Dec. 20, 1966 J. E. STREB ET AL 3,293,067

PRODUCTION OF COATED PAPER

Filed March 27, 1963

Fig. 1

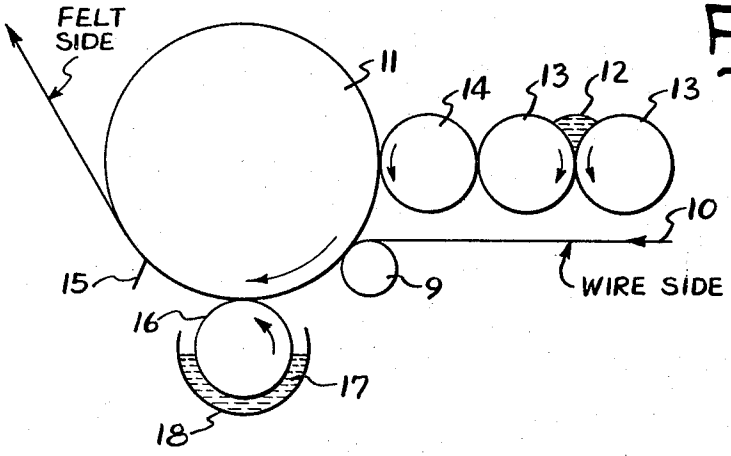


Fig. 2

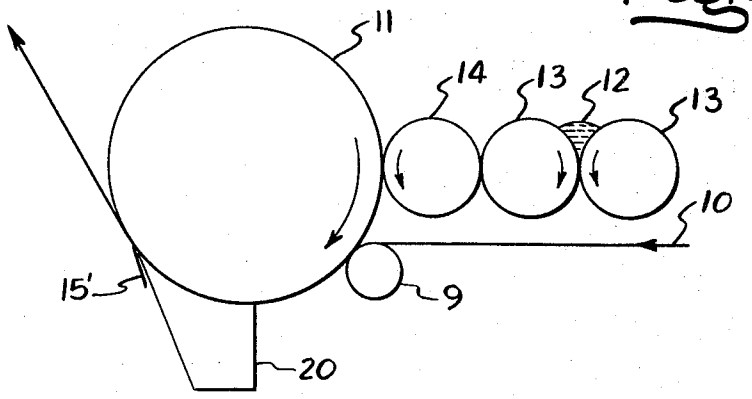
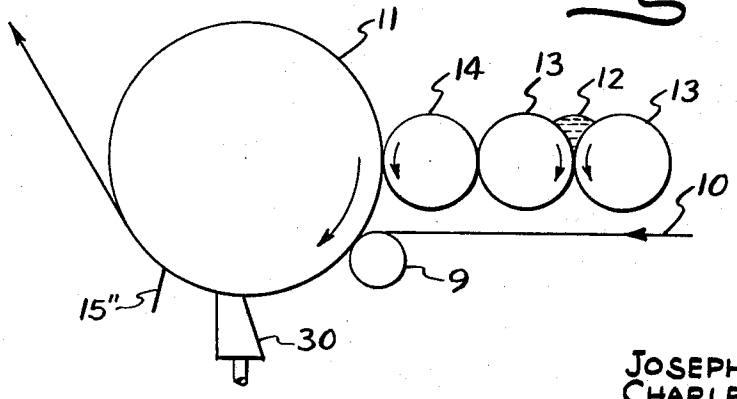


Fig. 3



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United States Patent Office 3,293,067 Patented Dec. 20, 1966

3,293,067

PRODUCTION OF COATED PAPER

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Filed Mar. 27, 1963, Ser. No. 268,291
5 Claims. (Cl. 117—68)

This invention relates to the production of coated paper of desirable printing properties by a novel method and means.

The method of the present invention is directed to the production of paper of high gloss, smoothness, opacity, and ink holdout and which is eminently suitable for high speed coating of publication grade of printing paper.

The method of the present invention is characterized by the application of paper coating composition composed of conventional aqueous suspension of mineral pigment and binder to the opposed surfaces on a forwardly moving uncoated, dry paper web, the coatings being applied to the opposed surfaces of the web substantially simultaneously in a novel and economical manner.

In accomplishing the foregoing method and objects of the present invention, and as a further characterization, the opposed surfaces of the forwardly moving web are coated substantially simultaneously by two different coating means, although each per se is of known generally conventional character.

Thus, in accomplishing the method of the present invention the forwardly moving paper web is coated on one side by conventional roll coater means comprising a pair of gate rolls between which a pool of coating composition is maintained and which meter and pass the composition to one or more distributor rolls, following which the coating is transferred in the form of a preformed film to a resilient surfaced applicator roll, the pre-formed film of coating composition being transferred therefrom to the forwardly moving paper web by imprint transferring it thereto under pressure, also known as the Massey roll coater.

As distinguished from conventional roll coating practice wherein the opposed surfaces of the web are passed between the nip of a pair of applicator rolls, in the practice of the present invention the web is caused to be wrapped about a portion of the applicator roll, as will be hereinafter more fully described, and as it is wrapped about the applicator roll and the film of coating composition is being transferred to one surface of the web, the opposed surface of the web is subjected to coating by trailing blade coater means.

The term trailing blade coating means as employed herein will be understood to comprehend conventional and known devices wherein a coating composition is applied to the paper web for example by a dip roll from a body of aqueous coating composition and then doctored by means of an inverted flexible blade spaced from the roll; the puddle type wherein the paper on the backing roll, in this case the same applicator roll, passes through a body of coating composition contained in a trough, the outer or trailing edge of which is defined by a flexible blade; and forms wherein the coating composition is applied under pressure through a jaw-like trough extending transversely of the web, the trailing or defining edge comprising a blade which may serve as a metering edge, or which may employ a spaced flexible doctor blade; and others known to the art.

In the practice of the present invention, the forwardly moving web is maintained wrapped about the applicator roll to a minimum extent and promptly after the outer surface is doctored the web is stripped and subjected to conventional drying.

The resulting product provides paper which permits use with a minimum amount of supercalendering, thereby minimizing opacity losses while providing sufficient smoothness, brightness and ink holdout to be considered a good printing paper.

Moreover, the process of the present invention unexpectedly improves the printability of the paper as compared with paper which has been coated on its opposed surfaces with conventional roll coaters.

In the conventional practice of coating the opposed surfaces of the paper web by roll coating means, the wire and felt sides still have their original differences. As distinguished from this and by the practice of the present invention it has been found that the printing properties of both faces become substantially equalized.

Moreover, as distinguished from paper which is roll coated on its opposed surfaces, the practice of the invention permits the production of coated paper having less coat weight with comparatively better printing qualities.

Thus, for example, the wire side of an uncoated web of paper has a greater pick strength than the felt side. It is rougher than the felt side and normally has poorer printability when coated than the felt side. It has less fines than the felt side. The wire side is relatively free from surface fuzz compared to the felt side and for coating it is the wire side which is generally more trouble-free than the felt side. Also, the felt side is generally more troublesome with respect to ink receptivity than the wire side of the paper. Thus, two sidedness is usually the prime offender in paper heretofore roll coated on its opposed surfaces. This problem is minimized by the practice of the present invention which tends to equalize the printability, ink receptivity, pick strength and other physical properties on the opposed faces.

An important advantage of the process and apparatus of the present invention is that it enables the employment and retention of equipment normally existing on a roll coating machine and permits ready conversion thereof to the combination of roll and trailing blade coating with attendant desirable advantages as hereinbefore pointed out bringing about the desirable ability to simultaneously blade coat the wire side of the web and roll coat the felt side thereof. Although the foregoing is the preferred practice, it will be understood that the practice of the present invention is also feasible to a non-fully equivalent extent by blade coating the felt side and roll coating the wire side of the paper.

While it would appear that a marked improvement in the printability of the wire side by the present process would be the prime result, actual practice has indicated that there is not only received the expected increase of printability on the wire side but also an unexpected increase in printability on the felt side.

It is postulated that the blade of the present coating arrangement smooths the coating on both sides of the sheet during the time when both coatings are still quite fluid as the sheet coated on the applicator roll passes by the trailing blade. Apparently this smoothing action improves the lay of the roll coating and this in turn is reflected by improvement in printability of the roll coated surface, improvement in felt side printability being obtained without any increase in coat weight while at the same time improving wire side printability.

Thus, while we do not wish to be bound thereby, it is believed that the improved results noted herein are at least in part due to the fact that the felt side of the paper web which is preferably in contact about the applicator roll is still fluid when the blade is used to remove excess coating from the opposed outer or wire side. Thus, not only does the practice of the present invention achieve greatly improved quality but it does this at a very minimum capital cost because many conventional roll coaters can

be converted to a roll-blade coating capability without rearranging existing conventional drier equipment, as might be the case if one side were roll coated first, dried in between, and the opposed surface blade coated.

The accompanying drawings diagrammatically illustrate for the purpose of illustration and not limitation the process of the present invention and arrangements of apparatus for carrying out said process.

FIG. 1 diagrammatically illustrates one arrangement of apparatus.

FIG. 2 diagrammatically illustrates a modified arrangement of apparatus.

FIG. 3 illustrates another modified arrangement of apparatus.

Referring to FIG. 1 of the drawings, the reference numeral **10** designates a dry, uncoated, forwardly moving paper web, first wrapped about the roll **11** which serves the dual purpose here of an applicator and backing roll, by means of the pressure roll **9**, the web **10** being moved forwardly by the roll **11** which is of conventional character having a resilient surface and generally of about three feet in diameter.

As previously indicated, and although not limited thereto, in the preferred practice of the present invention, the felt side of the paper web is wrapped around and brought into contact with the applicator roll **11** so as to cause the felt side to be roll coated and the outer or exposed wire side of the web subjected to trailing blade coating. A pool of coating composition **12** is maintained in the nip of the oppositely rotating gate rolls **13**, **13** which meter the desired amount of coating and work and transfer it to the distributor roll **14**, one of which is shown in the illustration although more may be employed if desired as is well known. The coating is then transferred from distributor roll **14** to applicator roll **11** in the form of a film of uniform character and this film is transferred to the forwardly moving web **10** which may be moving at the rate of about 1,000 feet or more per minute in the form of a pre-formed film by imprint transfer thereto under pressure.

The coating composition **12** is of generally conventional roll coating composition character and typically may comprise 18 parts by weight of enzyme converted corn starch as adhesive, 1 part by weight of ammonium stearate as lubricant, and 100 parts by weight of coating clay, with other adjuvants such as dispersing agents and water made up to an aqueous dispersion of say from 45% to about 55% solids content, the solids content being roughly in proportion to the degree of wrap of the web about roll **11**. Thus, if the degree of wrap of the web **10** about roll **11** from the point of the nip between pressure roll **9** and roll **11** and the doctor blade **15** is at the preferable maximum of about 105° on a 3-foot diameter roll, which is equivalent to about 2.75 linear feet, the solids content of the composition **12** should be not more than about 50% by weight, whereas with a wrap of about 65° equivalent on a 3-foot roll to about 1.7 linear feet of web, the solids content can be as high as 55% or more.

Other conventional mineral pigments such as titanium dioxide and calcium carbonate may be employed in whole or partial replacement of the clay. Likewise, other adhesives can be employed such as casein, hydroxy ethyl corn starch, or various synthetic aqueous polymeric dispersions or latices of for example polyethylene, polyvinylacetate, polyacrylic resin, butadiene-styrene copolymer and the like, either alone or in combination, together with dispersing agents such as tetrasodiumpyrophosphate and other adjuvants such as algenates as is conventional.

Thus, another typical coating composition can be composed of 50 parts of coating clay, 25 parts of titanium dioxide, 25 parts calcium carbonate, 8 parts of butadiene-styrene copolymer latex solids, 15 parts enzyme converted corn starch and 1 part of ammonium stearate.

The web **10**, after being brought into contact with the applicator roll **11**, and the surface of the web **10** in contact with the roll thus coated by means of the film of coating composition deposited on the roll **11**, next passes through the blade coater means which in this case compises the dip or coating applicator roll **16** rotating in a body of paper coating composition **17** in the receptacle **18**.

After the coating **17** has been applied to the exposed or wire side of the web **10**, it is then doctored by means of the blade **15** which removes excess coating and smooths and levels the coating thereon, following which the web is removed from the roll **11** and sent to conventional driers.

The coating composition **17** may for example be composed of 100 parts of coating clay, 15 parts of enzyme converted corn starch and 0.8 part calcium stearate. This blade coating composition **17** can have a solids content as high as 60%. Generally speaking, the coating solids here are not appreciably effected by the amount of web wrap. Thus although the solids content of the coating applied by the blade coater can be greater than that employed in the practice of the present invention for the roll coating composition **12**, nevertheless the coating **17** as applied retains a high degree of fluidity and is of a lubricating character since the web has already been coated on the felt side with a film of coating composition and the web impregnated with the aqueous content thereof.

Since, however, these two coatings are applied substantially simultaneously, the coatings on the opposed faces remain quite fluid so that the web readily strips from the roll **11** which acts as an applicator roll for the roll coating and a backing roll for the blade coating step.

The components of the coating composition **17** can be varied as explained with respect to the roll coating composition **12**, and thus another typical coating composition **17** for the trailing blade coating can be as follows: 50 parts coating clay, 30 parts titanium dioxide, 20 parts precipitated calcium carbonate, 4 parts casein, and 14 parts vinyl acetate latex solids.

Thus, while the coatings applied to the opposed surfaces of the web have a degree of fluidity which permits smoothing of both surfaces by the externally applied blade **15**, yet it will be noted that both compositions **12** and **17** applied to the felt and wire sides respectively are of rather high solids content and of stiff character enabling good coating of the fibers and production of a sheet of smooth opaque character highly suitable for printing.

FIG. 2 of the drawings illustrates a modified arrangement of apparatus wherein the trailing blade coating means is of a modified construction, the roll coating means remaining the same as that with respect to FIG. 1. Thus, in FIG. 2 the blade coating means comprises the enclosed pressurized coating applicator **20** for applying a batch of coating composition such as that described with respect to composition **17** hereinbefore. The pressurized coater **20** terminates at its trailing edge with a flexible blade **15'** forming part of the enclosure **20** and serves to doctor the coating applied through the unit **20** in a manner described with respect to FIG. 1.

The arrangement shown in FIG. 3 also employs roll coating means the same as that described with respect to FIGS. 1 and 2, but differs slightly with respect to the trailing blade coater means. In this case, a coating applicator **30** flows and spreads coating composition to the wire side of the web, such as the coating composition **17** described with respect to FIG. 1. In lieu of the blade **15'** forming a part of the device **20** in FIG. 2, in the arrangement of FIG. 3 a separate spaced blade **15''** is employed similar to that of blade **15** of FIG. 1.

A typical paper which can be suitably coated in accordance with the practice of the present invention is one having for example a basis weight of 38 pounds per ream of 3,300 square feet and a coat weight applied in accordance with the practice of the present invention of 3.5 pounds per ream on the wire side and 5.0 pounds on the felt side. The coated product had a Bekk smoothness in seconds of 1600 for the wire side and 1700 for the felt

side. The Vendercook rating was 95 for the wire side and 85 for the felt side, and the K & N ink receptivity was 62 for both the wire and felt sides.

The angle of the blade **15** is typically 50° from a tangent to the roll **11** and employed at a pressure of from about 3 to 5 pounds per linear inch, it being understood that the blade extension and pressure thereof may be suitably regulated by conventional means not illustrated. The dip roll **16** may likewise be regulated in conventional manner to control the amount of coating applied to the web **10** so that a clearance of 6 mills may be typical. The pressure roll **9** may also be regulated in conventional manner at typically 35 pounds per linear inch.

The length of arc of wrap of the web **10** about the applicator-backing roll **11** is preferably the minimum within which the trailing blade coater can be disposed, with a maximum of about 120° on a 3-foot diameter roll equivalent to about 3 lineal feet, and preferably a maximum of 105° on said roll so as to insure even film split at the time the web **10** is stripped from the roll **11**. To some extent this angle of wrap is effected by the speed of the web so that with greater speeds greater angles of wrap are permissible and conversely with slower speeds the arc of wrap should be relatively smaller.

What is claimed is:

1. The method of making printable coated paper which comprises roll coating the felt side surface of a forwardly moving uncoated dry paper web with an aqueous paper coating composition, and substantially simultaneously trailing blade coating the opposed wire side surface of said web, while maintaining it in contact with the roll coating applicator roll, by applying thereto a second aqueous paper coating composition, stripping the coated web from the said applicator roll and heat drying the resulting coatings applied to the opposed surfaces of the web.

2. The method of making printable coated paper which comprises coating the felt side surface of a forwardly moving uncoated dry paper web with an aqueous coating composition comprising mineral pigment and adhesive, by imprint transferring thereto under pressure a preformed film of said composition from a resilient surfaced applicator roll coated with a metered amount of said composition distributed thereto from a pool maintained between a pair of gate rolls, and substantially simultaneously coating the opposed wire side surface of said web, while maintaining it in contact with said applicator roll, by applying thereto a second aqueous coating composition comprising mineral pigment and adhesive, wiping and leveling the latter coating while the web is still in contact with said applicator roll, stripping the coated web from the latter roll and heat drying the resulting coatings applied to the opposed surfaces of the web.

3. The method of making printable coated paper which comprises roll coating the felt side surface of a forwardly moving uncoated dry paper web with an aqueous coating composition comprising mineral pigment and adhesive, by imprint transferring thereto under pressure a preformed film of said composition from a resilient surfaced applicator roll coated with a metered amount of said composition distributed thereto from a pool maintained between a pair of gate rolls, and substantially simultaneously trailing blade coating the opposed wire side surface of said web, while maintaining it in contact with said applicator roll, by applying thereto a second aqueous coating composition comprising mineral pigment and adhesive and wiping and leveling the latter coating while the web is still in contact with said applicator roll, stripping the coated web from the latter roll and heat drying the resulting coatings applied to the opposed surfaces of the web.

4. The method of making printable coated paper which comprises roll coating the felt side of a forwardly moving uncoated dry paper web with an aqueous coating composition comprising mineral pigment and adhesive, by imprint transferring thereto under pressure a pre-formed film of said composition from a resilient surfaced applicator roll coated with a metered amount of said composition distributed thereto from a pool maintained between a pair of gate rolls, and substantially simultaneously trailing blade coating the opposed wire side of said web, while maintaining the web in contact with said applicator roll, by applying thereto a second aqueous coating composition comprising mineral pigment and adhesive, wiping and leveling the latter coating while the web is still in contact with said applicator roll, stripping the coated web from the latter roll and heat drying the resulting coatings applied to the opposed surfaces of the web.

5. The method of making printable coated paper which comprises coating the felt side surface of a forwardly moving uncoated dry paper web with an aqueous coating composition comprising mineral pigment and adhesive of from about 45 to about 55% solids content, by imprint transferring thereto under pressure a preformed film of said composition from a resilient surfaced applicator roll coated with a metered amount of said composition distributed thereto from a pool maintained between a pair of gate rolls, and substantially simultaneously coating the opposed wire side surface of said web, while maintaining it in contact with said applicator roll for a linear distance of not more than three feet, by applying thereto a second aqueous coating composition comprising mineral pigment and adhesive, wiping and leveling the latter coating while the web is still in contact with said applicator roll, stripping the coated web from the latter roll and heat drying the resulting coatings applied to the opposed surfaces of the web.

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