

Nov. 21, 1933.

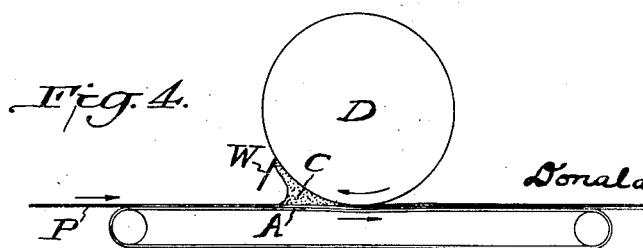
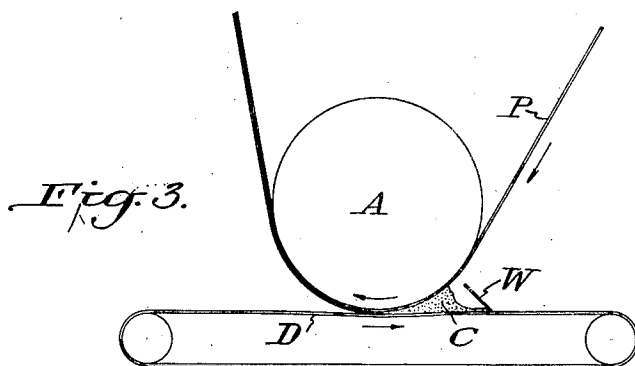
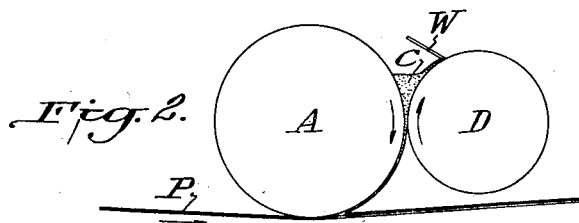
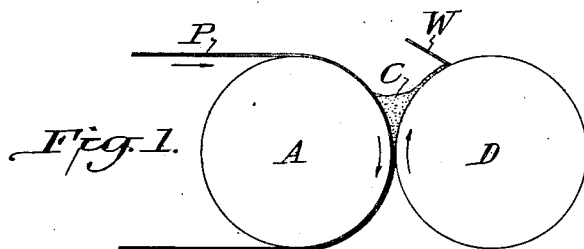
D. B. BRADNER

1,936,286

MINERAL COATED PAPER

Filed Dec. 17, 1931

2 Sheets-Sheet 1



Inventor:

Donald B. Bradner

By *Byrnes, Townsend & Potter*

his Attorneys

Nov. 21, 1933.

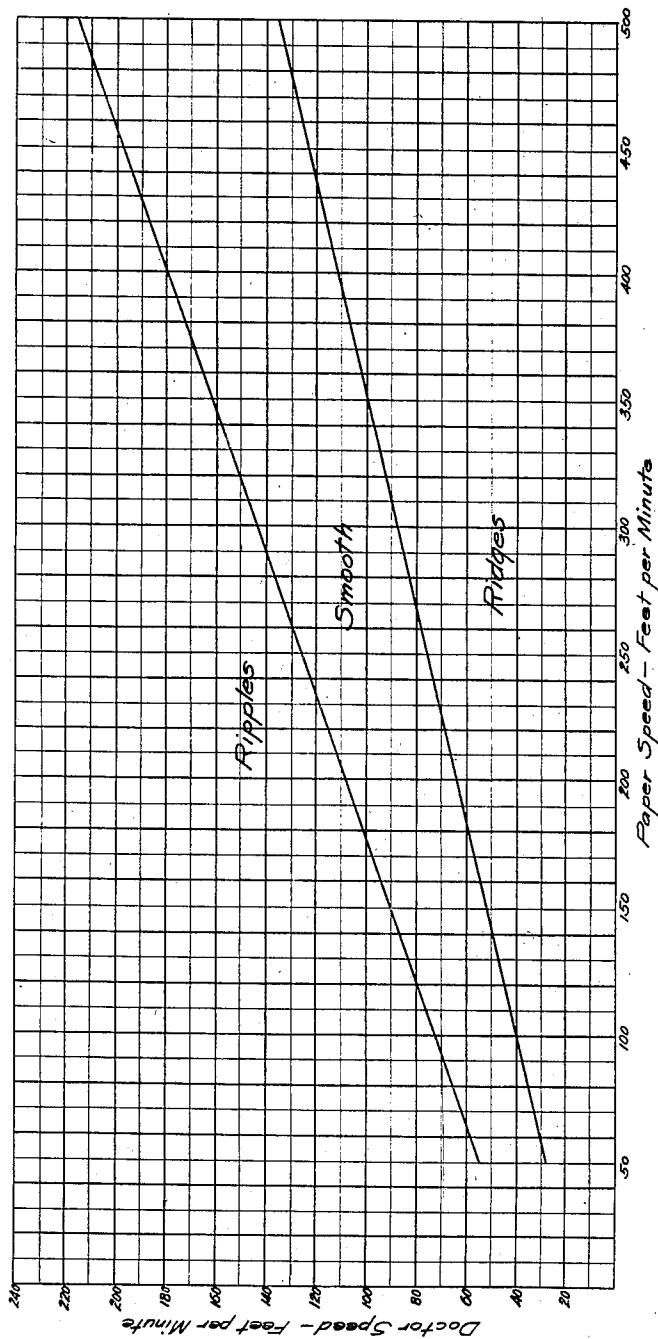
D. B. BRADNER
MINERAL COATED PAPER

1,936,286

Filed Dec. 17, 1931

2 Sheets-Sheet 2

Fig. 5.



Inventor:

Donald B. Bradner
By *Byrnes, Townsend & Potter*
his Attorneys

UNITED STATES PATENT OFFICE

1,936,286

MINERAL COATED PAPER

Donald B. Bradner, Oxford, Ohio, assignor to
The Champion Coated Paper Company,
Hamilton, Ohio, a corporation of Ohio

Application December 17, 1931, Serial No. 581,752,
and in Canada July 29, 1931

4 Claims. (Cl. 91—68)

This invention relates to the provision of mineral-coated papers.

In my co-pending applications Serial No. 290,093, filed July 3, 1928, and Serial No. 339,165, filed February 11, 1929, there have been described a plurality of processes adapted to the production of mineral-coated papers. By the expression "mineral-coated paper" I mean paper, including postcard, cardboard and the like, coated with an aqueous coating composition which, on the dry basis, comprises at least two-thirds by weight of mineral pigment (for example, clay, satin white, blanc fixe and the like) and not more than one-third adhesive (for example, casein, starch, glue and the like). In the aforesaid applications there are described processes which in essence comprise applying a layer of aqueous mineral coating composition in excess of the desired weight of the final coating to a moving surface on which a predetermined layer of said mineral coating composition is to be formed, removing all except the desired weight of the said layer by means of a doctor member whose surface contacts with the said layer and is at a predetermined distance from the aforesaid moving surface, which doctor member surface moves in a direction opposite to that of the aforesaid moving surface and at a predetermined speed which with respect to the speed of the aforesaid moving surface is greater than .15 and not greater than about 1, and continuously cleaning the surface of said doctor member. If the said moving surface be a web of paper, the process is completed simply by suitably drying the so-coated web: if, however, the said moving surface be that of an applicator member, such, for instance, as the surface of an applicator roll, the process is completed by transferring the so-formed layer of coating from the applicator surface onto the surface of a web of paper by contacting the surface of applicator with a web of paper moving in the opposite direction to that of the applicator and thereafter suitably drying the coating. Whether the coating be formed on the web or on the applicator member surface, the processes are characterized by adjustment or maintenance of the ratio between the surface speed of the doctor member and the speed of the surface on which the desired layer is being formed so as to avoid the formation of ridges and frothiness in or on said coating layer and to produce at will either a mineral coated web having a smooth surface and appearance, i. e., showing neither ridges, ripples nor frothiness, or else a mineral coated web showing a rippled

effect. By "ridges" is here meant parallel, spaced, elongated areas or stripes, of greater or lesser width, of heavier coating with intervening elongated areas, or stripes, of lighter coating, these elongated areas running longitudinally of the web. The expression "rippled effect" is here meant to define a distinctive, non-repeating, irregular, patternless, variety of relatively faint waves or crescent-shaped to icicle-shaped markings, of various sizes and in various positions in the surface of the coating and running generally transversely to the grain or length of the web of coated paper. By this I purpose to distinguish the appearance of my ripple coatings from that of a sheet decorated with a repeated design, or printed sheet. The above-mentioned smooth coating is characterized by the uniformly smooth, homogeneous and flat lay of the coating and by its freedom from ridges, ripples and brush marks.

A general type of apparatus which has been found suitable for carrying out the present invention consists, in essence, of means for applying an excess of mineral coating composition to a moving web of paper without special regard to the evenness of the applied layer, and a doctor member consisting of either a roll or belt whose surface moves in a direction opposite to that of the web and is maintained in contact with said coating composition but at a predetermined distance from the web. The doctor member is provided with a wiper to continuously clean its surface as it approaches the web. The doctor member removes from the web all except the weight of coating desired on the finished paper. Experimenting with a machine of this type I have discovered certain unsuspected phenomena regarding the behavior of mineral coatings as follows: At relatively low surface speeds of the doctor member with respect to the paper speed, the coating is disposed on the paper in parallel ridges extending parallel to the length of the web. As the surface speed of the doctor member is increased, these ridges gradually disappear until a zone of coating of extraordinary smoothness is reached. With still further increases in doctor member surface speed the coating assumes a rippled or wavy appearance which ripples become smaller and smaller as the doctor speed is progressively raised until finally the ripples disappear and the coating is smooth but frothy and full of pin holes.

The coating applied under the conditions of the second state above referred to, namely, above a doctor speed producing ridges and below that

producing ripples, requires no subsequent smoothing or spreading process of any kind before drying, and is in fact much more uniform and homogeneous than is produced on the usual machines used for manufacturing mineral coated paper. It is noted that in such transfer of formed coating from applicator surface to paper, whatever the condition of the coating on the former, i. e., ridged, smooth, or rippled, that condition is duplicated in the coating after transfer to paper.

While the ratios between the doctor member surface speed and the speed of the moving surface may not be numerically the same for all kinds of aqueous mineral coating compositions, it may be stated as a generality (based upon the results of many hundreds of tests using a wide variety of mineral coating compositions and a wide variety of paper stocks) that ridges occur when the doctor surface speed is as low as one-seventh the speed of the said moving surface, and that ripples are produced when the doctor surface speed about equals, or exceeds, that of the said moving surface. Between these extreme limits there may readily be found by simple tests for any particular set of conditions (including: kind of coating composition used; width of nip between doctor surface and the aforesaid moving surface) a narrower range of doctor surface speeds, for any particular speed of said moving surface, on which smooth coatings occur.

The invention will be described in greater particularity with reference to the appended drawings, of which:

Figs. 1 to 4, inclusive, are diagrammatic representations of four embodiments of a machine for carrying out the invention; and

Fig. 5 is a graphic representation of conditions associated with the operation of the said machine.

Referring to Fig. 1, the paper P is carried around roll A which is designated as the applicator roll. D is a doctor roll which rotates in the same direction as roll A so that the surfaces of the two rolls are moving in opposite directions at their points of nearest approach (i. e., at the nip). W is a wiper which removes substantially all of the coating from D. C is a pool of aqueous mineral coating composition maintained in the nip between the rolls A and D.

Each of the rolls A and D is smooth, round, straight, concentric with its journals, and fabricated from a material, such, for example, as steel, which is not absorbent to aqueous mineral coating compositions. Each of the rolls A and D is provided with any known means for revolving it at any desired speed.

The wiper W may be of rubber, soft metal, or other suitable material. Aqueous mineral coating composition may be fed to pool C by any known means such as, for example, a spout.

In using this machine, if the paper is maintained at a given speed and the doctor roll D is rotated very slowly in the same angular direction as the applicator roll A (Fig. 1) the coating is distributed on the paper in the form of longitudinal ridges of relatively thick coating alternating with stripes of thin coating. As the speed of the doctor roll D is increased these ridges gradually become less pronounced and closer together and finally disappear giving a very uniform film of coating on the paper. As the doctor roll D is further speeded up the film of coating takes on a peculiar streaky appearance and at still higher speeds the coating assumes a wavy or

rippled appearance. These ripples may be heavy and broad, or small and numerous, or comet-shaped, depending upon the relative speed of the doctor roll, the nip opening, and the particular character of the aqueous mineral coating composition employed. As the doctor roll speed is still further increased the ripples become smaller and closer together eventually being no longer separately distinguishable, but the coating becomes frothy, which produces pin holes in the coated paper. In other words, as the speed of the doctor roll relative to the paper speed is increased, the coating on the paper is first ridged, then smooth, then rippled, and finally smooth but frothy. These effects may be accomplished by maintaining the paper at a constant speed and increasing the doctor roll speed, or by maintaining the doctor roll at a constant speed and decreasing the paper speed. The transition from one condition of coating to another is usually a very gradual one. For example, starting with a heavily ridged coating and increasing the doctor roll speed, the ridges become progressively thinner and fainter, gradually fading out until they are no longer discernible to even an experienced observer. Notwithstanding this difficulty in determining the exact transition points, the results obtained on repeated experiments have been remarkably reproducible, indicating that control over the various factors involved can be readily obtained.

At higher paper speeds the transition from ridges to smooth paper occurs at a higher doctor speed than for lower paper speeds. Notwithstanding this, the zone of smooth coating is broader at higher paper speeds, since the transition to rippled paper occurs at a much higher doctor speed. This occurrence of ridges, smooth and rippled coatings is shown graphically in Fig. 5. On this graph abscissae represent paper speeds in feet per minute and ordinates represent doctor roll speeds in feet per minute for a coating operation using a mineral coating composition of casein, clay, and water, said coating composition containing about 40% solids. The values between lines x and y represent ratios of doctor roll speed to paper speed yielding smooth coatings: those values lying above line x represent ratios causing or tending to cause the formation of ripples in the coating, while those values lying below line y represent ratios causing or tending to cause the formation of ridges in the coating. It will be observed that the zone of smooth coating is roughly wedge-shaped, broadening out at higher paper speeds. It will be observed from the said graph that in operating in accordance with the process of the present invention using the illustrative conditions set out above, smooth coatings are obtained by controlling the speed of the doctor roll with relation to the paper speed as follows:

Paper speed	Doctor speed range for smooth coatings
100 ft. per minute.....	40-72 ft. per minute.
200 ft. per minute.....	62-107 ft. per minute.
300 ft. per minute.....	86-143 ft. per minute.
400 ft. per minute.....	110-178 ft. per minute.
500 ft. per minute.....	136-214 ft. per minute.

The process may be carried out using modifications of the machine shown in Fig. 1. Several of these modifications are shown diagrammatically in Figs. 2 to 4, inclusive. Thus, in Fig. 2 the apparatus differs from that shown in Fig. 1

in that the layer of coating is first deposited on the applicator roll A and thereafter transferred to the paper web P by a wiping action; that is, the paper web P moves in the opposite direction to the applicator roll A at their point of nearest approach.

In coating paper by means of the machine indicated in Fig. 2, ridged, smooth, rippled and frothy coatings are produced on the applicator roll by varying the speed of the doctor roll with reference to the applicator, in the same manner as has been described in depositing the coating directly on the paper by the type of machine shown in Fig. 1. In order to obtain a satisfactory transfer of the coating from the applicator roll to the surface of the paper the applicator should travel faster than the paper and preferably from one-and-one-half to two times paper speed.

In Fig. 3, the doctor, instead of being a roll, is a belt; and in Fig. 4 the applicator is in the form of a belt. It is obvious that instead of the coating being deposited directly onto the paper as is shown in Figs. 3 and 4, it may be deposited on the applicator member first and thereafter transferred to the paper according to the same principle as is indicated in Fig. 2. In all cases the doctor member is made of material non-absorbent to mineral coating.

In carrying out the process it is advisable to pre-wet or condition the web of paper to insure a completely coated sheet. Otherwise small "skips" or minute bare spots of uncoated paper are likely to result. This skipping is apparently due to air entrapped in the valleys or low places in the web. A variety of methods of pre-wetting may be employed; for example, by applying excess coating to the paper by means of a reversely turning roll before contacting with the applicator member, by subjecting the web to treatment with moist steam, etc. For adequate pre-wetting the essential thing is to have the whole surface of the web which is to be coated entirely wet before application of the desired weight of coating.

This application contains subject matter in common with my co-pending applications Serial No. 290,093, filed July 3, 1928, and Serial No. 339,165, filed February 11, 1929, and therefore is to be considered as being a continuation-in-part of said applications.

The processes which comprise the subject matter of these said applications may be used to produce at will either a mineral coated paper having an extraordinary smooth layer of coating, or the coating may be in the rippled condition. In the former case the coated paper is characterized by an unusual uniformity in the distribution of the coating, complete absence of brush marks and other defects resulting from the brushes, rolls or other devices commonly employed to smooth out the wet coating after the desired weight of coating has been applied to the paper. This paper prints better than paper of the same grade made according to the methods now employed in the art, and can readily be distinguished from such paper by those skilled in the art.

In the case of the rippled coating the product has considerable artistic merit and may be used for a variety of useful purposes such as fancy wrappings, lamp shades, etc.

I claim:

1. As a new product, a mineral coated paper characterized, as contrasted in representative samples with coated papers produced by prior art practice, by the uniformly smoothly homoge-

neous and flat lay of the coating and by the latter's relative freedom from skips, ridges, ripples, brush marks and other similar smoothing effects, said product being further characterized in that it is obtained by the process which comprises applying an excess of aqueous mineral coating composition to a moving surface on which a predetermined layer of said mineral coating composition is to be formed, removing all except the desired weight of said coating composition by means of a doctor member whose surface is at a predetermined distance from aforesaid moving surface, which doctor member moves in a direction opposite to that of the aforesaid moving surface and at a predetermined speed which is greater than one-seventh and less than equal to the speed of the aforesaid moving surface, and continuously cleaning the surface of said doctor member.

2. As a new product, a mineral coated paper characterized, as contrasted in representative samples with coated papers produced by prior art practice, by the uniformly smoothly homogeneous and flat lay of the coating and by the latter's relative freedom from skips, ridges, ripples, brush marks and other similar smoothing effects, said product being further characterized in that it is obtained by the process which comprises applying an excess of aqueous mineral coating composition to a moving surface on which a predetermined layer of said mineral coating composition is to be formed, removing all except the desired weight of said coating composition by means of a doctor member whose surface is at a predetermined distance from aforesaid moving surface, which doctor member moves in a direction opposite to that of the aforesaid moving surface and at a predetermined speed which is greater than one-seventh and less than equal to the speed of the aforesaid moving surface, transferring the resulting layer of said coating composition on to one surface of a moving web of paper by contacting said moving surface with a web of paper moving in opposite direction thereto, and continuously cleaning the surface of said doctor member.

3. As a new product, a mineral coated paper characterized, as contrasted in representative samples with coated papers produced by prior art practice, by the uniformly smoothly homogeneous and flat lay of the coating and by the latter's relative freedom from skips, ridges, ripples, brush marks and other similar smoothing effects, said product being further characterized in that it is obtained by the process which comprises applying an excess of aqueous mineral coating composition to one surface of a moving web of paper on which a predetermined layer of said composition is to be formed, removing all except the desired weight of said coating composition by means of a doctor member whose surface is at a predetermined distance from the said web, which doctor member surface moves in a direction opposite to that of the aforesaid web and at a predetermined speed which is greater than one-seventh and less than equal to the speed of the said web, and continuously cleaning the surface of said doctor member.

4. As a new product, a mineral coated paper characterized in that the coating presents connected groups of a variety of non-repeating, irregular, patternless, relatively faint wave or curvilinear-shaped marks said groups extending generally transverse to the grain of the paper, presenting a rippled effect obtained by the process

ess which comprises applying an excess of aqueous mineral coating composition to one surface of a moving web of paper on which a predetermined layer of said composition is to be formed, removing all except the desired weight of said coating composition by means of a doctor member whose surface is at a predetermined distance from the said web, which doctor member surface moves in a direction opposite to that of the aforesaid web and at a predetermined speed which is at least equal to the speed of the said web, and continuously cleaning the surface of said doctor member.

DONALD B. BRADNER.

10	85
15	90
20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150