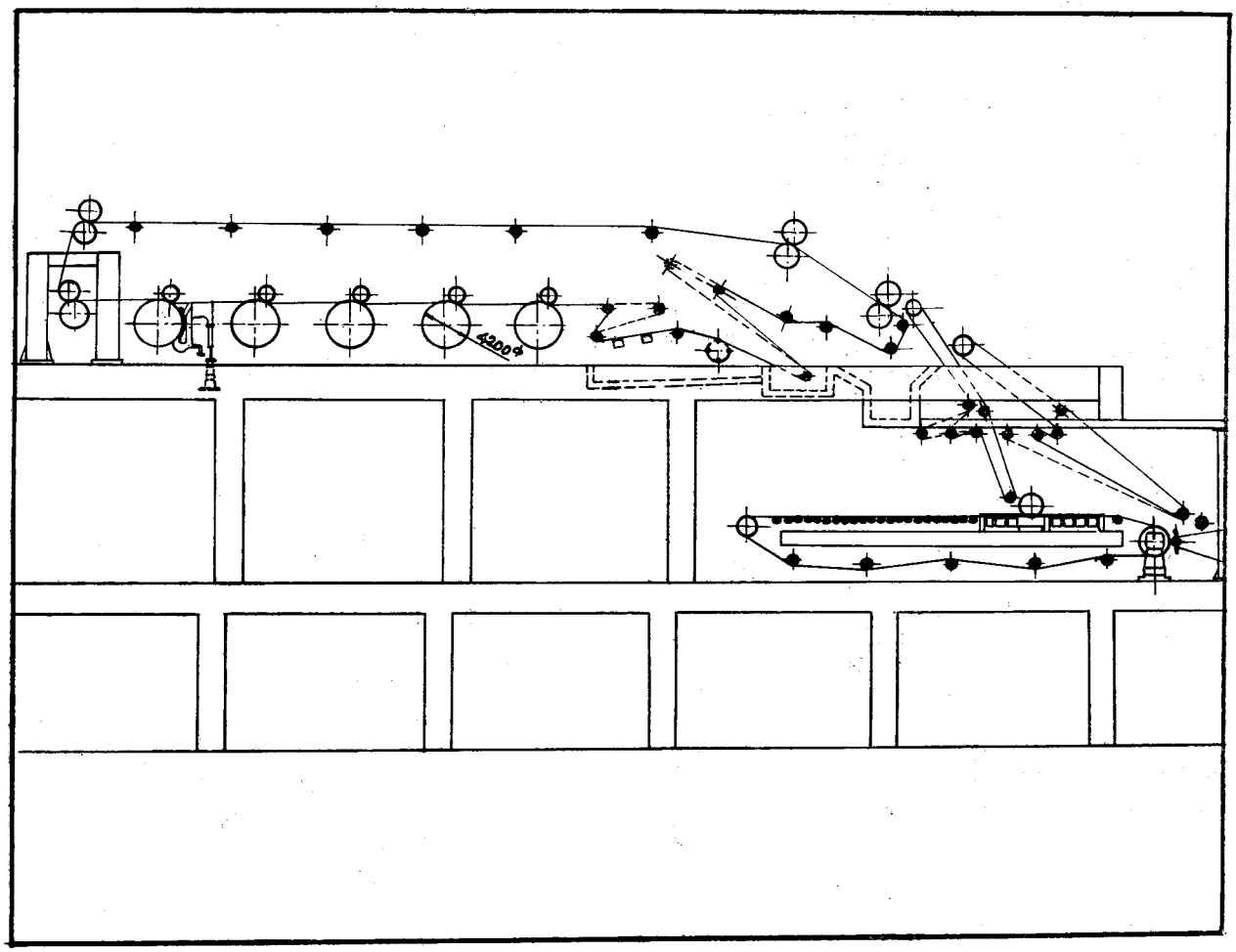

Fig. 28

sheet formation, burst ratio etc....

— the jet/wire velocity ratio which conditions also a good sheet formation and the desired mechanical characteristics.

The regulating devices and instruments installed on modern headboxes enable to operate them with a much greater reliability than in the past.

FOURDRINIER SECTIONS

For the majority of pulp which are spread on the machine wires, the following results are sought in most of the cases :

— a progressive formation of the shet in the first zone of the Fourdrinier

— a draining a sextensive as possible after the first zone.

The specialist has now at his disposal all free and forced draining equipments enabling him to proportion the draining effect according to the expected results.

The main equipments to be mentioned in this respect are, of course: forming boxes, simple or multiple wire doctors, small or large dimension foils, vacuum foils, wet flat boxes, conventional suction boxes or belt type suction boxes.

The application of the above equipments is in full development, and they are used in conjunction with the increasing application of single or multistrand plastic wires.

Apart from the particular problem of issue papers, of long fibres and highly refined pupls, it is essential to design the Fourdrinier frames to comply with the following imperative conditions :

— The Fourdrinier beams should be arranged in such a manner to enable the installation of all the items described above without major modifications. For this purpose, they should be equipped with suitable fixing slides arranged on their entire length.

— The save-all pans should be arranged between the Fourdrinier beams to drain

the white waters with a minimum fall, thus avoiding air entrainments.

It has been observed that, when using diversified fibre blends, a progressive and undisturbed formation of the sheet is of the greatest interest and that it should take place as soon as possible after spreading the stock on the wire. This is why wire doctors without suction effect are used in the first stage, and draining effect is then perfected by foils and suction boxes without impairing two sidedness or other asymmetry of the paper when these effecs should be avoided.

It is never recommended to have a low retention on the wire, as the resulting losses in fibres and loads will cause both an overload of the recovery system and more important variations of basis weight in the headbox — a law governs this phenomenon and, furthermore, it has always been confirmed by site measurements.

Fig. 16 gives a general idea of a Fourdrinier designed according to the above considerations.

It should also be mentioned that a part of the draining equipment can be retracted at will by the machine tender in a very short time, in order to adjust the water line position according to the basis weights, and also to operate the dandy roll under the best moisture conditions.

The application of plastic wires does not bring major changes to the wire return circuit, especially when the Fourdrinier design allows for pre-stretching of this wire when mounting it on the machine. Owing to the longer life of plastic wires, it is possible to choose a small much with the result of improving retention on the wire, provided that the wire return circuit be efficiently cleaned and conditioned.

Finally, even if a Fourdrinier is designed at the first stage for medium speeds, it is essential to provide from the beginning for a suction couch and turning roll unit for the followig reasons:

- picking up of the sheet from the sloped part of the wire is facilitated if there is no closed press circuit, and this applies more particularly to blends containing a high percentage of short fibres when the machine is operating at appropriate fabrication speeds.
- turning of the wire is greatly facilitated, both for metal plastic wires,
- it will be possible to equip the machine with a closed press circuit at a later stage,
- the power required for vacuum at the suction

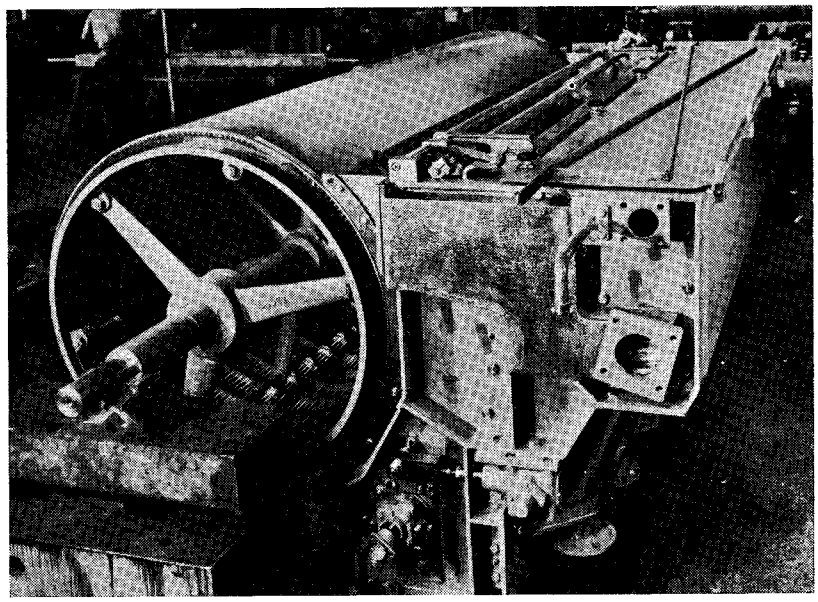

Fig. 29

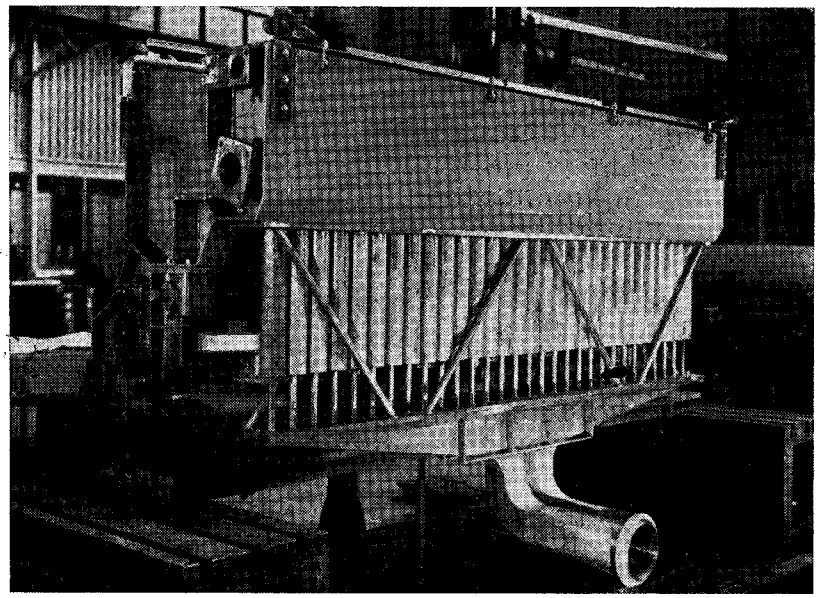

Fig. 30

couch can be substantially reduced.

Fig. 17, 18, 19 and 20 illustrate the draining equipments described above.

THE PRESS PART

This section of the wet part of the paper machines has been deeply modified during the last years and, in our opinion, it is the result of a close cooperation between papermakers machine manufacturers and also felt manufacturers.

The results obtained from this cooperation are of very great interest and show the fruitfulness of concerted development actions. The most important of the improvements obtained are:

— in open circuit :

— an appreciable reduction of the vacuum circuit with the consequent saving in power,

— a much longer life of the machine clothings.

— a gain in dryness permitting a lower steam consumption or an increased machine speed,

— an improved threading of the sheet, and more particularly of the tail, when starting the machine,

— a considerably improved distribution of the dryness in the crosswise direction of the sheet when the later enters the dryer part.

— In closed circuit

— all the advantages enumerated above for the open type circuit,

— more particularly an increase of the machine speed limit, especially for papers composed of an intricate blend of various pulps.

OPEN TYPE CIRCUIT OF MODERN DESIGN

This type of circuit is shown in **Fig. 21.** It applies, for instance, to paper machines manufacturing food box boards, corrugated boards, kraft liners, and generally speaking, heavy products at medium speeds, the produced tonnage being important on account of the basis weight of the above grades.

The sheet is picked up between the suction couch and the turning roll. It is stabilized by a lead roll and then conveyed through the FIRST PRESS which may be of the suction type of the minimum fabrication speeds are less than 100-120 m|min. On the contrary, this press may be of the **grooved type,** provided that the minimum speed of the machine is sufficient.

The gain in dryness is slightly increased with a grooved press and its main advantage is that, when threading the tail, the latter is at the same dryness as the whole sheet. This is due to the fact that the grooved press operates as efficiently on a small width than on the entire sheet width. On the contrary, with a suction press, the full vacuum only builds up when the sheet is spread on the full width of the press.

In second position, the grooved press gives, in most cases, excellent results and enables to gain several per cents drnyess as compared to a conventiona l press. As a matter of fact, it is possible, on this type of press, to take advantage of the increased limit of crushing, in order to obtain a maximum gain in efficiency by applying an important linear pressure.

In third position, a solid grooved press without rubber lining, or a fabric press, enables to perfect the high degree of dryness required.

The combination of the above arrangements, which has only been developed since a few years, is particularly favourable in the fabrication of papers containing an important percentage of high yield pulp.

The main object is a good operating stability which is obtained with the above arrangements, as in each press the wet strength of the sheet is increased by the gains in dryness and the good crosswise dryness regularity.

A special care must however be taken in the choice of the press

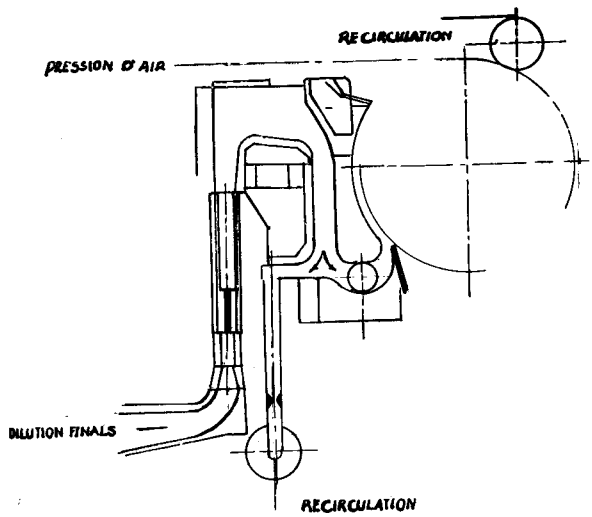

Fig. 31

felts and of their condiitoning. This choice has become easier on account of the increased varieties of felts offered by the manufacturers and it should also be mentioned that these manufacturers are now quite conscious of the technical requirements in this respect; they have now perfectly mastered the problems of proportioning conventional and synthetic fibres, and also the needling processes.

As regards felt conditioning, the power saved from the vacuum system of the suction press may be transferred to suitably designed felt conditioning boxes arranged on the entire machine width.

To conclude this paragraph on open type circuit, it may be mentioned that the above results may still be improved by the use, in third or second position, of "swimming" type upper presses with adjustable camber.

With this type of press, it becomes possible to reduce the di-a meter in appreciate proportions, which results in an increase of the specific nip pressure and a new gain in dryness.

Finally, and this applies particularly to open type circuits, lumpbreaker rolls with self cleaning (peeler) linings have been mounted on top of the suction couch roll, and have also given a slight gain in dryness where the sheet leaves the wire. The lumpbreaker roll also avoids sending to the press part undesirable lumps which are a cause of sheet breaks.

All the above improvements have a common tendency towards an increase of the wet strength of sheets having a low resistance at the considered dryness, especially if they are composed of different fibre blends, and more particularly of short fibres.

More or less closed circuits.

They have the very great advantage of eliminating speed boundaries of the machine. It becomes therefore possible to reach very quickly, after starting the machine, the maximum possible speed with the fibre blend used.

A great number of different types of closed circuits are presently in operation and, although a complete historical record could be made of their applications, two typical examples of the most up-to-date design have been choosen because they have proved to be the most reliable of all. **Fig. 22** shows an arrangement adopted on a writing-printing paper machine which is still in the manufacturing stage and is designed to use a blend of 20% softwood long fibres and 80% annual crop fibres.

The sheet is picked up from the wire, after the lumpbreaker roll, by the first press acting as pick-up and reverse suction press. This press has three suction zones :

— the first zone picks up the sheet off th ewire,

— the second zone maintains the sheet against the felt during its transfer to the third zone,

— the third zone plays the part of a suction press.

It is obvious that the values of the vacuums are different from one zone to another: the pick-up and suction press zones have a vacuum of 500 mm Hg, and the transfer zone a vacuum fo only 200 mm.

It should be noted that, to obtain a correct operation of this type of press, the felt must be conditioned by a high efficiency wringer roll (of the suction or grooved type), a well designed felt suction box, efficient showers and a variable camber roll giving a good spreading of the felt. Furthermore, shadow marking will be avoided by an appropriate composite type felt.

In the present cas,e the second press is of the straight fabric type, and is combined with the smoothing press.

With this equipment, the dryness off the press part can reach between 37 and 42% according to the basis weight. There is no limit to the range of basis weight and it is possible, with this arrangement, to produce light as well as heavy weight grades. As a matter of fact, th efirst press takes care of the sheet transfer entirely by vacuum, which results in the fact tha tthe felt plays more the part of the couch felt than of a pick-up felt, in spite of the particular structure of its face in contact with the sheet. The above arrangement is already remarkably compact, but it has also the advantage that the paper draw only atkes place when the drynesses has reached 32 to 36%, thus eliminating the problem of sheet weekness due to the fibre composition or treatments.

However, for fibre compositions giving a very low wet strength, this problem can be solved even better by adopting the arrangement shown on **fig. 23** which is referred to as the double "ISO-STACK". In this case, the first pick-up reverse suction press is associated to a second grooved or fabric press. According to the basis weights produced, the sheet is transferred to a high efficiency straight press of the grooved or fabric type, or on the contrary, directly to a lower drying cylinder.

To close this paragraph, it should be noted that the closed circuit presses described above have a tendency to alter the aspect of the back of the sheet leaving the

wire, as compared to what is usually observed.

Therefore, when choosing an adequate solution, this phenomenon should be kept in mind, as it is very important to proportion correctly the vacuum values together with the number and position of the pressing zones.

THE DRYER PART

All the provisions made in the design of high efficiency wet parts are obviously brought to the benefit of the dryer part.

The higher dryness and crosswise dryness regularity of the sheet obtained at the entry of the dryer par tallow for a reduction of the number of dryness, or pre-dryers if a size press is used.

However, the results obtained in this part of the machine must be in line with those obtained in the wet part.

An improved crosswise dryness regularity has been obtained by combining the action of blow-through steam with siphons or siphon scoops for condensate removal, with the result of increasing the heat transfers. In the blow-through steam system, the dryer sections are arranged in cascade with high, medium, low and sometimes very low pressure stages. This design aims to obtain the best thermal balance, by re-delivering the fish steam recovered from the high pressure stage to th medium stage, and so on down to the last stage.

However, a very good crosswise dryness regularity cannot, in spite of the above provisions, be achieved without the help of auxiliary equipments which are common to the entire dryer part, such as :

- closed hoods which have the interest of obtaining a symmetry in the vapour removal and a balanced blowing-in of hot air,
- normal air blow-in rolls or dryness equalizing rolls,
- dryer screens which have a much higher porosity than conventional dryer felts. This is in our opinion one of the most important improvements brought to the dryer parts, in order to obtain an almost constant rate of evaporation across the sheet.

As a consequence, various treatments to which the paper may be submitted in the dryer part such as passage in breaker stacks, sizing or coating by sizepresses or coating bars, glazing by MG cylinders can be performed under the best possible conditions.

Modern designs also tend to apply, as the sheet travels through the dryers, the most appropriate means to obtain the required dryness. Therefore high efficiency hoods for conventional dryers or MG cylinders should be placed at the points where their addition is the most efficient.

Finally, according to the manufactured product, a carefull discrimination is made when fractioning the mechanical sections of the dryer or pre-dryer part.

The arrangements chosen are very different from eac hother, for instance:

- for the production of sacks, the draw on the paper will be gradually decreased in the zone of high shrinkage. This result is obtained by the use of very short dryer sections, without felts, of high efficiency hoods and of paper draw regulating devices,
- for writing-printing papers, the number of dryer sections will depend upon the fibre composition of the sheet and the freeness of the pulp brand used.

Size presses are also changing, and their actual design is adapted to the machine speed and to the strength of the sheet, to avoid under draw on the paper and intricate sheet circuits, particularly when composite fibre blends having a lower breaking length are used.

A typical example of the present tendency is given by **Fig. 24 :**

- the sheet circuit is as simple as possible through an oblique passage size press,
- special care has been taken to dampen jerks in the paper draw by using a compensating roll with air springs and shock absorbers.

If there is a post-dryer part, when producing writing-printing paper for instance, it is of the greatest importance that its capacity be suitably calculated.

We have been given to observe the operation of paper machines in which the pre-dryer and post-dryer parts were completely unbalanced. The capacity of the post-dryer parts is often underestimated, and this results in limiting the production when sizing the paper.

This remark applies particularly to blends containing a high percentage of hardwood fibres or annual crops. The additional moisture brought into the paper in the size press may cause the sheet dryness to drop down easily to 60%, if not 55%, and this shows all the interest of a correct design of the post-dryer part.

Fig. 25 shows a dryer part in which it has been attempted to balance adequately the pre and post-dryer parts, by the use of a

suitable combination of dryer felts and screens.

CALENDER AND REEL

The efficiency of Calenders has greatly improved since the adoption of "swimming rolls". These rolls have first been installed at the place of the king roll, and also of the top roll. With this arrangement, it has been possible in most cases to reduce the number of intermediate rolls. This is due to an even nip pressure, and furthermore, additional loads can be applied without creating excessive local pressure on the sides of the sheet. In addition to the adoption of "swimming rolls", it has been possible to improve the design of the complete stack by devices eliminating perisitic loads due to the intermediate rolls, doctors, bearings, etc....

As regards the Reel, a particular attention has been brought to its drive, and specialists of electric sectional drives have devised a constant pre-determined paper draw system between the dryer part, the Calender and the Reel, with due consideration of the basis weight and strength of the paper.

MULTI-PLY MACHINES

Secondary headboxes have alalready been mentioned; the user's interest is obviously to produce a two-ply sheet under the most economic conditions of multi-ply formation. The application of secondary headboxes has been extended to kraft liners and special light boards. They also facilitate the use of a high quality pulp in small quantity combined with a large quantity of diversified blends.

Fig. 26 shows the lay-out of such an arrangement.

Multiple Fourdrinier machines have made it possible to combine different qualities of pulp for the manufacture of board. Their general lay-out and sheet circuits must be designed in order to obtain the best "marriage" of the two plies, at the most adequate dryness, and between faces of the sheets having the best properties for this marriage.

Fig. 27 shows a typical lay-out of a double Fourdrinier machine in which one of the plies is reversed between the two Fourdriniers, in order to obtain proper marriage between the two faces opposite to the wire.

Finally, dry cylinder moulds are now capable of forming elementary plies of more regular qualities than those obtained by parallel or reverse flow moulds. They have been used successfully on medim production machines, as they allow to combine a greater number of plies composed with any one of all the pulps mentioned in the foregoing paragraphs.

Dry cylinder moulds have given a new attraction to multi-vat or multi-Fourdrinier machines, and an example is shown in **Fig. 28. Fig. 29, 30,** and **31** give a general idea of these controlled flow dry moulds, in which several principles applied to modern machines headboxes have given successful results.

CONCLUSION

From the economic point of view, it is no doubt of great interest to use blends of short or comparatively short fibres which are found in tropical plants. Whether these fibres be used on single or multi-ply machines, they do not require an extensive refining degree. As a consequence, machine users and manufacturers have been compelled to adapt their equipments to the use of these pulps to obtain products complying with international standards. As already explained above, it has therefore become necessary to alter accordingly the design of the various sections of paper and board machines.

The results obtained as regards improvement of sheet formation and special treatments have made it possible to obtain a much better sheet regularity than in the past. The savings made in power, steam, overall dimensions and machine clothings have been added to the savings resulting from the use of new raw materials which have been put at the disposal of the paper makers in their own countries.

It is our opinion that this harmonization will take further developments in the near future, for the results already obtained are still far from having reached their optimum.

Manufacturers, should constantly keep in mind these considerations in their research, development and design work. A very large quantity of new raw materials or of which no extensive application has yet been made: will gradually become available in addition to conventional fibre brands. Our intention is not to neglect this evolution but, on the contrary, our aim will be to adapt the sheet formation systems to the new requirements, in order to facilitate the operation of the machines and increase their efficiency.

Presented by G. Lagacherie at the International Seminar of IPPTA, held at New Delhi, December 3, — 5, 1969.