Adopting Recent Innovations for Improving Wet Part of Paper Machines

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The importance and the necessity of adoption of some of the recent innovations for improving the wet part of the papers machine has been discussed. In view of the current recession and competitive trend in the paper market all over the world, the smaller units can survive by taking recourse to production of special grades and qualities of paper to fetch a better price or by operating very efficiently for which purpose adoptation of recent innovations appears to be essential.

A tremendous stride has been made in the past decade in the paper industry, particularly on the paper machines. The quality of product, which in the present competitive world market, comes foremost has not only been retained but interestingly enough, has been improved much beyond the expectations, inspite of the higher paper machine speeds, mostly by the ingenuity of the paper machinery builders, machine clothing manufacturers and lastly but not the least by the paper technologists. Of course the combined efforts of one and all have been to produce paper faster but at the same time of positively improved quality to satisfy the stringent demands of the paper consumers for their various specific needs. The instrument mannufacturers and computer designers have played a very significant role in the development of high speed twin wire single ply machines without whom the present progress would not have been possible at all.

The most recent innvoations without which the speeding of the paper machines to the present day level would never have been realised are the Microturbulence head boxes, synthetic monofilament or multifilament wires, foils and vacuum assisted foils, wet boxes, single ply twin wire formers having both side equal drainage capability, introduction of new vertical flow felt designs and transversal flow press units with practically very little or no draw configurations etc. etc. Extensive research, clear concept and understanding of new theories and ideas of press units and pressing principles have contributed largely to these developments. Though the caption of the article being presented here does not require going in the details of the various developments yet we feel that a brief explanation of the working principles of various innovations would not be out of place here.

In this competitive world and with the recession in the paper trade the smaller units can only survive either by taking over to manufacture of very special grade and qualities of papers which would fetch high realisation per tonne of paper or by sheer dint of their operating efficiencies resulting in overall economics. With the conventional and orthodox design of the equipments and the paper machines specially when using short fibred agricultural residues and paper cuttings etc. the efficient

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working of a small unit with the conventional and obsolete equipment does not appear to be possible. At least, our extensive experience with some existing small units which we have had the opportunity to survey well endorses our contention. We very strongly feel that unless and until the paper machine and auxiliaries (atleast) are performing at peak operating efficiencies both as regards to quality as well as the quantity, the question of small units survival in the competitive market against their well established partners in the industry poses a problem of great magnitude. Perhaps the only reason why some small units with conventional and outdated machinery are still surviving in our country, is on account of their low overheads. Quality and profit wise, unless the small units have taken to manufacture of some speciality grade paper, they are not performing upto the mark. As long as the sellers market prevailed due to acute shortage and dearth of paper, lower quality product was acceptable in the market till about last year. However, now since the whole situation has changed due to acute recession in the country, not only smaller units producing poorer grades of paper but also the larger units are facing serious problems in selling their product in the market. It is high time now that our small entrepreuners already established in the paper industry or wishing to set up new mini paper plants give serious consideration to the quality of their product and just not be lured by minimul capital investment but should on the other hand have a foresight to instal equipment and process which may enable them to produce a product, which though not superior, yet may compare favourably with the product of the larger units in the paper industry. This does not imply that the new units (Big or Small) should resort to sophisticated equipment and instrumentation to a large degree but it is only stressed here that all units whether small, large or new should take advantage of the recent innovations in the paper industry. It is however, advisable to avoid extremely sophisticated and difficult to operate/maintain equipment as far as possible but highly efficient and easy to operate/maintain machinery may be installed which may be useful for the smaller units and serve practically the same purpose as the highly instrumented and sophisticated equipment in most modern mills having very fast paper machines. We will now endeavour to offer some suggestions to improve the performance of some of our existing paper machines or suggest incorporating various recent innovations in the design of new units rendering them more efficient and economical to operate, keeping in view what our paper machinery manufactures could supply from indigenous sources and know-how.

Wire Part

On very high speed paper machines, the conventional Fourdrinier has been almost superseded by the twin wire single-ply sheet formers and their success is mainly attributed to Microturbulance Head boxes, impinging a very stable jet of stock in between the two wires where the flow freezes immediately and then various devices are used by different machinery builders to extract water very gently and evenly from both sides of the sheet through the two wires. The Papri-former (Dominion and KMW design), Verti Forma, Bel Baie Former, Duo Former etc. are all designed with the same basie principles excepting for slight variation in technical details. However the Svm Forma has somewhat a different approach which could perhaps be adopted to give the advantages of the twin-wire formers even on slow speed machines. All twin-wire formers claim extremely uniform cross direction profile, even Z direction fibre distribution and strength properties, better retention of fines and fillers due to even and gentle drainage from both sides of the sheet, excellent sheet formation, better printing surface with less linting during printing and much more even sided sheet. A final drier sheet is also claimed with less streaking for the twin-wire formers with overall low power consumption. Approximately 30% less wire marks and better reten-

tion of fines and fillers have contributed to production of better grade of writing and printing surfaces with these twin wire formers.

Higher sheet dryness leaving the twin-wire formers has contributed substantially to less number of paper breaks at press section with subsequent improvement in overall performance of the paper machines.

With use of short fibred agricultural residues and paper cuttings, with the conventional fourdriniers it may not be possible to attain a maximum operating speed of over 180 m/min. In adopting the twin-wire formers for such low speeds, the main difficulty appears to be high turbulance boxes of various designs, where a stable jet can not be attained below a speed of 215/220 m/min. In view of the above and lured by the advantages claimed for the twin-wire formers, it would be worthwhile for us to explore the possibilities of incorporating a very short formation table & then resorting to the principles of a twin-wire former by adding a solid forming roll as in case of Peri-Forma-D followed by drainage foils and vacuum transfer box etc. This arrangement could eliminate the expensive imported suction rolls and still enable us to design a simpler twin-wire former to improve the quality of product of our medium speed machines using agricultural residues in their furnish.

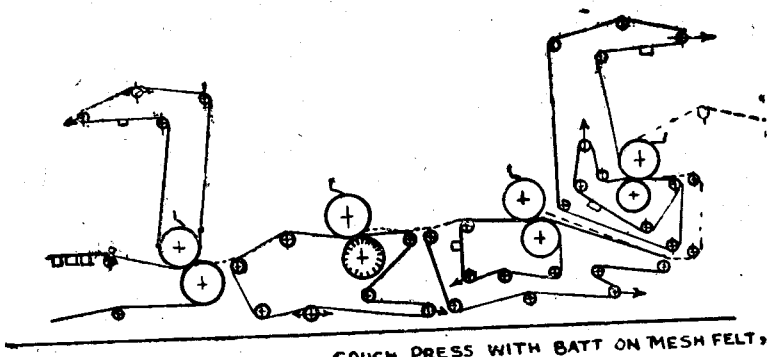
Now reverting to the conventional Fourdriniers our open head boxes with projection slice can be improved and a more stable jet obtained by inserting vertically parrallel thin fin units just ahead of the last rectifier roll. Though this may not give as stable a jet and cross machine profile as claimed for the high turbulance boxes, yet it will definitely improve our uneven profile associated with the jet hitting the forming board or the table roll and disturbances caused by the atmospheric pressure.

The table rolls which cause a very high degree of two sidedness in the sheet could fully or partially be replaced with foil units to minimise the washing and stock jump created by the table rolls. The drainage can further be improved for a short wire table by augmenting the foils with vacuum assisted foils. The wire suction boxes and the foil units installed must have a low coefficient of friction top to minimize wire wear.

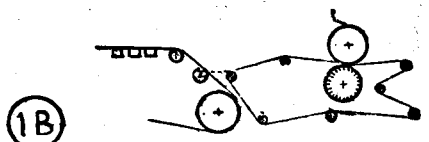
Synthetic wires would assist In improving the sheet formation when run in conjunction with foil units and will be extremely helpful in obtaining longer wire life. Our indigenous wire manufacturers should strive to provide us synthetic wires at reasonable price not only for the fourdriniers but also for the fabric Inner Belts.

Suction couch, with double compartment box on the conventional fourdriniers and multi-compartment suction couches on the very high speed twin wire single ply formers are now the standard equipment and their role in delivering a drier sheet cannot be disputed. However, such equipment which we are still not in a position to fabricate in India for want of centrifugally cast phosphore broze shells, is a luxury on slow and medium speed paper machines and can be very successfully substituted either by the conventional arrangement of the couch press using a Bat-on-Mesh felt instead of a jacket or a Baggalley Box equipped with low coefficient of friction top and using high vacuum or perhaps a combination of a couch press with a Baggaley Box as indicated in (Fig. 1A), (1B) and (1C) for speeds up to 150 or perhaps 180 m/min., no operating problem is envisaged at such speeds and the sheet dryness leaving the couch is not likely to deteriorate. One of the leading Swedish felt manufacturer has carried out extensive trials and now recommends a lump breaker roll to be clothed with a Bat-on-Mesh type of felt for better operating results. The cleaning and removing water from the Bat-on-Mesh felt is however very important in this instance and could be accomplished with a narrow opening full width box.

For lighter and medium weight papers a foil type pick up box eliminates the necessity of even a couch press or for that matter, a suction couch completely; fig 2A,



(1A)



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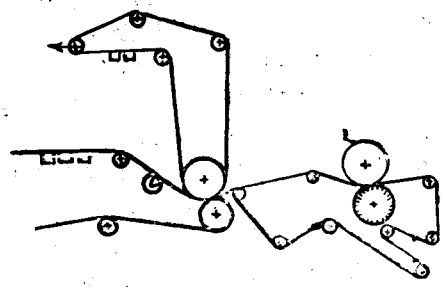


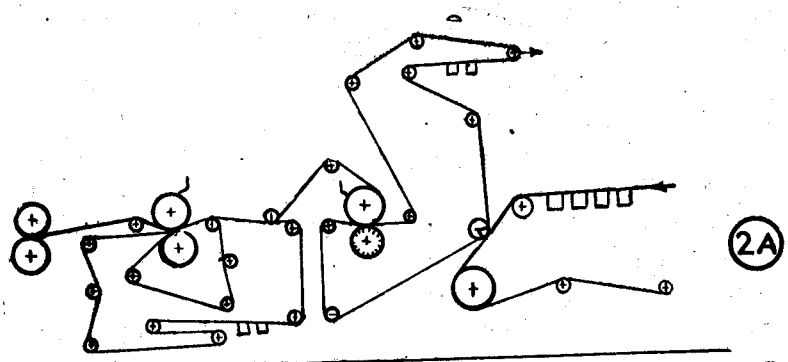
(1C)

(Fig.-1A), (1B) and (1C)

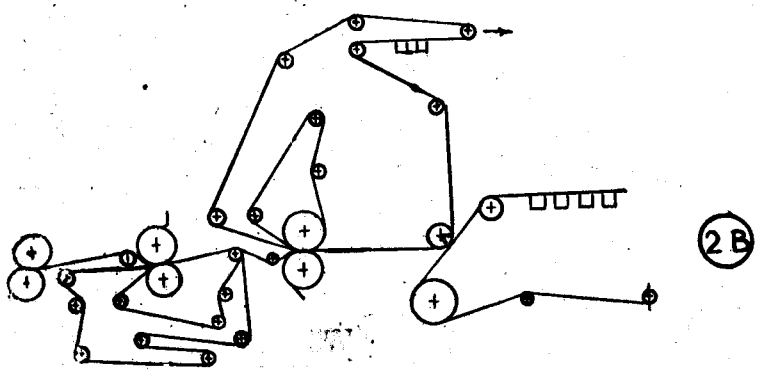
2B However the pick up box must be so adjusted in relation to the wire so as to provide a pressure pick up rather than a suction pick up. If so adjusted, the pick-up ledge in contact with the wire will force the water from the sheet through the wire and the vacuum in the box will not only assist the sheet to adhere the felt surface but will also help in removing water from the felt. When the box is adjusted to dig a bit into the wire, pick-up of the sheet could be established with a pick-up felt running fairly dry before the pick-up point.

Pressing And Presses

Better understanding and clearer concept of the pressing theories has led to better dewatering with suhsequent higher sheet dryness leaving the press section. Though completely closed draw designs were available for M.G. machines for quite some time now, yet a completely close draw design for the press for the M.F. machines has been evolved now. The no draw presses have practically eliminated open draws on the M.F. grade of papers and have not only contributed to fewer or virtually no breaks at the presses, but have assisted in safer transfer of wet web of sheet to the dryers thereby contributing to higher nip pressures and drier and better sheet consolidation. This has resulted in increase in tensile, tear and Bursting strength of paper at much higher machine speeds and at practically the same freeness of stock as used earlier. It is a well established fact that more the sheet is strained in the Press section the more will be the dry papers chances to rupture. A press section in which the first draw comes at high dryness, will therefore produce paper



FOIL TYPE PICK UP BOX WITH CLOSED SHEET TRANSFER TO 1st REVERSE GROOVED/BLIND DRILLED RESS FOR LIGHT WEIGHT M.F. MACHINE.



FOIL TYPE PICKUP BOX WITH CLOSED SHEET TRANSFER TO INVERSE 1ST FABRIC PRESS FOR LIGHT WEIGHT M.F. MACHINE.

Fig.–2A, 2B

with relatively high extensibility and toughness. Therefore it is most advantageous to have closed transfer presses.

Pressing improvements have been accomplished firstly by improving the press part components such as press roll designs, Loading systems, Grooving/ Blind drilling of the press–rolls as well as introducing newer felt/ fabric designs weave structure and incorporating higher synthetic contents in the felts. Secondly, further improvements have been brought about by introducing new press part configurations and new layout/designs to reduce or to completely eliminate open draws so that the sheet does not stretch and weakens causing press breaks.

Recent developments of the transversal flow presses (Grooved /Blind drilled and Fabric presses) have had a very high impact on the higher nip loadings and better dewatering capabilities. Though the drilling pattern as well as the shell material construction for the suction-press rolls have been greatly improved in recent past to offer higher nip loadings yet the inherent weakness of a press roll is its shell thickness. It is quite obvious that increasing the shell thickness to increase press nip loading positively hampers quicker evacuation of shell holes filled with water expressed at the press nip and consequently the dewatering rates of the press. However, a suction roll on account of its high dewatering capabilities, particularly where the sheet contains high moisture contents, is more or less indispensable for the high speed pick-up and first press positions. On slower and medium speed machines the Grooved or Fabric press rolls including the Blind drilled rolls have very successfully replaced the suction press rolls in some cases. This success has not only been responsible for developments of better rubber covering compositions but has also introduced stainless steel grooved rolls for higher linear pressures. Keeping the grooves open and clean under high nip pressure has been responsible for introduction of stainless steel press rolls. Introduction of variable hydraulically loaded crown, with fabric, blind drilled and grooved rolls, in order to provide uniform moisture profile

under varying nip loading conditions have further improved their utility on wide and high speed machines. Under certain conditions, closing of the grooves under higher nip pressure had created problems with rubber covered rolls. Blind drilled press rolls, with holes drilled 2.5 mm in dia and 15 to 20 mm deep in the rubber cover having a hardness not over 20° P & J (or less) have given fairly satisfactory results. The hole volume is almost 5 times the volume of the grooves in grooved press on the face value of it, it appears to be better equipped to handle large volume of water and can be successfully installed on positions such as the first press or the frst pressure roll on M.G. whereas the sheet is relatively wet and contains large voeume of water. Evacuation of holes/grooves is accomplished by foils or vacuum foils on slow/medium speed machines. On faster machines, the holes/grooves clean automatically due to centrifugal force or high pressure purge showers have to be used.

The combination of various suction, Fabric Blind drilled and Grooved rolls with configuration of the newer press designs to meet the specific pressing requirements have offered paper Makers highly efficient presses not only with regards to water removing capabilities but also initially eliminating the possibilities of press breaks at even very high paper machine operating speeds.

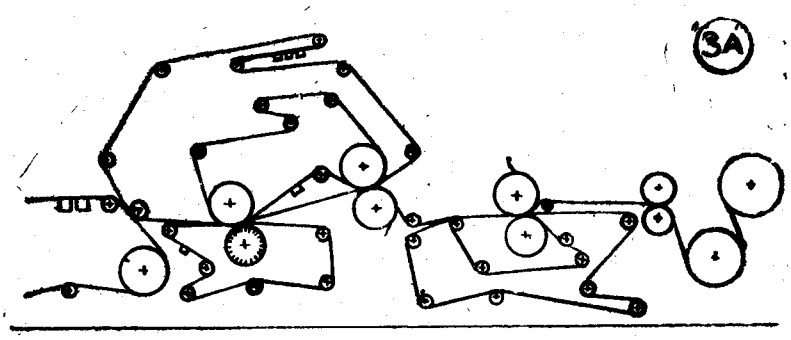
While Beloits have improved their press design for the high speed machines extensively in the shape of Tri-nip press. Valmet have offered Sym-press with practically no open draw right from wire to the 1st dryer though uniform transfer of sheet from the last hard smooth press roll by means of a felted suction roll may offer certain problems. Like blowing & creasing, all the other leading paper machinery manufacturers have applied more or less no open draw principles to their various press configurations. The only major difference being installation of a combined suction pick-up/suction press roll as in case of KMW Unipress or a suction pick-up roll independent of the first suction press roll. Introduction of the better pick-up felt qualities have to a certain extent diminished the importance of the KMW's Unipress design where a press configuration demands separate pick up and press rolls but on heavier weight sheets the principle and layout of Unipress type arrangement is still unique.

Advent of Grooved press rolls, Blind drilled rolls and the Fabric Press arrangement alongwith the improved felt designs, have almost obviated the necessity of a suction press roll on slow and medium speed machine even for the first press position. Not only a suction press roll is expensive to operate but also to maintain and is unfortunately not available in India at present (atleast the shell has to be imported). In view of the above and more operating experience with the Grooved, Blind drilled and Fabric Press rolls, for slow narrow machines various press configuration are being suggested here in Figs. 1 to 7 which we believe would definitely work more efficiently and would provide positive relief to not only our small and large mills but also to our indigenous paper machinery manufacturers.

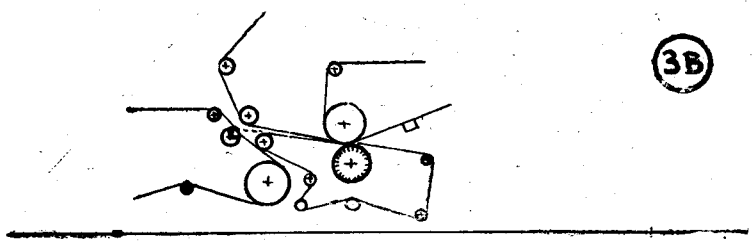
For the reasons already explained above, a first plain press roll could very easily be substituted with a Blind drilled/Grooved roll not only for better water removal purposes but also for higher nip loading which would certainly result in higher sheet dryness leaving the press. In view of transversal/vertical drainage at the press nip, less crushing and less press pick-up problems are expected to be experienced. However, care has to be exercised to provide a very symmetrical and uniform pressing/dewatering. The second press in this instance could be designed as a straight through Fabric press and a third press as a reverse or preferably as an Inverse Fabric Press depending on the type of papers to be produced and finish of paper requirement. but it should be remembered that the inverse Fabric Press is not very desirable on very slow speed machines on account of expressed water collecting at the nip. The first press can easily be loaded, with a suitable

needled felt, to 25/30 kg/cm, the second press to 35/40 kg/cm and the final press to 45/50 kg/cm or higher provided the rolls are suitably designed. The camber carried by the rolls is an important factor in loading the presses to their suggested nip pressures. It is also significant to note that in Fabric presses though the fabric has large void volume area yet Fabric run may always be arranged, wherever there is large volume of water to be extracted, in such a way that the fabric is running at an incline to the press nip as shown in figure 3A, 2nd press position to avoid any crushing in view of the large water volume extracted at the nip. The same holds true for a Blind drilled or a Grooved roll as shown in Figure 3B.

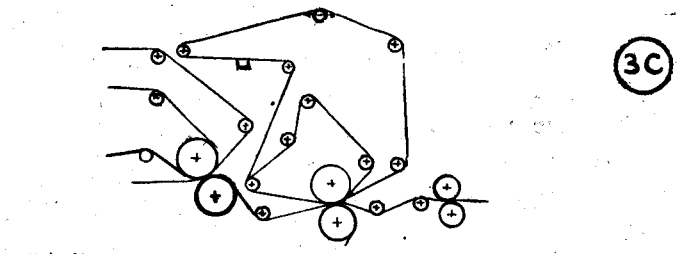
In case of a light and medium weight sheet using agricultural residues and a foil type vacuum pick up arrangement, a first double felted double nip press incorporating a Grooved/Blind drilled bottom roll, a fabric in the top roll position would be found to be extremely useful in both side dewatering of the sheet. The same fabric could be used at the second press nip after installation of a fabric cleaning box in between the first and the second press nip. The configuration of the press part is shown in (Fig. 3A) with this arrangement the first open draw of paper comes after the second nip only, by the time sheet has been fairly consolidated minimising the number of press breaks even while using very fine short fibred agricultural residue stock. Of course the selection of the right quality of felts for the top and bottom positions cannot be over emphasised.



WITH PICKUP ARRANGEMENT FOR LIGHT WEIGHT PAPERS



WITH BAGGALEY BOX AND TOP FELT FOR HEAVY WEIGHT PAPERS



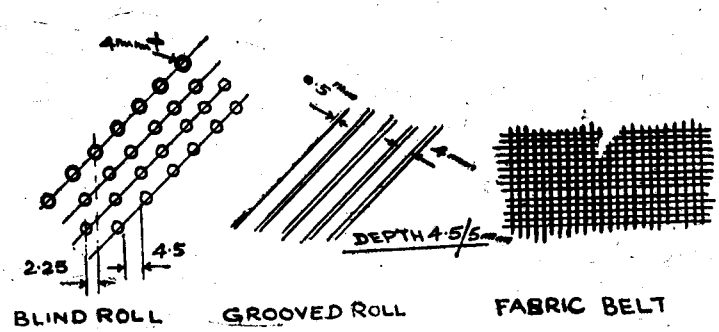
WITH AN INVERSE FABRIC PRESS IN THE THIRD PRESS POSITION

(Fig.–3A) Fig.–3B, Fig.–3C

In Fig 3B the alternative arrangement for running an open draw from the wire to the first double

felted double nip press has been shown and this arrangement on heavier grammage sheet could prove to be highly effective. With the suggested arrangement heavier sheets could be more heavily loaded at the press nip with subsequently improved sheet dryness figures. In case of design given in Fig. 3A wet web leaving the double felted double nip press has the added advantage that the wire side of the sheet comes into contact with a bare Granite/ Stonite/Microrock roll at the second nip which helps in oblilerating the wire marks. The press configuration also helps in easier leading of the sheet to the following press, whether it be of the inverse or the reverse type fabric press as shown in Fig. 3A and 3C. Also in these cases broke handling could be easier after the second press as suggested in the layout, it could either be handled manually or could be diverted to the Hog-pit by means of a screw conveyor and water shower. The proper crown carried by the various rolls can not be over emphasised in this case too for the nip loading carried by the press rolls.

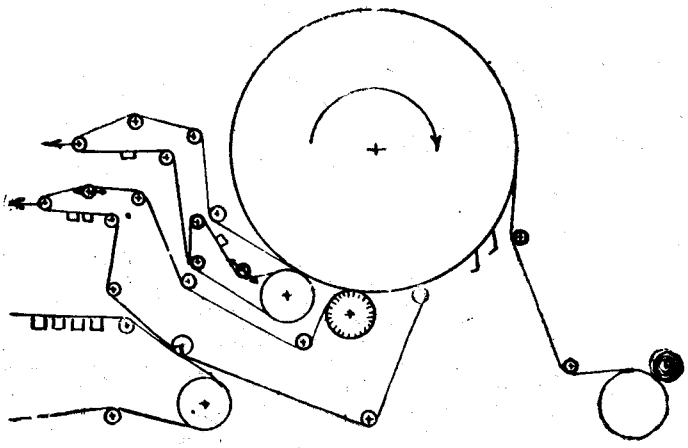
The felt cleaning arrangement could comprise of a narrow slot full width suction box having a low coefficient of friction box top material. Similarly the fabric cleaning could be carried out by a full width box having low coefficient of friction box top material. The box in case of the felt could be connected to a vacuum pump whereas the box for the fabric could be connected to blower type suction fan with a water separator. However, the capacities of the felt and fabric cleaning pump and fan should be adequate.



Figure–4

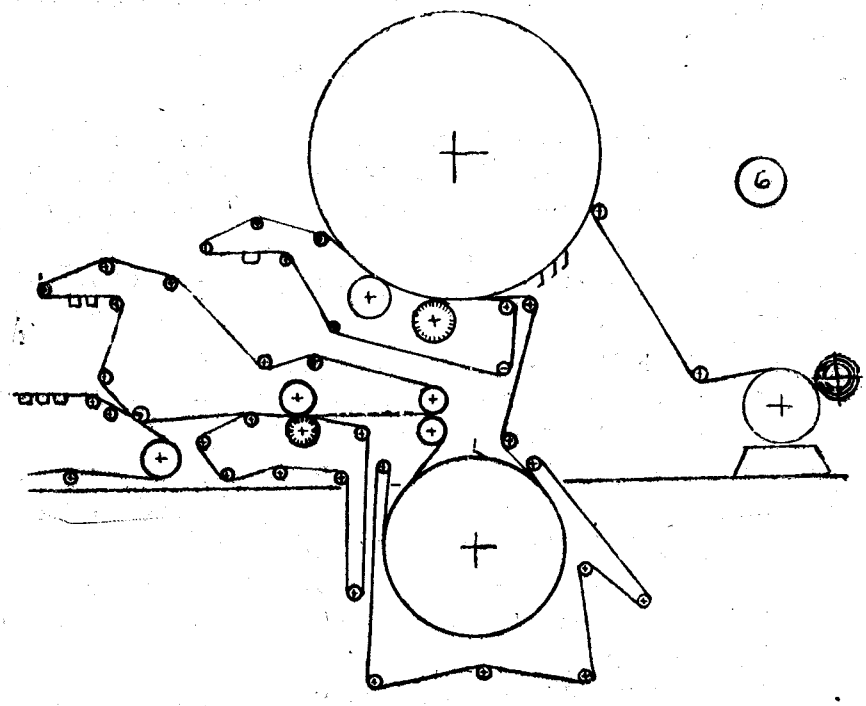
In case of a M.G. machine the arrangement, could be more simpler and very encouraging result could be achieved without much problem. However it has been proved beyond doubt, that two M G. pressure rolls (couch rolls) with independent felt for each roll not only permits longer life and trouble free operation but also makes the machine more versatile as either a ribbed or a plain felt could be mounted at the second nip position (second pressure roll) without interfering with the main suction pick up felt or the felt carrying rolls and pressure rolls. The proposed arrangament is shown in Fig. (5). It will be observed that for light weight sheet no couch or a press has been provided and all the dewatering is done by the grooved/drilled first pressure roll as well as the second pressure roll draped with an independent felt and fabric. The fabric incorporated at the second nip allows high dewatering of the sheet and also obliterates the grooved or the drilled hole markings from the first M.G. pressure roll. It has been our experience that while using a grooved roll for the first pressure roll position and while carrying the same felt through the second pressure roll also, the markings from the first pressure roll persist in the paper. Therefore it is important to carry an independent felt for the second pressure roll. The cleaning of the pick up and the glazing felt could be accomplished very satisfactorily with the full width narrow opening suction boxes. The felt wash press or the aqueous press have not been found to be very effective as it not only compacts the felt but also wears it out faster as compared to the felt cleaning boxes.

In case of a basement type of a M.G. machine, the drying capacity of the M.G. could be further improved without deteriorating the quality of the product by passing the sheet over a large diameter predryer after transferring the sheet through a transfer press to the bottom cylinder. (Figure 6). However this arrange-



YANKEE MACHINE WITH FOIL TYPE PICK UP BOX 1ST DRILLED M.G PRESSURE ROLL AND 2ND M.G PRESSURE ROLL WITH FABRIC FOR LIGHT WEIGHT PAPERS.

Figure–5



M.G MACHINE FOR LIGHT, MEDIUM AND HEAVY WEIGHT PAPERS WITH OR WITHOUT PICKUP/BAGGALE BOX, 1ST GROOVED/BLIND DRILLED PRESS. TRANSFER CYLINDER, SINGLE PREDRYER AND COMMON GLAZING FELT WITH 1ST GROOVED/BLIND DRILLED AND THE 2ND PLAIN M.G PRESSURE ROLL.

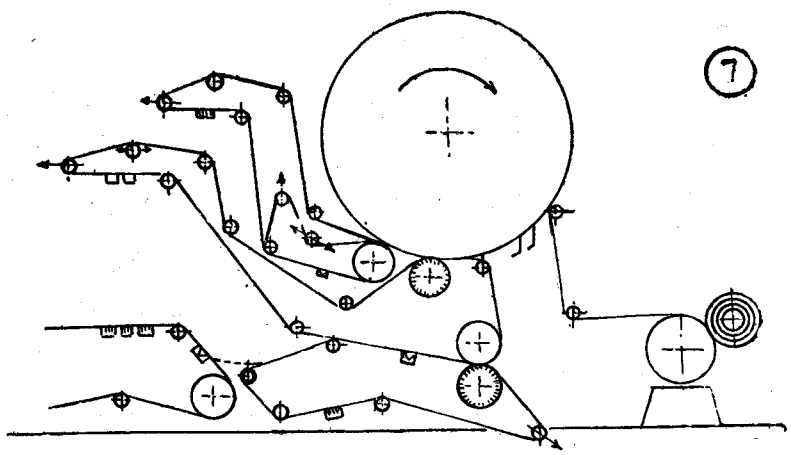
Figure–6

ment complicates the feeding of paper to the M.G. nip and has to be done manually and therefore not suggested for light basis weight papers in particular. A much more efficient and simpler way to increase the capacity of an M.G. machine is to instal a regular grooved/Blind drilled press as shown in (Fig. 7).

The stress placed in this article on the Grooved/Blind drilled presses is simply on account of the improved efficiency and low initial investment & running cost. Besides the factors mentioned here the other reason for incorporating these rolls is that the rolls could be made available indigenously and no reliance has to be placed. The emphasis on the use of a fabric is merely on account of dewatering characteristic and efficiency of dewatering. As can be observed from the sketch attached it will he noticed that the fabric has comparatively large void volume area and the distance the expressed water has to travel at the nip is the shortest. The only shortcoming of a fabric inner belt is its independent set of felt carrying rolls, guide and stretcher etc. and the extra attention which has to be paid to it during normal operation of a paper machine. To avoid these complications a Batt-on-Mesh felt can be easily substituted for the fabric but while doing so hundred percent dependence will be on the imports of these felts till the time our indigenous felt manufacturers have included it in their manufacturing programme. Introduction of a Fabric Belt will

entail import of the inner belt only and the suitable quality of felts could be obtained from indigenous source.

Our suggestions are based partly on our own experience but mostly on the experiments carried out by more experienced technologists abroad. However, the main idea is to draw the attention of our friends here about some ways and means of incorporating recent innovations for improving the performance of our Paper machines. Perhaps better ways of implementing these things can be suggested by the galaxy of our learned technologists present here for the benefit of one and all.



YANKEE MACHINE WITH BAGGALEY BOX, GROOVED/ BLIND DRILLED 1ST WET PRESS AND BLIND DRILLED M.G PRESSURE ROLL IN THE 1ST. PRESSURE ROLL POSITION, FOLLOWED BY A 2ND M.G PRESSURE ROLL WITH A FABRIC FOR LIGHT AND MEDIUM WEIGHT PAPERS.

Figure 7

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