March 30, 1965 G. D. MUGGLETON 3,175,532

ROLLER APPARATUS FOR COATING PAPER WEB

Original Filed April 14, 1960 2 Sheets-Sheet 1

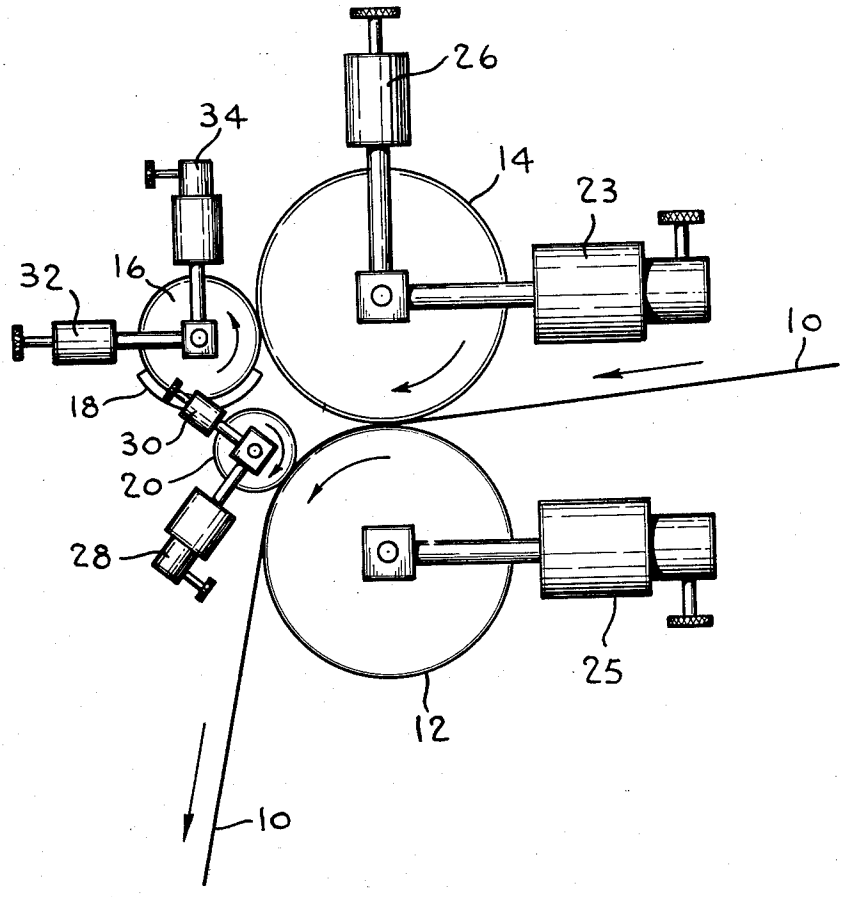


FIG. 1

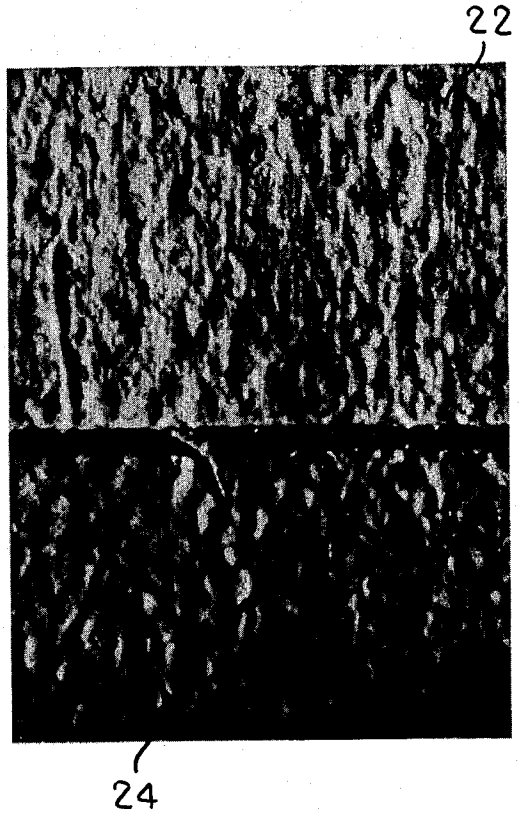
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FIG. 2



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ROLLER APPARATUS FOR COATING PAPER WEB

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Continuation of application Ser. No. 22,158, Apr. 14, 1960. This application May 17, 1963, Ser. No. 288,848
1 Claim. (Cl. 118—119)

This application is a continuation of the application of Gerald D. Muggleton, Serial No. 22,158, filed April 14, 1960, for Coating Process, now abandoned.

This invention relates to improvements in the roll coating of a travelling web of paper and particularly to the smoothing of the coating as applied to the web so that undesirable pattern is eliminated or so reduced that it will be commercially acceptable.

As used herein "coating" refers broadly to a suspension of: starch, casein or other adhesives; clay, pigment or minerals; and additives. This is sometimes referred to in this art as "color." Generally the adhesives range from 15% to 20% and the minerals from 85% to 80% of the total solids dry. The solid content may vary from 40% to 65% and the viscosity ranges from 500 to 10,000 centipoise. Viscosity is controlled by modification of the adhesive. The coating is applied to the web of paper which in current commercial practice is travelling at speeds ranging from 400 f.p.m. to 2,000 f.p.m. The moisture content of the web at the stations of application of the coating may vary from 5% to 25%.

With regard to these general conditions it is an object of this invention to apply a maximum quantity of color to the web to form a uniform coated optimum printing surface free of commercially non-acceptable pattern or pebbly surface.

Another object of this invention is to provide a means for so coating a web of paper which: (1) operates with a minimum of power and is resistant to wear thus insuring uniformity of surface from reel to reel and day to day; (2) effects smoothing, levelling, and even distribution of the coating from high to low spots in the web; (3) operates with a low application of pressure insufficient to injure the fibres of the web of paper; (4) does not create a hazard to uninterrupted continuous travel of the web; and (5) is economical to install and maintain.

These objects are obtained by using with well known coating rolls, through the nip of which the web passes, a smoothing roll positioned below the nip so that it will ride on the coating applied to the web above the place where such web is no longer supported on one of such rolls and spread and smooth such coating while it is still in a mobile or wet, slippery state. This smoothing and spreading is done near the nip within a space of time substantially not in excess of one tenth of a second. At speeds of approximately 400 f.p.m. this smoothing roll will be less than 50° angularly spaced from the nip. During this time the web absorbs some water from the coating which makes the inner layer of the coating viscous or doughlike. However, during this short interval of time the entire coating will not set and become tacky and sticky. The outside surface will remain mobile or wet and will be slippery.

Thus a small diameter smoothing roll pressing against the outer surface of such coating while the web is still on one of the coating rolls will smooth and level the

high spots caused (1) by the inherent roughness of the web (cockle), (2) uneven distribution of coating on the roll, and/or (3) the pattern caused by surface tension in the coating as it splits at the nip. The smoothing action forces the high areas of the coating into the low areas making a uniformly smooth surface which is commercially acceptable.

The pattern caused by the split of the coating at the nip between such small diameter smoothing and levelling roll and the web on the supporting roll is not of practical significance. The small diameter, say 6 inches, of the smoothing roll as compared with the large diameter of the web supporting roll of the coater, say 18 inches, and the fact that the surface of such roll is wet with water and/or picked-up coating of lower viscosity than the coating on the web appears to prevent detrimental pattern. Furthermore, pattern at this area of split can be avoided by driving the small roll in the same direction of travel but at a different peripheral speed than the speed of the web.

One example of the embodiment of this invention and its operation as applied to a roll coater will be described in connection with the accompanying drawings in which:

FIG. 1 is a diagrammatic view in side elevation of a roll coater and smoothing member embodying the present invention, and

FIG. 2 is a reproduction of a photomicrographic top plan view of the surface of a web paper coated by the roll coater using the smoothing member and the surface of a web of paper coated at such roll coater without using the smoothing member.

In this exemplification the web of paper **10** is shown as it continuously advances through a standard paper making machine. In this instance the roll coater is stationed in the so-called dry section of the machine in advance of the calender stack which can act most efficiently on the coated surface of the web as smoothed by use of this invention. However, it is not essential that the coating be done in the paper making machine. This apparatus can effectively coat as a separate process a web of previously rolled paper.

The web of paper **10** at the station shown in this example is travelling at a speed of approximately 420 f.p.m. This is slower than the usual commercial practice but in this case a slower speed was selected to illustrate the effectiveness of the smoothing action at a lower speed where the smoothing is more difficult. The web at this station has a moisture content of approximately 16%.

The roll coater consists of a supporting or backing up roll **12** and a coating roll **14** forming a nip through which the web **10** passes. The web **10** is guided by the usual guide rolls (not shown) so that it follows and stays in engagement with the surface of roll **12** for approximately one quarter of its circumference. The coating is applied to the coating roll **14** by an applicator roll **16** continuously supplied with coating (as heretofore defined) from a pan **18**.

The rolls of the roll coater are all mounted in a manner well known in this art and are separately controlled as to speed, direction of rotation and inter-roll pressures at each nip (see U.S. Patent No. 2,398,844). The supporting or backing up roll **12** is mounted in fixed bearings and driven at variable and reversible speeds by a variable speed reversible drive shown diagrammatically at **25**. The coating roll **14** is suspended in movable bearings which permit

it to be moved toward and away from the supporting roll **12** by hydraulically operated cylinder and piston devices shown diagrammatically at **26**. The coating roll **14** is also independently driven at adjustable and reversible speeds by a variable speed reversible drive shown diagrammatically at **23**. The applicator roll **16** is independently controlled as to speed and direction of travel by means of a variable speed reversible drive diagrammaticaly illustrated at **34**. The pressure of this roll with respect to the coating roll **14** is controlled by hydraulically operated cylinders and pistons shown diagrammatically at **32**. Thus the roll coater can be adjusted to control the thickness of the film of coating applied to the travelling web. While under some circumstances and conditions the surfaces of these rolls may be varied, it has been found advantageous to provide the back-up roll **12** with a hard or metal surface and coating roll **14** and applicator roll **16** with soft or rubber surfaces.

In this exemplification these rolls are approximately 18" in diameter. This is a fairly standard size. The diameter, however, may vary with roll length and nip pressures prescribed.

The film of coating as applied to the coating roll **14** is pressed on the travelling web **10** at the nip between rolls **12** and **14**. However, this film because of its viscosity, splits. Part adheres to the roll **14** and part is deposited on and clings to the travelling web which starts to absorb the moisture of the coating. As the split occurs surface tension causes an undesirable pattern on the coated surface of the web. This pattern is also affected by the inherent unevenness in the web (cockle). It has high and low spots of such degree of difference that even subsequent calendering will not result in a good commercial printing surface.

In FIG. 2 the lower section indicated at **24** is a photomicrographic reproduction of the surface of a web coated in the manner herein described without using any smoothing member on the surface of the coating while the web is still on the supporting roll **12**. This view shows the relative depth of the low areas with respect to the high areas which constitute undesirable pattern.

This undesirable pattern is changed to an acceptable pattern (as shown in the upper section **22** of FIG. 2, a photomicrographic reproduction of the surface of a web coated and smoothed as herein described) by working the surface of the coating on the web between the place where it leaves the nip between rolls **12** and **14** and the place where it leaves the roll **12**. As previously explained, the coating has not set in the short time required for this travel. The upper layer at least is still watery or milky and slippery and can be worked to move the high areas into the low areas and spread the coating to make a smooth acceptable printing surface or a surface which after calendering is a good commercially acceptable printing surface. This working can be done at pressures which are not detrimental to the fibres of the web and without undue use of additional power by a small diameter (6 inch) roll **20** which evenly contacts the web **10** for its width at a place below the nip of rolls **12** and **14** and the place where the web leaves roll **12**. This roll is supported in the usual manner and is separately controlled as to peed, direction of rotation, radial movement toward and away from the roll **12**, and the pressure to be applied on the web by a variable speed reversible drive shown diagrammatically at **28** and by pressure controlling hydraulically operated cylinders and pistons illustrated diagrammatically at **30**.

Depending upon the conditions of the web and coating as heretofore pointed out, the roll **20** can be run in the same direction of travel as the web, at the same peripheral speed as the supporting roll **12**, at a faster or slower speed to create slippage between roll **20** and the coating on the web **10**, and can be reversed. In the coating of the web reproduced in FIG. 2, section **22**, the circumferential speed of the roll **20** was approximately 240 f.p.m.

as compared to a web speed of 420 f.p.m. The smoothing roll was travelling in the same direction as the web. This slippage was sufficient to prevent any appreciable split and pattern occurring between the roll **20** and web **10**. The pressure of the roll **20** toward the web **10** is variable but only that minimum required to make complete widthwise contact with the web is necessary.

An advantage resulting from the use of a smoothing roll is that its surface is continually moistened or wetted by contact with the coating. However, if this proves ineffective in the smoothing operation a small amount of water may be applied to the roll **20** by well known spray or condensation methods to maintain the required sliding relationship with the coated surface. Another advantage of the controlled roll **20** is that in starting it may be run at the same direction and speed as the web to prevent any damage to the web and coating occurring because of the high friction present before the roll **20** becomes wetted.

It is desirable to place the roll **20** as near the nip of rolls **12** and **14** as is posible giving consideration to available space, roll length and attendant diameter requirements. The closer to such nip the greater the web speed can be and still obtain good smoothing action.

The surface of the roll **20** may be metal or a more resilient material such as rubber. It is also practical to provide the roll **20** with a limited oscillating axial movement to help spread the high areas crosswise of the web toward low areas. This can also be accomplished by putting a spirallike design on the surface of the roll **20** which would have such crosswise levelling function when the roll **20** is run at peripheral speeds different from that of the web.

It is also within the contemplation of this invention to coat both sides of the web **10**. This can easily be done by adding to the supporting roll **12** a coating applicator substantially like that used with the coating roll **14**. This applicator could also be used to apply a thin film of water to the roll **12** to insure that the web **10** adheres to the roll **12** and avoid so called fluttering as the web leaves the nip.

I claim:

A roll coater for installation in a standard paper making machine to coat a web of paper travelling through the machine comprising,

a supporting roll and a coating roll positioned above the supporting roll and forming a nip therebetween located substantially at the top of said supporting roll, said supporting roll being adapted to engage and carry through said nip a web of paper continuously travelling through the standard paper making machine and thereafter support the web for a substantial part of its circumference located below said nip and above a horizontal plane passing through the axis of rotation of said supporting roll,

means for supplying coating to said coating roll,

means for relatively adjusting said supporting and coating rolls as to speed, direction of rotation and inter-roll pressure to control the thickness of the film of said coating to be applied to a web,

a smoothing roll adapted to work the surface of the coating on a web of paper travelling through a standard paper making machine to remove the undesirable pattern imparted to such coating as it leaves said nip, said smoothing roll being positioned below said nip and above a horizontal plane passing through the axis of rotation of said supporting roll and adapted to be in rolling contact with the coated surface of a web of paper while supported on said supporting roll below said nip and above the place where the web of paper is no longer supported by said supporting roll, said smoothing roll engaging the coating with a minimum pressure not detrimental to the fibres of the web of paper, and

means for driving said smoothing roll at peripheral speeds different from the speed of the web supporting surface of the supporting roll and in the same direction of travel to work the surface of said coating and move high areas into low areas and remove unacceptable pattern while having sufficient slippage to prevent appreciable split and pattern occurring between said smoothing roll and said coating.

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RICHARD D. NEVIUS, *Primary Examiner.*