July 11, 1972 W. E. SPEARIN ET AL 3,676,184

METHOD FOR CONTROLLING VARYING LIQUID PENETRATION OF A CONTINUOUS PAPER WEB

Filed Aug. 22, 1969

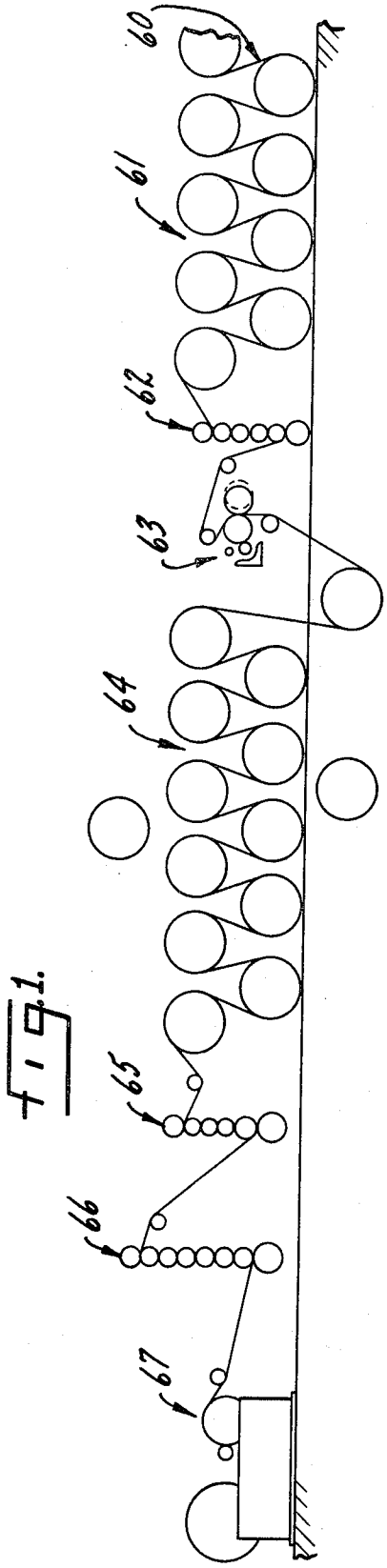



Fig. 1.

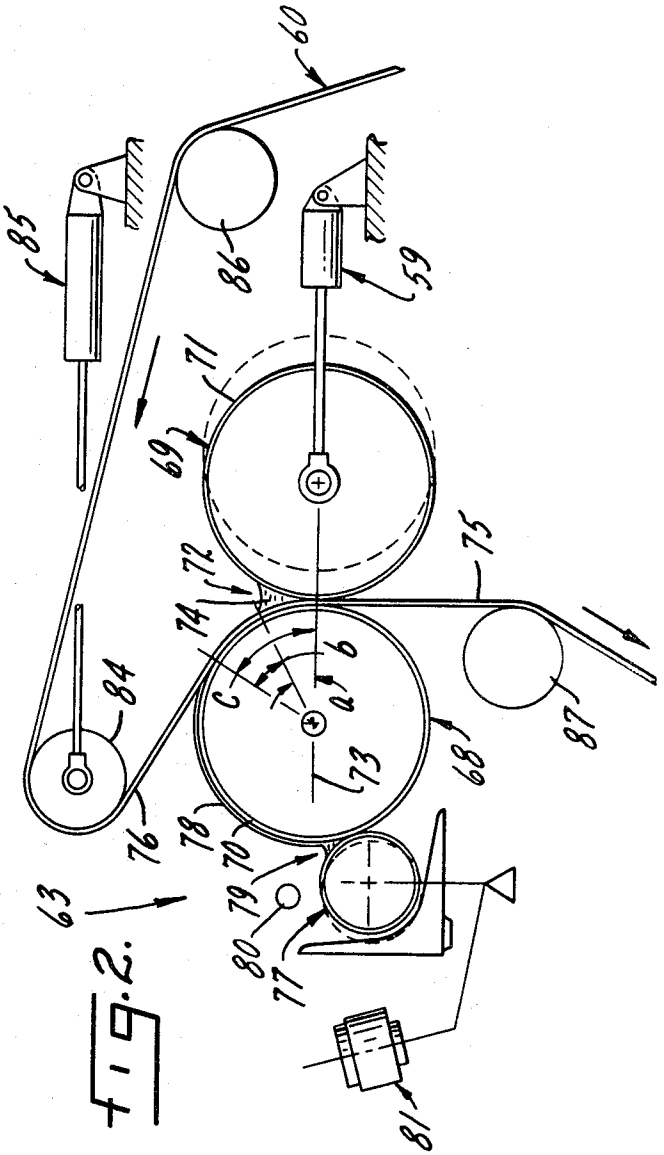



Fig. 2.

INVENTORS.
WALTER E. SPEARIN
HAROLD S. VANDERHEI
BY Parker, Carter & Markey
Attorneys.

United States Patent Office 3,676,184 Patented July 11, 1972



3,676,184

# METHOD FOR CONTROLLING VARYING LIQUID PENETRATION OF A CONTINUOUS PAPER WEB

Walter E. Spearin and Harold S. Vanderhei, Roaring Spring, Pa., assignors to Combined Paper Mills, Inc., Combined Locks, Wis.

Filed Aug. 22, 1969, Ser. No. 852,426
Int. Cl. B05c 9/04
U.S. Cl. 117—68 4 Claims

## ABSTRACT OF THE DISCLOSURE

A method for controlling coating liquid penetration into the substrate of a continuous web which includes application of a barrier liquid to the first side of the web prior to the time the coating liquid is applied to the second side of the web.

This invention relates to the coating of paper during its manufacture, and specifically to a method for controlling penetration of a liquid or liquids into the substrate of a continuous web, such as a coating liquid applied at a coating station.

Sliding roll coaters are known which include a pair of substantially uniform diameter rolls in a coating station. The rolls, when brought into peripheral contact with one another, form a nip area through which a continuous web of paper to be coated is passed. In a conventional coating station, a positioning roll or other equivalent device may be located upstream from the nip area so as to ensure movement of the moving web vertically downwardly into and through the nip area, the moving web being coated on one or both sides as it moves through the nip area. The positioning roll upstream from the nip area may however be so positioned as to cause the moving web of paper to be lapped against one of the rolls in the coating station, usually the hard surfaced supporting roll, so that only a single pool of coating or other liquid medium is formed, and only one side of the web is coated. In this instance it may be desirable to apply a barrier coat to the surface of the web opposite to the surface to which the coating liquid is applied to prevent strike through of the coating. Various expedients may be employed, one of which involves the formation of a pool of barrier liquid in a nip area formed between a barrier liquid roll which is in peripheral contact with the supporting roll. A thin film of barrier liquid is picked up from the pool by the supporting roll and carried around and applied to the opposite surface of the web as it passes through the coating station nip area at the time the web makes contact with the pool of coating liquid.

Further modifications of the above described system may be employed to advantage, such as the maintenance of a speed differential between the supporting roll and the coating roll in the coating station and the use of a softer surface on the sliding coater roll, and it will be understood that these expedients may be employed concurrently with the employment of the instant invention.

The liquid applied to the web at the coater station, which for convenience will hereinafter be referred to as the coating liquid, may have penetrating qualities with regard to the substrate of the web which may be detrimental to the quality of the final product. The coating



liquid may for example contain encapsulated dye materials which should not be permitted to strike through the paper and reach the opposite side because of the possibility of premature rupture of the encapsulated materials and the resultant degradation of the quality of the surface of the paper.

Applying a barrier liquid to the opposite side of the web tends to counteract this penetrating or strike through characteristic of the coating medium. However, when the application of the barrier liquid to the opposite side of the web commences at substantially the same instant the coating material is applied to the web, strike through of the coating material may not be acceptably controlled. The penetrating ability of the coating material is governed by several factors which may vary from coating to coating, such as the nature of the liquid (i.e. the viscosity, temperature, and polarity), the thickness of the film, and the contact time between the liquid and the continuous web. If these factors combine to cause quick strike through, a poor quality paper may result.

Accordingly a primary object of this invention is to provide a method and apparatus for controlling penetration of a liquid or liquids into the substrate of a continuous web, particularly a liquid or liquids applied at a coating station at a paper making machine.

Another object is to provide a method and apparatus as above described which is simple in construction and operation and may be quickly placed into and out of operating position during normal down time of a paper making machine, whereby no additional down time, and expense, due to set up of the system is incurred.

Yet another object is to provide an apparatus which will accomplish the foregoing objects and which can be fabricated by a relatively slight, and inexpensive, change in the basic equipment currently used in many paper mills.

Other objects and advantages of the invention will be apparent from the following description of the invention.

The invention is illustrated more or less diagrammatically in the accompanying figures, wherein:

FIG. 1 is a schematic view of a portion of a paper making machine which includes the present invention, and

FIG. 2 is an end view, partly diagrammatic in nature, to an enlarged scale of an exemplary apparatus for practicing the invention.

Like reference numerals will be used to refer to like parts throughout the following description of the figures.

Referring first to FIG. 1, a web having a substantial moisture content is indicated generally at **60** passing through a dryer section **61** in a paper making machine. After leaving the drying section **61** the web **60** enters a breaker stack, indicated generally at **62**, after which it enters a coating station which might be a size press indicated generally at **63**. After leaving the size press **63** the web **60** enters additional drying means, indicated at **64**, after which it enters a first calendar stack **65**, then a second calendar stack **66**, and finally into reel section **67**.

Referring now to FIG. 2, the size press section **63** includes a supporting roll **68** and a coating or applicator roll **69**. The supporting roll may be a hard surfaced roll such as, for example, a steel walled cylindrical shell covered by a 5/8" thick 304 stainless steel cover **70**, the entire assembly being approximately 26" in diameter. Preferably the surface is ground to a fine finish with a flat profile. The applicator roll **69** is of the same diameter and may for example be constructed of a steel walled cylindrical shell

covered with about a 1" thick rubber cover which may for example be equivalent to Stowe-Woodward Micromate S brand with a rubber hardness of nominal 35 P and J Plastometer (92 Shore A Durometer). The rubber cover **71** is prepared by grinding to a fine final finish with a slight crown.

The nip **72** formed by the peripheral contact of these two rolls is controlled in width by the amount of force exerted along the horizontal plane **73** passing through the axes of the rolls by a lever system actuated by any suitable mechanism, such as a piston-cylinder arrangement indicated diagrammatically at **59**. As a specific example, a nip pressure of approximately 80 lbs. per linear inch may be used. The piston-cylinder arrangement **59** functions to move applicator roll **69** from the solid line coating position to the dotted line disengaged position. A pool of liquid, which may for purposes of description be considered to be a coating liquid, is indicated at **74**. Any suitable means may be employed for replenishing the pool as the coating is applied to surface **75** of the moving web **60**.

Means are indicated at **77** for applying a liquid medium to the side **76** of the web in contact with supporting roll **68** so as to provide a sealing or barrier action and/or curl control at the same time that the coating liquid **74** is applied to the opposite sides **75** of the web. The application of a film of sealing or curl-control liquid, **78**, which will hereafter be referred to as a barrier liquid, is accomplished by forming a pool **79** of the barrier liquid in the nip between rolls **77** and **68**. The barrier liquid may be supplied from any suitable means such as the header **80** which is indicated schematically. The barrier liquid cylinder **77** is moved into and out of nip forming engagement with roll **68** by an air piston-cylinder arrangement indicated generally at **81**. Roll **77** may for example be a slightly crowned steel-wall cylindrical shell covered with approximately a 1" thick layer of neoprene self-skinning rubber with a P and J Plastometer reading of 80 (Shore A Durometer reading of 63). In operation, a typical nip loading may be on the order of about 23 lbs. per linear inch.

A web positioning roll is indicated generally at **84**. In its illustrated position roll **84** causes web **60** to make contact with roll **68** along a lapped area subtended by an arc indicated at *c*. It will be noted that the coating liquid in nip **72** contacts web **60** in that portion of the total lapped area represented by the arc subtended by angle *a*, and that web **60** contacts roll **68**, but not the coating liquid **74**, in that portion of the total lapped area represented by the arc subtended by angle *b*.

Roll **84** may however be positioned at any desired location by adjusting means **85**, indicated diagrammatically as a piston-cylinder arrangement. If for example the equipment is required to operate as a conventional coater roll **77** may be moved to the disengaged position, and adjusting mechanism **85** actuated to move roll **84** to a position in which web **60** passes vertically downwardly to the nip area **72**, the web then receiving a coating on both sides.

A guide roll is indicated at **86**, and a spreader roll at **87**. Roll **87** may be a steel walled cylindrical shell covered with a thin Teflon film to provide easy release and self cleaning properties as the wet web passes over its surface. In addition the roll **87** may be grooved along its surface in spiral fashion emanating from the center line in each direction to provide a spreading action as the web passes over the surface. The imparting of a spreading action tends to remove any wrinkles in the web caused by expansion of the web due to wetting action resulting from application of liquids by coating roll **69** and liquid barrier roll **77**.

The use and operation of the invention is as follows.

The nature and intensity of the liquid coat applied in nip area **72** will be determined by several factors, including the nature of the liquid (viscosity, temperature, and polarity). If the nature of the coating liquid is such that strike-through to surface **76** is a problem a liquid barrier is applied from the surface of roll **68**, the liquid barrier being a film drawn from the replenishable pool **79** of a barrier fluid.

If the coating material **74** has quick strike through characteristics the placement of the liquid barrier coating on web surface **76** may not be effective if web **60** comes in contact with roll **68**, at the same instant the web contacts coating pool **74**. That is, if web **60** makes contact with roll **68** along an area defined by the arc subtended by angle *a*, the liquid barrier may not be completely effective to prevent penetration into the substrate of the web **60**.

To ensure formation of a liquid barrier which will prevent penetration of coating material **74** into the substrate of the web **60**, positioning roll **84** is placed in the illustrated position so as to cause web **60** to be lapped against the surface of roll **68** along the additional distance indicated by the arc substended by angle *b*. Thus, as any point on the web moves along arc *b* it is absorbing barrier liquid from the surface of roll **68**, and by the time any given point reaches that point at which contact with coating liquid **74** commences, the barrier liquid will be formed and partially dispersed on the surface **76** of the web. The barrier liquid will of course continue to strike in as the web moves from the initial contact point with liquid **74** down to the apex of the nip area at which time contact is broken with roll **68**. The effect of the barrier coat is to fill the pores of the web starting from the surface **76**, and thereby prevent undesirable strike through of the coating liquid **74** starting at a later time from surface **75**.

The magnitude of angle *b* is definite, but variable, as determined by placement of roll **84** with respect to roll **68**. By controlling the lap area of the web against roll **68** the contact time between the liquid and the continuous web may be controlled, and the control of this contact time represents the primary means for controlling penetration of the liquid derived from pool **74**.

It will be understood that various modifications may be made within the spirit and scope of the invention by those skilled in the art. Accordingly it is intended that the foregoing description be taken as illustrative only, and not definitive, the scope of the invention being defined by the scope of the hereinafter appended claims when interpreted in the light of the foregoing specification and the pertinent prior art.

What is claimed is:

**1.** In a single station paper coating method the steps of

applying a film of penetration controlling barrier liquid to a first roll in a two roll coating station,

initiating transfer of said film of penetration controlling barrier liquid to one side of a moving web of paper by contacting said film bearing first roll with said one side of said moving web of paper while the other side of said moving web of paper is uncoated, and

thereafter, and prior to drying of said barrier liquid, contacting said other side of said moving web with a liquid coating material having substantially instant strike through capability,

initial contact of said barrier liquid with said web occurring at the coating station at a point in time sufficiently prior to contact of said coating liquid with said web such as to enable penetration of the substrate of the moving web by the barrier liquid and thereby preclude any substantial strike through of the coating liquid to said one side of the moving web.

**2.** The method of claim **1** further characterized in that the barrier liquid is applied in the same coating unit in which the coating liquid is applied.

**3.** The method of claim **2** further characterized in that the barrier liquid is applied by one of the rolls forming the nip area at which the coating liquid is applied.

4. The method of claim 3 further including the step of lapping the web against the roll which applies the barrier liquid to the web,

the initial point of contact of the web with said roll being upstream from the point at which said web initially contacts the coating liquid.


**References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 668,301 | 2/1901 | Wells et al. | 117—111 UX |
| 1,195,888 | 8/1916 | Wheelwright | 117—68 UX |
| 1,402,288 | 1/1922 | Fisher | 117—68 |
| 2,229,316 | 1/1941 | Van Cleef | 117—68.5 |
| 2,645,201 | 7/1953 | Muggleton | 117—68 X |
| 2,695,251 | 11/1954 | Bright | 117—68.5 X |
| 2,772,604 | 12/1956 | Muggleton | 117—68 X |
| 2,981,171 | 4/1961 | Hruby et al. | 117—68 X |
| 3,293,067 | 12/1966 | Streb et al. | 117—111 X |
| 3,483,017 | 12/1969 | Korpman | 117—155 X |
| 2,443,222 | 6/1948 | Bergstein | 117—60 |





WILLIAM D. MARTIN, Primary Examiner

B. D. PIANALTO, Assistant Examiner

U.S. Cl. X.R.

117—111 R; 118—224, 246