This invention relates to paper making machines, and more particularly, to a suction press roll arrangement for paper making machines.

In U.S. Patent No. 2,694,347, issued to Lloyd Hornbostel on November 16, 1954, and assigned to the assignee of the instant application, there is described and claimed what is known in industry as the "air bleed" press. In the air bleed press a pair of press rolls cooperate to define a press nip and one of the press rolls is a suction roll having a suction area straddling the press nip. In other words, the suction area extends an appreciable distance from the press nip on both the oncoming and off-running sides of the nip. The suction area is covered completely by a felt and the web is guided so as to contact the felt only at the nip and to leave the felt uncovered for most of its run over the suction area on both the on-coming and off-going sides of the nip.

The separation of the web from the felt in these critical areas has been found to improve significantly the operation of the press. At the on-coming side the suction area serves to free the uncovered felt from retained moisture and to open the pores thereof so it will be more effective at the press nip. At the off-running side the immediate separation between the felt and the web serves to assist the function of the felt in drawing away the moisture, presumably because the relatively impervious web tends to create a slight vacuum between the felt and the web if these two elements remain together. This vacuum retards the ease with which water is drawn into the off-running section of the suction area and also tends to pull water directly through the nip.

Although the air bleed press has met with widespread acceptance and commercial success, there is always room for improvement. The air bleed press is so effective at removing water from the web that it permits greatly increased paper machine operating speeds. It has now been found that an additional variable is introduced into the paper machine operation when extremely high speeds are employed. A careful analysis of this situation has led to the discovery that in certain situations there is a tendency for the web to be pulled down onto the oncoming suction area to a variable extent depending upon the number of operating conditions. The instant invention provides means for eliminating this variable and preventing substantially any pulling down of the web onto the oncoming side of the suction area. This is accomplished by the use of specific means for sticking the moist web to the bare roll surface in the suction press comprising an upper bare roll and a lower air bleed suction press roll. In particular, the variable herein mentioned is noticeable when the air bleed suction press roll is a lower or bottom roll in the press.

It is, therefore, an important object of the instant invention to provide a paper machine suction press comprising an upper bare press roll, a lower air bleed suction press roll operating therewith to define a press nip, a felt covering the suction area of the suction roll, and a felt covered perforate rotatable shell defining a second nip with the bare roll at the oncoming side of the suction press nip for pressing the web against the bare roll to retain the same thereon during its travel to the suction press nip. Other and further objects, features and advantages of the present invention will become apparent to those skilled in the art from the following detailed disclosure thereof and the drawings attached hereto and made a part hereof.

On the drawings:

Figure 1 is a diagramatic representation of an embodiment of the present invention;

Figure 2 is a diagramatic representation of a second embodiment of the present invention;

Figure 3 is a diagramatic representation of a third embodiment of the instant invention;

Figure 4 is a diagramatic representation of a fourth embodiment of the instant invention.

As shown on the drawings:

In Figure 1, a press section indicated generally by the reference numeral 10 is shown comprising a first looped felt 11 carrying a web W on the up-running side thereof. The felt 11 may conveniently pick up the web W via a suction roll (not shown) covered by the felt 11 and urged against a suitable forming surface (not shown). The felt 11 carries the web W around a turning roll 12 equipped with a suction area 12a for retaining the web on the felt 11 as it turns around the turning roll 12. Next the web W is carried by the felt 11 into a press nip N-1 defined by a bare roll 13 and a suction roll 14 with a suction area 14a. In this arrangement the suction roll 14 is beneath the bare roll 13. At the nip N-1 the web W transfers from the felt 11 to the surface of the bare roll 13. The web W travels on the surface of the bare roll 13 over the top thereof and through a second nip N-2 defined by an upper suction roll 15 with an air bleed suction area 15a covered by a felt 16 and the bare roll 13. In this arrangement the air bleed suction press roll 15 is above the bare roll 13 and there is not the tendency for the web W to be drawn against the felt 16 at the oncoming side of the air bleed suction area 15a.

Next the web W is taken from the surface of the bare roll 13 and around a guide roll 17 and then onto a felt run 18a of a third press felt 18. The felt run 18a extends in a generally horizontal direction between a felt guide roll 19 and a perforate rotatable shell 20, herein shown as a suction roll 20.

As will be appreciated, suction rolls are formed by a perforate rotatable shell mounted for rotation around a fixed suction gland which defines the location of the suction area. Here the suction area defining gland 20a is shown in dotted lines diagrammatically; but it will be understood that the general structure of suction rolls is recognized in the art and need not be further described herein.

Next in the press section here shown, there is an upper bare roll 21 and a lower air bleed suction press roll 22 cooperating therewith to define a press nip N-3 receiving the wet web W. The air bleed suction roll 22 has a suction area 22a straddling the nip N-3. The felt 18 is trained through the nip N-3 completely laps or covers the suction area 22a. As will be seen the felt 18 passes over perforate rotatable shell 20 and then away from the bare roll 21 around a guide roll 23 and then back through the nip N-3. The customary additional guide and tensioning rolls (not shown) also mount the remainder of the felt 18. The felt covered perforate rotatable shell 20 defines a low pressure nip N-4 with the bare roll 21 at the oncoming side of the nip N-3 for pressing the web W against the bare roll 21 to retain the web W thereon during its travel from the nip N-4 through the nip N-3. It is in
this region of travel that the generally downwardly directed web $W$ tends to pull down farther onto the felt 18 at the oncoming side of the suction area 22a; and it is for this reason that the felt covered perforate rotatable shell 20 is employed to press the web $W$ against the bare roll 21.

As will be noted, the nip N–3 lies in a plane P (indicated in dotted lines) which is generally tangential to both the rolls 21 and 22; and it is important to keep the web $W$ on the bare roll side of this plane P immediately before and after the nip N–3. Suitable means such as the dryer drum 24 here shown are mounted at the off-running side of the nip N–3 on the bare roll side of the plane P to guide the web in the direction desired. Of course, it will be appreciated that the web $W$ tends to adhere to the bare roll 21 naturally after it passes through the nip N–3, but the guide means 24 are also conveniently employed. As shown here, the first dryer drum 24 receives the web $W$ whereupon it is covered by a dryer felt 25 turning upon a dryer guide roll 26 in the customary manner.

The felt covered perforate rotatable shell 20 serves as means on the oncoming side of the nip N–3 mounted on the bare roll side of the plane P for pressing the web $W$ against the bare roll 21 to cause the web $W$ to adhere thereto. In this structure, the felt 18 is uncovered for most of its run over the suction area 22a on both the oncoming and off-running sides of the nip N–3. Actually, the nip N–3 involves only about 5 to 20% of the felt area at the oncoming or the off-running sides of the suction area 22a.

The felt covered perforate rotatable shell 20 is, as here shown, a suction roll 20, with the suction area 20a at the oncoming side of the nip N–4, primarily for the purpose of smoothing the web $W$ and holding the web $W$ securely against the felt roll 18. The pressure at the nip N–4 can, of course, be relatively high so as to obtain an appreciable dewatering effect, but for the purposes of the instant invention it is necessary only to employ sufficient pressure at the nip N–4 to cause the web $W$ to adhere securely to the bare roll 21 and such pressure will involve a relatively small amount of dewatering (which can be handled by the suction area 20a).

Referring now to Figure 2, there is shown a paper machine section indicated generally by the reference numeral 30, which comprises a first press defined by an upper bare roll 31 and a lower suction press roll 32 covered by felt 33. The felt 33 carries on its top surface a web $W'$ through the nip N–5 defined by the press rolls 31 and 32.

Next the web $W'$ is carried along a substantially horizontal run 33a of the felt 33 to and over a perforate rotatable shell 34 (the perforations of which are shown diagrammatically). The felt 33 is reversed about the perforate rotatable shell 34 and returns over a guide roll 35 and then back over the customary tensioning and guide rolls (not shown) employed for mounting felts.

Next in the section 30, which is shown in Figure 2, there are an upper bare roll 36 and a lower air bleed suction press roll 37 cooperating to define a nip N–6 for receiving the web $W'$. The suction area 37a in the air bleed suction press roll 37 straddles the nip N–6 and is completely covered by a press felt 38 separate and apart from the press felt 33 previously described, which is also mounted on the customary tensioning and guide rolls, only one of which is here shown. The web $W'$ traveling on the first felt run 33a passes over the perforate rotatable shell 34 and is adhered to the bare roll 36 at a nip N–7 defined by the bare roll 36 and the felt covered perforate rotatable shell 34. The web $W'$ thus adhered to the bare roll 36 travels on the surface thereof through the nip N–9 so that the web $W'$ contacts the press felt 38 only at the nip N–4 and the felt 38 is uncovered by the bare roll 36 and the web $W'$ in most of its run over the suction area 37a on both the oncoming and off-running sides of the nip N–6. The web $W'$ continues after the nip N–6 to a dryer roll 40 whereas it is covered by a dryer felt 41 turning on a dryer guide roll 42 in the customary manner.

The roll 34 is a perforate rotatable shell, which may have the same structure as the ordinary drilled suction roll, except that no suction gland is mounted interiorly. Instead, only the perforate rotatable shell 34 is employed and this shell 34 is perforate so that air (and moisture) can pass through the perforations in the shell 34 just before and after the nip N–7. As indicated in connection with the previously mentioned nip N–4, a great deal of pressure is not required at the nip N–7 because the web $W'$ tends to adhere to the surface of the roll 36. For this reason, it is a relatively small amount of dewatering takes place; but there is a tendency for water and air to build up between the web $W'$ and the felt run 33a just before and after the nip N–7. If this air (in particular) cannot escape readily it tends to cause the web $W'$ to float temporarily on the felt 33 rather than lying smoothly against the felt 33. This can cause imperfections in the web and difficulties at the nip N–7. For this reason a perforate rotatable shell 34 is employed to permit the escape of air.

It will also be noticed that the perforate rotatable shell 34 is swingably mounted on a bellcrank 43 carried on a fixed pivot 44. One arm of the bellcrank 43 carries a rotatable shell 34 and the other end is connected to actuating means such as a diaphragm 45 here shown. The diaphragm 45 is actuated by fluid under pressure such as air entering line 46 which in turn urges the diaphragm arm of the bellcrank 43 down and the perforate shell 34 against the bare roll 36. This arrangement permits the convenient application of the desired pressure at the nip N–7 and also permits movement of the perforate shell 34 away from the bare roll 36 when such is desired, for example, during start-up of the machine. In the latter instance, the "brake" may be conveniently dropped from the felt covered shell 34. The swingable or shiftable mounting for the perforate rotatable shell 34 is an advantageous feature in the use of the perforate rotatable shell rather than a suction roll (because of additional complications in mounting of the suction gland for such swinging movement).

Referring now to Figure 3, which shows another embodiment indicated generally by the reference numeral 50, it will be seen that a web $W''$ passes over a press roll 51, around the guide roll 52 and onto a generally horizontal run 53a of felt 53 mounted on guide rolls 54 and 55, a tensioning roll 56 and a perforate rotatable shell 57. The perforate rotatable shell 57 and guide roll 54 define a generally horizontal belt 58 which receives the web $W''$ and conveys the same to a bare roll 58 defining a press nip N–8 with the perforate rotatable shell 57, whereat the web $W''$ is adhered to the bare roll surface.

The bare roll 58 defines a press nip N–9 with a suction press roll 59 therebetween having an elongated suction area 59a straddling the nip N–9 in the manner herebefore described. The web $W''$ is caused to adhere to the bare roll surface 58 at the first nip N–8 and remains thereon through the second nip N–9, from which it passes onto a dryer roll 60 and is covered by a dryer felt 61 turning on a dryer guide roll 62. As previously described, a press felt 63 covers completely the air bleed suction area 59a in the suction roll 59 and this press felt 63 is mounted on suitable guide and tensioning rolls, only one of which, the roll 64, is here shown. The felt 63 is separate and apart from the carrier felt 53 which is employed to convey the web $W''$ to the bare roll 58.

The perforating shell 57 can, of course, be mounted for movement as was the felt 33 with the mounting for the rotatable shell 34 in Figure 2.

Referring now to Figure 4, it will be seen that a more complete press section, indicated generally by the refer-
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ence numeral 100, is shown comprising a looped pickup felt 101 urged by a suction pickup roll 102 (with suction area 102a) against a forming wire 103 passing over a couch roll 104 (with suction area 104a) and a turning roll 105. The wire 103 has a web W" thereon which is picked up by the pickup felt 101 and carried on the bottom side thereof around a suction turning roll 106 (with suction area 106a) which retains the web W" on the felt 101 as it turns around the roll 106. The web W" is then passed through a press nip N-10 defined by a bare roll 107 and a suction roll 108 (with suction area 108a). At the nip N-10 the web W" is retained on the surface of the bare roll 107 and the felt 101 is separated therefrom. The felt 101 travels around guide rolls 109, 110, 111 and 112 and through a dryer nip N-11 formed by a press roll 113 and a suction roll 114 (with suction area 114a).

The web W" is then taken through a very short open draw at X and dropped down to a press felt 115 which travels over a guide roll 116 in generally horizontal alignment through a press nip N-12 defined by an upper bare roll 117 and a lower suction roll 118 (with suction area 118a) and then over a perforate rotatable shell 119 having the structure hereinbefore described. The rotatable shell 119 is preferably mounted for movement on a bellcrank (not shown) in the manner described in Figure 2. The press felt 115 is also mounted on guide rolls 120 and 121 in the conventional manner. The rotary perforate shell 119 transfers the web W" onto the surface of a bare press roll 122 at a nip N-13. Beneath the bare roll 122 is a suction roll 123 having an air bleed suction area 123a defining an air bleed nip N-14 with the bare roll 122. A press felt 124 mounted on guide rolls 125 and 126 covers the air bleed suction area 123a at the nip N-14 in the manner hereinbefore described. The web W" is taken away from the nip N-14 on the surface of the bare roll 122 and fed into the dryers.

In the arrangement 100 of Figure 4, certain advantages are obtained. First of all, the web W" is passed first through a reverse nip N-10 whereas the wire side of the web W" is initially pressed against a surface of a bare roll 107. During startup the brake may be removed from the bare roll 107 by a self-dumping doctor 127. During regular operation, the paper web W" is lifted from the surface of the bare roll 107 carried through a very short open draw (which actually amounts to or little more than dropping the web across a small space) onto the felt 115. The web W" and the felt 115 is initially subjected to a dewatering operation wherein the top side of the web is pressed against a bare roll 117. Then, the web W" is passed from the nip N-12 generally horizontally without an open draw to the air bleed press defined by the rolls 122 and 123. The web W" is pressed onto the surface of the bare roll 122 by the perforate shell 119 covered by the felt 115 so as to insure consistent travel of the web W" through the air bleed press 122-123.

It will be understood that modifications and variations may be effected without departing from the spirit and scope of the novel concepts of the present invention.

I claim as my invention:

1. A paper machine suction press comprising an upper bare press roll, a lower suction press roll cooperating therewith to define a first press nip receiving a wet paper web, said suction roll having a suction area straddling said first nip, a felt trained through said first nip and completely lapping the suction area of said suction roll, the web contacting the felt only at said first nip and said felt being uncovered by said bare roll and the web for most of its run over the suction area on both the oncoming and off-going sides of said first nip, and a felt covered perforate rotatable shell defining a second nip with said bare roll at the oncoming side of said first nip for pressing the web against the bare roll to retain

2. A paper machine suction press comprising an upper bare press roll, a lower suction press roll cooperating therewith to define a first press nip receiving a wet paper web, said suction roll having a suction area straddling said first nip, a felt trained through said first nip and completely lapping the suction area of said suction roll, the web contacting the felt only at said first nip and said felt being uncovered by said bare roll and the web for most of its run over the suction area area on both the oncoming and off-going sides of said first nip, and a felt covered perforate rotatable shell defining a second nip for pressing the web against the bare roll to retain

3. A paper machine suction press comprising an upper bare press roll, a lower suction press roll cooperating therewith to define a first press nip receiving a wet paper web, said suction roll having a suction area straddling said first nip, a felt trained through said first nip and completely lapping the suction area of said suction roll, the web contacting the felt only at said first nip and said felt being uncovered by said bare roll and the web for most of its run over the suction area area on both the oncoming and off-going sides of said first nip, and a perforate rotatable shell lapped by said felt defining a second nip with said bare roll at the oncoming side of said first nip for pressing the web against the bare roll to retain

4. A paper machine suction press comprising an upper bare press roll, a lower suction press roll cooperating therewith to define a first press nip receiving a wet paper web, said suction roll having a suction area straddling said first nip, a felt trained through said first nip and completely lapping the suction area of said suction roll, the web contacting the felt only at said first nip and said felt being uncovered by said bare roll and the web for most of its run over the suction area area on both the oncoming and off-going sides of said first nip, a second felt receiving the paper web, and a perforate rotatable shell lapped by said second felt defining a second nip with said bare roll at the oncoming side of said first nip for pressing the web against the bare roll to retain

5. A paper machine suction press comprising an upper bare press roll, a lower suction press roll cooperating therewith to define a first press nip receiving a wet paper web, said suction roll having a suction area straddling said first nip, a felt trained through said first nip and completely lapping the suction area of said suction roll, the web contacting the felt only at said first nip and said felt being uncovered by said bare roll and the web for most of its run over the suction area area on both the oncoming and off-going sides of said first nip, a second felt receiving the paper web, and a perforate rotatable shell lapped by said second felt defining a second nip with said bare roll at the oncoming side of said first nip for pressing the web against the bare roll to retain

6. A paper machine suction press comprising an upper bare press roll, a lower suction press roll cooperating therewith to define a first press nip receiving a wet paper web, said suction roll having a suction area straddling said first nip, a felt trained through said first nip and completely lapping the suction area of said suction roll, the web contacting the felt only at said first nip and said felt being uncovered by said bare roll and the web for most of its run over the suction area area on both the oncoming and off-going sides of said first nip, a second
felt, a perforate rotatable shell lapped by the second felt defining a second nip with said bare roll at the oncoming side of said first nip for pressing the web against the bare roll to retain the web thereon during its travel from the second to the first nip, a second suction roll within the loop of said second felt and a second bare roll defining a third press nip with the second suction roll to press the web therein before it is conveyed to the second nip on the second felt.

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