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2,237,068

METHOD FOR MAKING COATED PAPER

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Fig. 1,

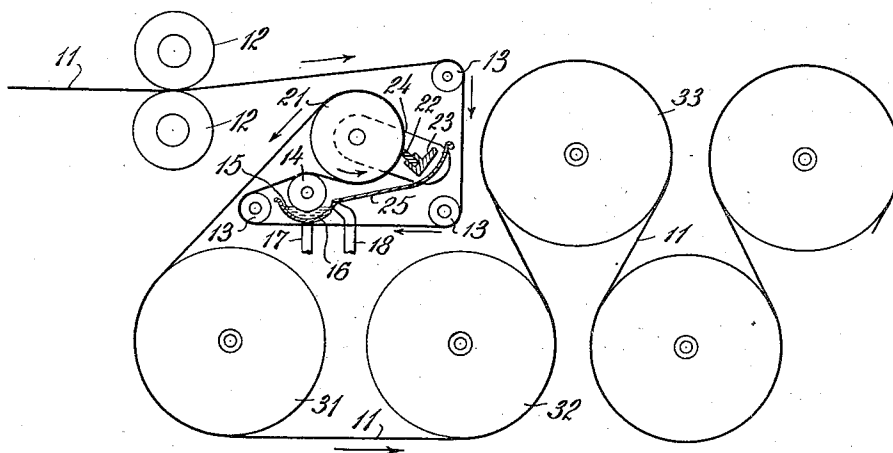
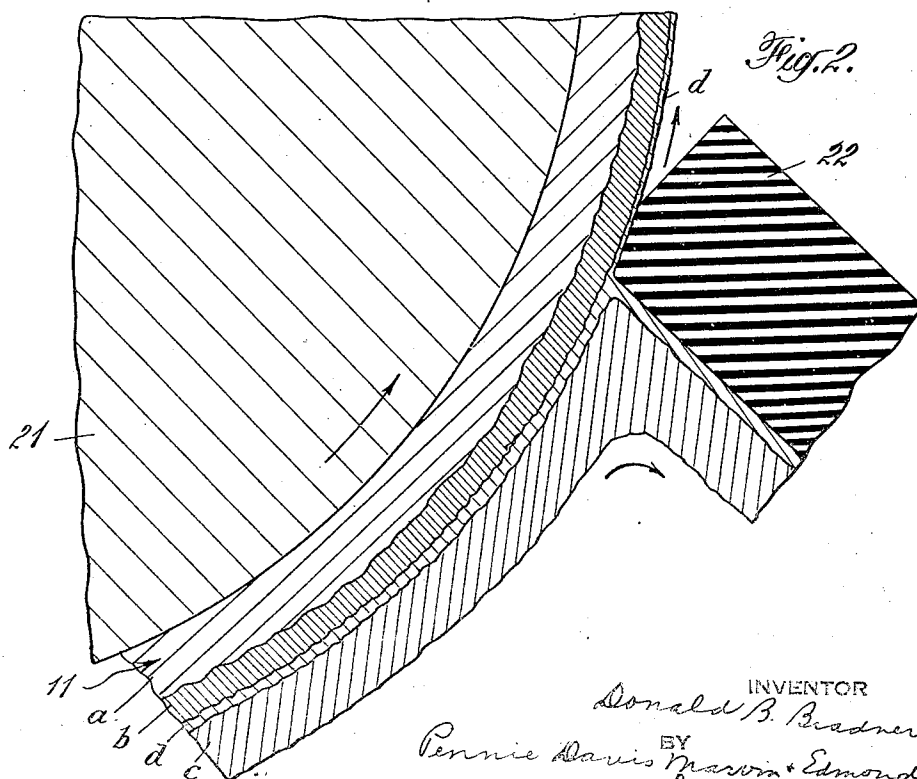


Fig. 2.



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UNITED STATES PATENT OFFICE

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METHOD FOR MAKING COATED PAPER

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4 Claims. (Cl. 92—40)

This invention relates to methods for making coated paper and particularly for making coated paper on a paper machine.

It has been the almost universal practice in the manufacture of coated paper to make the paper raw stock on a paper machine, wind it into rolls, and then as a separate operation to apply the coating composition, such as, for example, clay, calcium carbonate, blanc fixe, satin white, and the like and adhesive such as, for example, casein, starch, etc., in aqueous suspension to one or both surfaces of the web by means of rolls, brushes, etc. Such coated paper is usually dried on festoons and then supercalendered. For a great many years attempts have been made to coat the paper while it was still on the paper machine, thereby effecting a saving in time, labor, and capital investment. So far as I am aware, however, none of these processes has given a product which ranked in quality with coated paper made by the two-step process.

I have succeeded in making coated paper directly on the paper machine, of a quality closely approximating, if not equalling, the quality of coated paper made on a coating machine from the same grade of raw stock and coating composition and festooning in the commonly practiced method. In some grades the product is indistinguishable from the usual coated paper, and in some respects, as for example printing qualities, the product is frequently superior to a corresponding grade of the usual coated paper.

In my copending application Serial No. 212,877, filed June 10, 1938, I have described a method of coating paper which may be advantageously carried out during the process of the paper manufacture on a paper making machine having the usual arrangement of screen, press rolls and drying cylinders.

The novel process to which my said copending application is directed is based on the discovery that upon the application of a suitable coating composition to the paper web in its passage through the paper machine a filter cake is formed of the coating composition immediately adjacent the surface of the paper web by the absorption by the paper of a portion of the water in the coating composition, while above the filter cake the liquid content of the composition is not substantially reduced, whereby the layer of coating composition is in effect converted into two layers of different liquid content so that this outer layer of higher liquid content may be removed, leaving on the paper a smooth, uniform layer of coating composition of such character that it can be

dried by contact with the steam heated cylindrical dryers commonly used in paper machines, without sticking to or being marred by said dryers.

5 The step of removing the excess coating composition from the paper web without impairing the filter cake described in my said copending application is accomplished by drawing the coated side of the web after the formation of the filter cake across a rounded scraper bar, or reversely rotating scraper roll, the pressure of the web against the scraper or roll being determined solely by the tension of the web. That is to say, there is no fixed roll, belt, or other backing for the web as it passes over the scraper, so that the paper rides freely over the scraper which wipes off the liquid coating composition and smoothes the surface of the filter cake.

15 The present invention has for its object the provision of an alternative method for removing the excess fluid coating composition above the filter cake.

25 As described in my above designated application, the apparatus for applying the coating composition may be installed on the paper machine to coat either the wire side of the web, or the felt side, or both. Although the coating may be applied to either side of the web at any point in the process of manufacture after the web is formed, the apparatus for coating the wire side of the web may be mounted between the last press roller and the first drying cylinder, while for coating the felt side it is desirable that the web be at least partially dried before the coating is applied, all as fully described in my above mentioned pending application. For the present application I have selected for illustration an arrangement of the coating apparatus in the paper machine to coat the wire side of the web at a point in advance of the first dryer section, but it will be understood that this apparatus may be installed to apply the coating to either or both sides of the web and at any other stage in the manufacture of the paper.

40 The invention will be further described by referring to the accompanying drawing in which:

45 Fig. 1 represents more or less diagrammatically one form of apparatus embodying the invention; and

50 Fig. 2 is a diagrammatic sectional view of a web of paper showing the filter cake and the removal of the excess coating.

In Fig. 1 the paper web is indicated by the numeral 11. It is shown passing through a pair of press rolls 12, 12 which may be the final

press rolls of the wet press section of the paper machine. It is then carried around carrier rolls 13, 13 to coating applying roll 14 which dips into coating 15 which is circulated and maintained at constant level in the pan 16 by constant inflow through a supply pipe 17 and overflow through a return pipe 18, which, by means of a suitable pump, not shown, take the coating composition from and return it to a supply tank, not shown. The applicator roll 14 rotates, advantageously, in a direction opposite to the travel of the paper thereover, and carries coating material from pan 16 and wipes it onto paper web 11, and thereby applies coating in considerably greater quantity than is desired on the finished paper. The paper web 11 then travels around roll 21 with the freshly coated side away from the roll. At a point where the web is firmly supported on roll 21, and at a distance from the applicator roll to allow the filter cake to form, is located a yielding or flexible wiper 22 which is carried on a rigid supporting member 23. The wiper 22 is advantageously made of natural or synthetic rubber or other suitable material of a thickness and density which permit it to yield by compression or flexure or a combination of the two before it will dig into the filter cake and roughen its surface or dislodge an appreciable amount of the solid material therefrom.

The coating composition applied in this manner is usually an aqueous suspension of finely divided mineral filler such as clay, calcium carbonate, satin white, etc., with an adhesive such as casein, starch, or the like. As the composition is applied by roll 14 the water in the composition begins to be absorbed by the paper web, and by the time the web reaches wiper 22, Fig. 1, a substantial percentage of the water in the coating composition immediately adjacent the surface of the paper web has been absorbed by the paper, thereby forming a filter cake of the desired thickness, with the surplus coating composition forming a more fluid overlying layer.

In order that the time allowed for filter cake formation, between the time of application of coating and the removal of the still fluid excess, may be regulated, the wiper 22 and its support 23 may be mounted on arms 24 so that it may swing around the axis of roll 21 to any position required, where it may be locked by known means, not shown. The coating material wiped from the paper web is directed back into pan 16 by a suitable apron 25.

The paper web 11 carrying the desired amount of coating passes off of roll 21 and around drying cylinders 31 and 32 with the coated side out, before the coated side contacts the dryer 33, by which time it is sufficiently hard that it will not adhere to or be marred by the surface of dryer drum 33. From this point it passes over a sufficient number of dryers to accomplish the necessary drying. It may or may not, as desired, be subsequently coated on the other side or have an additional coating applied to the same side.

It will be noted that after the coating and wiping operations the coated paper passes directly onto the dryers without the interposition of brushes, squeeze rolls, or any other type of smoothing devices or apparatus for re-applying coating above the wiped surface. Such devices are neither necessary nor desirable and may do great harm in disturbing the smoothness or firmness of the coating.

Fig. 2 shows diagrammatically what probably takes place during the removal of the excess coat-

ing composition. As here shown, *a* indicates the paper web with its rough and porous surface. Upon the application to this surface of the coating composition, there is a rapid absorption of water from the applied coating immediately adjacent the paper web, forming a layer of filter cake as illustrated at *b*. The absorption of the water by the paper is much more rapid than the equalization of the water content in the coating layer throughout its total thickness, hence the water content of the coating composition in the outer portion of the applied layer is altered but little for an appreciable time, and the coating in excess of that necessary to form the filter cake forms an outer layer *c* overlying the filter cake. The line of demarcation between the filter cake and the fluid coating composition does not appear to be sharp, and between the layers *b* and *c* there appears to be a transition zone which may be represented as a third layer *d*. The yielding scraper 22 (see also Fig. 1) is sufficiently resilient to project through fluid layer *c* and into layer *d*, exert pressure on the filter cake *b* and hold the paper web *a* in contact with the surface of roll 21 as shown. The scraper 22 is not so rigid as to dig through the layer *d* into the filter cake *b* and cause it to be scratched, cracked or broken loose from the paper. At least a part of the layer *d* is apparently removed by the scraper 22 and returned to the pan 16, but it must be borne in mind that the combined thickness of layers *b* and *d* is, in practice, less than one thousandth of an inch, so that the composition and even the existence of the layer *d* is largely speculative. Regardless of theory, however, a remarkably uniform coated paper is produced by my method.

While my new process is most advantageously carried out on the paper machine as herein described, it may also be employed for coating prefabricated paper as it leaves the paper machine by the simple expedient of running the web through the coating apparatus and then through an additional bank of drying cylinders. Also, of course, the paper may be wound into rolls in the usual manner and then subsequently coated by my new process and dried on internally heated drying cylinders, or other known types of dryers, as a separate operation. Nor is the process necessarily limited to the use of aqueous coating compositions; non-aqueous coating compositions may also be used.

No hard and fast rule can be laid down for making up coating compositions to be used in the practice of the present invention. Generally speaking, it is desirable to lower the water content of the coating composition as far as possible while still leaving it sufficiently fluid to be handled by the applying apparatus. The amount of water required is not critical, as variation in the amount of water in the composition may be compensated for by increasing or decreasing the time permitted for the formation of the filter cake. In the apparatus shown in the drawing, this increase and decrease in the time may be very readily effected by adjusting the wiper toward or away from the coating applying roll. Other conditions being equal, the more water present in the mixture the farther should the wipers be set from the applicator.

With the understanding that a firm filter cake of the desired weight is essential, those persons skilled in the paper coating art should have no difficulty in obtaining a suitable combination of raw stock and coating composition to give the

desired results, and in my above mentioned pending application I have given several examples of coating composition which have been found satisfactory for the process therein described and which may be employed with equally good results in the above described process. The principal difference in the two processes is that in the process of my pending application the penetration of the scraper to the surface of the filter cake and not into it is obtained by properly regulating the tension on the web of paper, while by the present process the proper penetration is secured by the flexibility of the scraper and is independent of the tension on the web. The process of this application is therefore particularly suited for coating webs under circumstances which make it difficult to properly regulate the tension on the web.

The term "wiping" as used in the appended claims should be understood as designating a rubbing or wiping action exerted on the coated surface of the web by a solid as distinguished from a fluid wiping medium, all as more particularly hereinbefore described.

I claim:

1. Process of making coated paper which comprises applying an excess of fluent coating composition, comprising a liquid vehicle containing pigment in suspension and adhesive, to a travelling web of paper which is absorptive to the liquid of the coating composition to a degree to form on the surface of the web a layer of firm filter cake from the pigment in the coating composition adjacent the web while the overlying coating composition remains fluent, and then after the formation of the layer of filter cake, yieldingly wiping off substantially all said fluent coating composition without removing substantially any of the filter cake, and firmly supporting the web on its other side at a location where the wiping is accomplished and thereafter drying the coated paper.

2. Process of making coated paper on a paper machine which comprises applying an excess of fluent coating composition, comprising an aqueous liquid vehicle containing pigment in suspension

and adhesive, to a travelling web of paper which is absorptive to the liquid of the coating composition to a degree to form on the surface of the web a layer of firm filter cake from the pigment in the coating composition adjacent the web while the overlying coating composition remains fluent, then after the formation of the layer of filter cake yieldingly wiping off substantially all said fluent coating composition without removing substantially any of the filter cake, and firmly supporting the web on its other side at a location where the wiping is accomplished, and thereafter contacting the coated surface with the surface of a heated dryer.

3. Method of coating paper on a paper machine which is characterized by the application of considerably more fluent coating material comprising adhesive and pigment in an aqueous vehicle than is desired on the finished paper, the formation on the surface of the fibrous web of a layer of firm filter cake corresponding to the quantity of coating desired on the finished paper, and the removal of substantially all the fluent coating material above the filter cake by means of a wiper more yielding than the filter cake, said wiper acting at a location where the other side of the web is firmly supported.

4. The process of making coated paper in a paper machine which comprises applying an excess of fluent coating composition containing adhesive and pigment in aqueous suspension to a partially dewatered travelling web of paper, at a location in the paper machine where it is sufficiently absorptive to liquid of the coating composition to form on the web a firm filter cake from the solids of the coating composition adjacent the web while the overlying coating composition remains fluent, then wiping off said fluent coating composition approximately at the surface of the filter cake by means of a wiper more yielding than the filter cake, said wiper acting at a location where the other side of the web is firmly supported, and drying the coated web in the paper machine.

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