This invention relates to the suction press sections of paper-making machines, its primary object being to bring about elimination from the inlet side of the nip itself of a press a high proportion of the water expressed from the paper web at the nip, by preventing the return to the nip of water remaining in the holes of the suction roll of the press and in the interstices of whatever endless permeable carrier is used to pass through the nip between the paper web and the suction roll. A further object of the invention is to reduce the amount of power consumed in the production of high vacuum in the suction roll. A still further object is to minimise the tendency of the suction roll to produce shadow-marking of the paper. 

Despite the subsection of the holes in the suction roll of the press to high vacuum, water can be retained in the holes until they once again return to the nip, and this retained water must first be removed from the holes when the holes next are subjected to the high vacuum. Consequently the high vacuum is not fully effective in performing its primary purpose of withdrawing into the suction roll as much as possible of the water that is actually being expressed in the nip. Similarly, water is retained in the interstices of the endless bottom carrier, and the return of this water by the carrierto the nip still further detracts from the full effectiveness of the high vacuum in the nip.

According to the present invention, a press section for a paper-making machine comprises a lower suction roll with a perforated shell, an upper roll forming a nip with the lower roll, a suction box in the suction roll having a suction compartment the mouth of which covers an internal arc of the shell that extends forwardly and rearwardly of the nip, and having two further compartments the mouths of which are disposed respectively forwardly and rearwardly of the mouth of the central compartment, an endless bottom carrier, and means to guide the carrier towards and away from the nip so as to cover the shell externally over a total arc corresponding to the arcs covered internally of the shell by the mouth of the central compartment and of at least one of the other compartments, and means to guide a paper web into the nip clear of the bottom carrier until the web and the bottom carrier together reach the mouth of the central compartment. 

The central compartment has a mouth much narrower, say only 2", than the usual single-mouthed suction box, of say 6" width. When connected to a source of high vacuum, say 15" or 20" or more Hg, it can be supplied by a correspondingly smaller suction pump for the extraction of water expressed from the paper web into the carrier in the nip itself, especially because water entrained in advance of the nip can be drawn into the suction roll by connecting the forward compartment to a source of lower sub-atmospheric pressure.

The bottom carrier may be guided so that it covers the shell of the suction roll over the mouth of at least one of the forward and rear compartments, in which case a compartment so covered needs to be connected to a source of low vacuum, say 30" and upwards Hg. However, the carrier may be guided so that at least one of the compartments remains uncovered, in which case a compartment so left uncovered needs to be connected to a source of high velocity air induced by a fan. The purpose of the various operational combinations thus made possible will be described below with reference to FIGURES 1 to 4 of the accompanying drawings, which also show in FIGURES 5 to 8 a further feature of the invention, viz., a second permeable carrier of open work character in direct contact with the shell of the suction roll, with means to guide the second carrier so that it covers the entire area represented by the three compartments of the suction box of the suction roll.

In the drawings, all of which are side elevations of a suction press, with the suction roll and its suction box in section: 

FIGURE 1 shows load-controlling means for the top roll of the press, means for guiding a paper web through the nip of the press, and guide means for an endless bottom felt, the felt being so guided into and away from the nip that it does not wholly cover the shell of the suction roll over either of the forward and rearward compartments of the suction box of the roll; 

FIGURES 2 to 4 show only the actual press of FIGURE 1, and in these figures the shell of the suction roll is covered by the bottom felt at one or other or both of the forward and rearward compartments of the suction roll; 

FIGURE 5 corresponds to FIGURE 1, but includes a second permeable carrier between the bottom felt and the suction roll; and 

FIGURES 6 to 8 correspond to FIGURES 2 to 4, but show the second carrier of FIGURE 1 included in the press roll. 

In FIGURE 1, a paper web 1 moving from the left is guided by rolls 2 into and out of the nip of a top press roll 3 and a lower suction press roll 4. The top roll 3 may be plain, or it could be provided with a suction box, or it could be a so-called porous roll. A lever 5 and a cylinder 6 control the pressure at the nip. An endless bottom felt 7 is guided into and out of the nip by rolls 8, 9, its return run being completed round guides and tension rolls 10. The metal sheel 11 and rubber cover 12 of the roll 4 are pierced by holes 13. 

A suction box 14 inside the roll 4 has a forward compartment 15, a central compartment 16, and a rearward compartment 17, each of which can be connected in the usual way to means for producing an appropriate degree of sub-atmospheric pressure in the compartment. 

In FIGURE 1, the felt 7 is guided by the roll 8 so that it does not cover the roll 4 over the mouth of the forward compartment 15, so that air is drawn directly into the holes 13 of the roll from the wedge of space A existing between the felt and the roll at the forward side of the nip. In this case, high velocity air is used for the compartment 15, by connecting the compartment to a fan, that provides a high volume flow through the holes 13 to extract from them any water still retained in them; at the same time, water expressed through the felt at the forward side of the nip is conducted into the compartment 15, together with any water drawn from the felt 7 by some proportion of the air flow through the felt itself. 

The holes 13 and the felt 7 thus pass over the mouth of the central compartment 16 after free water has been removed into the compartment 15. This enables high vacuum, say 15" to 20" Hg, in the central compartment 16 to operate effectively for the withdrawal of water directly expressed from the paper web 1 into the felt 7 in the actual nip of the rolls 3, 4.
On leaving the nip, the web leaves the felt, which in FIGURE 1 is guided by the roll 9 so that it does not cover the roll 4 over the mouth of the rearward compartment 15, that high velocity air, drawn directly into the holes 13 of the roll 4 from the wedge of space B existing between the felt and the roll at the outgoing side of the nip. Therefore, water retained in the holes immediately after the nip has been passed is immediately subjected to the extracting influence of the air, and withdrawn from the vicinity of the felt into the compartment 17.

In FIGURE 2, the felt is guided by the roll 8 so as to cover the roll 4 over the mouth of the forward compartment 15, the compartment being connected to the roll 8 of vacuum, less than that applied to the central compartment 16, but sufficient to produce a flow of air through the felt to assist in extracting water from the felt. A vacuum of 3" to 9" Hg is suitable for this purpose, at least when the felt is new. The vacuum may be later increased to 12" Hg or more.

The felt 7 is thus subjected to water-withdrawing influence before it meets the paper web 1 and passes with it into the nip proper, so that the carrier enters the nip in the driest possible condition and the full effect of the suction of the central compartment 16 is available for the extraction of water expressed within the nip. Since, over the mouth of the forward compartment 15, a degree of vacuum has already been set up in the holes 13, because of the partial sealing effect of the felt 7 itself, water drawn into the holes at this stage is already "conditioned" for the immediately subsequent application of a higher degree of vacuum from the central compartment 16, and is thus drawn very rapidly into the central compartment, in advance of water then directly expressed into the felt 7 in the nip and then drawn into the compartment 16. On leaving the nip, the felt in FIGURE 2 is so guided by the roll 9 (FIGURE 1) as to leave the same wedge of space as in FIGURE 1, for the extraction of water from the holes 13 by high velocity air into the compartment 17.

In both FIGURE 1 and FIGURE 2, such water as then remains in the felt 7 and in the holes 13 of the roll 4 after these have passed the rearward compartment 17 is subjected to the withdrawing influence provided at the forward compartment 15 as they come around to the inlet side of the nip.

In FIGURE 3, the felt 7 is guided (as in FIGURE 2) towards the nip so as to cover the mouth of the forward compartment 15. The felt is also guided away from the nip (by suitable positioning of the guide roll 9 of FIGURE 1) that it also covers the mouth of the rearward compartment 17. This enables the more powerful water-extracting influence to be applied to the felt 7 as it leaves the nip, by the application of low vacuum of 3" or more Hg.

In FIGURE 4, there is again a wedge of space A below the felt 7 over the mouth of the forward compartment 15, but the mouth of the rearward compartment 17 is covered by the felt (as in FIGURE 3). High velocity air is applied by the compartment 15 and a low degree of vacuum by the compartment 17.

In all of FIGURES 2 to 4, as in FIGURE 1, a high degree of vacuum is applied by the central compartment 16. In these figures, a save-all tray 18 surrounds the lower part of the roll 4 to catch water flung centrifugally from the belt 17 when the roll 4 moves.

In FIGURE 5, a second permeable carrier 19 of openwork character is guided in direct contact with the suction roll 4, rolls 20, 21 guiding it so that it covers the entire arc represented by the three compartments 15, 16, 17. The carrier 19 also passes around guide and tension rolls 22. The carrier 19 may be a woven fabric of wire or of substantially non-absorbent threads or filaments of plastic material, or it may be a perforated flexible rubber or like sheet. The interposition of the openwork carrier between the felt 7 and the holes 13 of the suction roll 4 reduces the tendency to shadow-marking that arises when a bottom felt is directly exposed to the holes, by providing a support for the felt across the mouths of the holes and thus reducing the tendency for differential expression of water as between the areas occupied by the holes and the surrounding surface of the roll.

Although not shown in the small scale of the figures, it will be understood that the mouths of the holes 13 at the outer surface of the roll 4 may be widened in the usual manner, by countersinking or otherwise. The carrier 19 provides a "bridge" across the widened mouths on which the felt 7 is supported.

FIGURE 5 shows the guide roll 21 for the second carrier 19 to be provided with a suction box 23, which serves to extract water retained by the carrier, if the nature of the carrier is such that it retains any significant quantity of water after passing over the rearward compartment 17 of the suction roll 4. An extension tray 24 serves to catch any water draining from the carrier 19 on its way to the roll 21, as well as water flung from the roll 21. The use of a suction roll 21 is optional; if the nature of the carrier 19 permits, it can be a plain guide roll.

The presence of the second carrier 19 in FIGURE 5 does not interfere with the operation of the compartments 15, 16, 17 in relation to the felt in the manner already described with reference to FIGURE 1, because water drawn from the felt 7 passes freely through the carrier 19. The same applies to FIGURES 6 to 8, where the guiding of the felt 7 with respect to the mouths of the compartments 15 and 17 is the same as in FIGURES 2 to 4 respectively.

What I claim is:

1. For a paper-making machine, a press section of the type consisting of a lower perforated suction press roll, a suction box with a plurality of compartments within the suction roll, an upper press roll, having its axis parallel to that of the suction roll, means for applying pressure between the rolls, an endless bottom felt, means to guide the felt through the nip of the rolls and to embrace an arc of the suction roll within which is formed the width of a narrow pressure area resulting from the pressure exerted by the rolls on the felt, the area being symmetrical with respect to the plane containing the axes of the rolls, and means for guiding a paper web to and beyond the nip to cause the web to embrace the arc of the upper press roll co-extensive with the width of the narrow pressure area, the suction box comprising three contiguous compartments, one being a central compartment the maximum width of which is exactly co-extensive to the width and symmetry of the narrow pressure area, so that perforations of the suction roll embraced by the compartment are wholly covered by the felt in the pressure area, another being an exit side compartment, the guiding means for the felt on the exit side of the nip being so disposed as to form between the felt and the perforations embraced by the compartment a space open to the atmosphere, and another being an inlet side compartment, the guiding means for the felt on the inlet side of the nip being so disposed as to bring the felt into proximity with perforations embraced by the compartment as the felt approaches the pressure area.

2. For a paper-making machine, a press section as claimed in claim 1, wherein the guiding means for the felt on the inlet side of the nip is so disposed as to form between the felt and the perforations embraced by the inlet side compartment a space open to atmosphere.

3. For a paper-making machine, a press section as claimed in claim 1, wherein the guiding means for the felt on the inlet side of the nip is so disposed as to cause the felt to cover the perforations embraced by the inlet side compartment.

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