

April 23, 1946.

G. D. MUGGLETON ET AL

2,398,844

PAPER COATING

Filed March 4, 1944

2 Sheets-Sheet 1

Fig. 1.

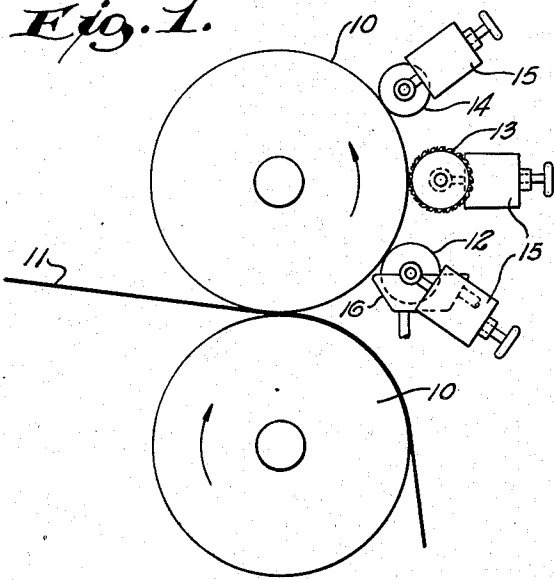


Fig. 2.

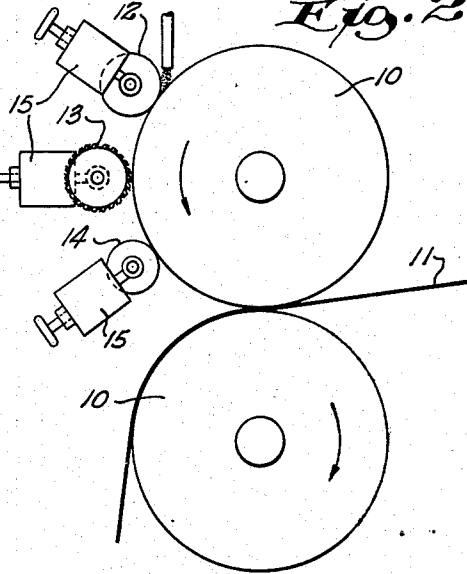


Fig. 3.

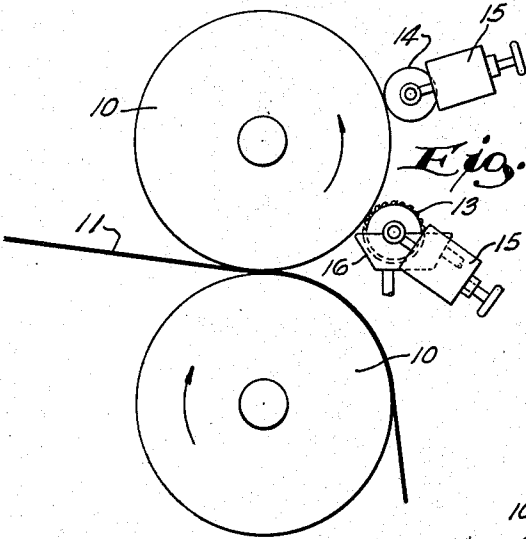


Fig. 4.

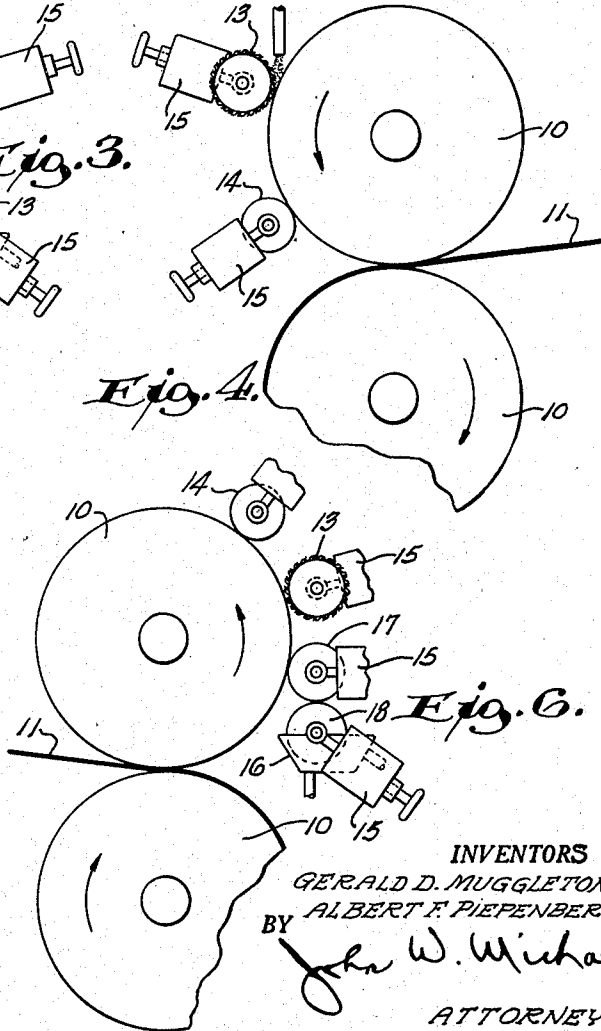


Fig. 5.

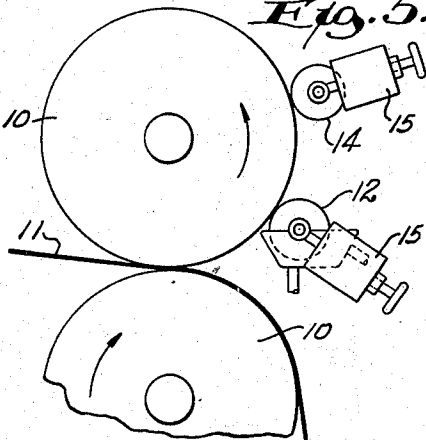


Fig. 6.

INVENTORS
GERALD D. MUGGLETON.
ALBERT F. PIEPENBERG.
BY *John W. Michael*
ATTORNEY.

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2 Sheets-Sheet 2

FIG-7-

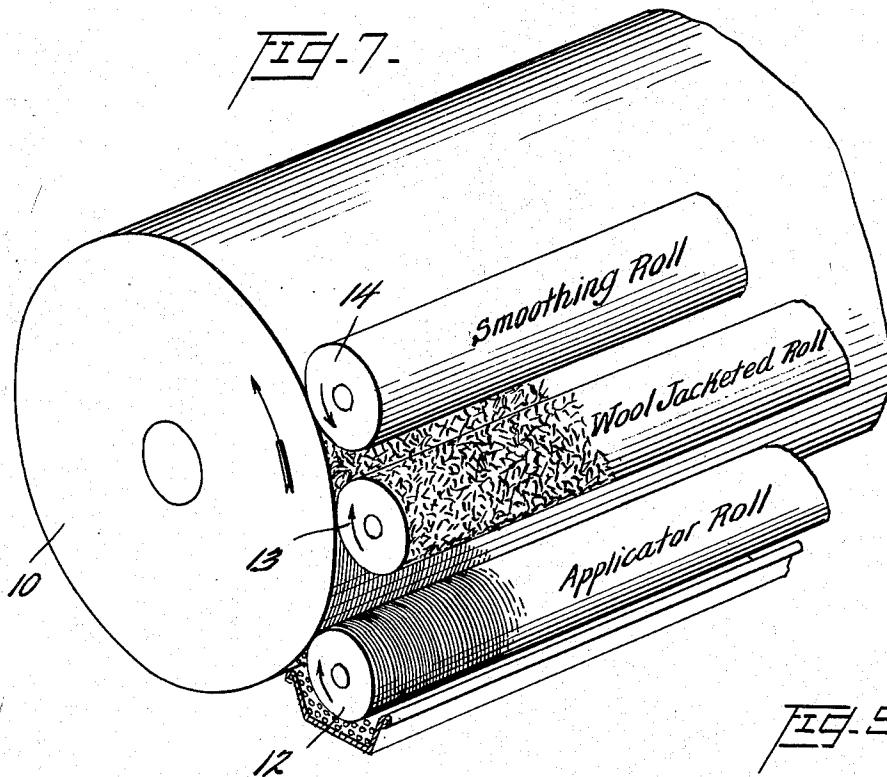


FIG-8-

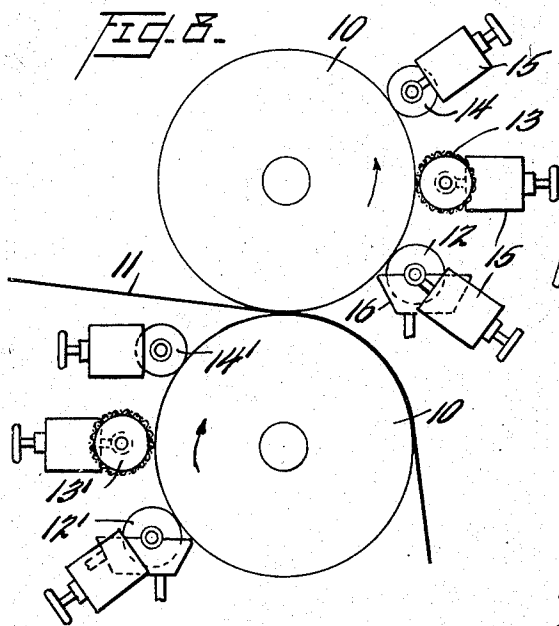
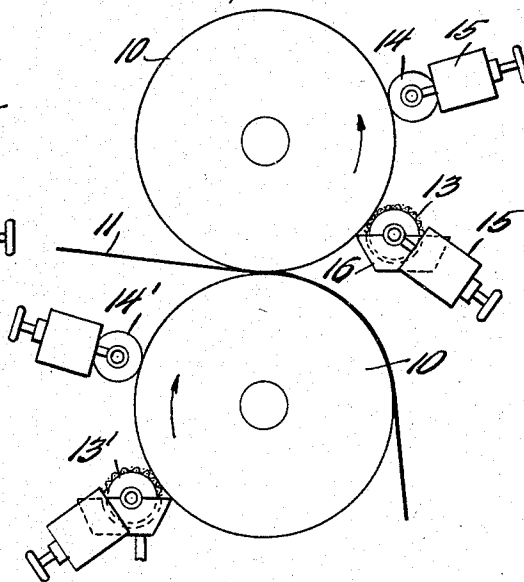


FIG-9-



Inventors

Gerald D. Muggleton
Albert F. Piepenberg,

By John W. Michael

Attorney

UNITED STATES PATENT OFFICE

2,398,844

PAPER COATING

Gerald D. Muggleton, Appleton, and Albert F. Piepenberg, Combined Locks, Wis., assignors, by mesne assignments, to Combined Locks Paper Co., Combined Locks, Wis., a corporation of Delaware

Application March 4, 1944, Serial No. 525,044

18 Claims. (Cl. 117-64)

This invention relates to improvements in the art of coating and more particularly to an improved apparatus for and method of coating paper.

Heretofore in coating paper it has been proposed to apply a film of the coating liquid upon the surface of one roll of a series of rolls in contact with each other and then transfer the film from roll to roll and finally to the paper by engagement of the last roll of the series with the paper. This method follows quite closely the common procedure of transferring ink films to type or plates in printing. Ink, however, is made up with an oil vehicle, while in paper coating water is employed as the vehicle in the great majority of cases. The viscosity of pigment-oil mixtures is not at all in the same range as the viscosity of clay-water mixtures. Films of the former when once formed retain their shape upon the surface of the roll until they come in contact with the type and paper. Films of the latter, however, are not so permanent and the centrifugal force created by the revolution of the rolls at the speeds commonly used in commercial coating is greater than the force of adhesion between the film and the surface of the roll so that the coating flows into surface tension ridges which are carried forward in the coating to the surface of the paper when the characteristics of the coating do not come within the narrow limits required to permit redistribution in the nip between the two rolls where the film is transferred to the paper. This is very apparent when the coating mixture happens to be such that it comes within the range where dilatency prevails. In such cases the surface of the coating on the paper when viewed under a microscope resembles a plowed field.

Numerous attempts have been made in the art to so apply the film of liquid coating to the coating roll, that is, the roll by which the coating is applied directly to the web of paper, so as to avoid or prevent the formation of these so-called surface tension ridges. One such proposal is shown in our prior application Serial No. 450,550, filed July 11, 1942, according to which a film of the coating liquid is applied to the surface of the coating roll by means of a metering roll having an indented or intaglio surface of uniform design. Such proposal has been found quite successful when working with a certain range of weights of coating. So also when, as further proposed in our said prior application, the film is applied to the coating roll by a smooth surfaced metering roll and thereafter subjected to

the action of a distributing roll having an intaglio surface to break up the surface tension ridges in the film. It has been found, however, in the use of the apparatus of our prior application, when employing coatings in other ranges of weights, that the uniform pattern imparted to the film by the metering roll or the distributing roll is not entirely obliterated in the coating or press roll nip, with the result that such pattern is carried forward to and is apparent on the surface of the paper. It is very difficult, if not impossible, when working with some coatings, to obliterate a uniform pattern imparted to the film of liquid coating on the coating roll whether originating in the metering roll or the nip between a subsequent distributing roll and the coating roll to such extent that such pattern is not carried through to the finished paper and discernible on the surface thereof. Then, too, the use of an indented or intaglio surfaced roll for applying or metering the film to the coating roll in the first instance limits the thinness of the film which may be measured or metered onto the coating roll in the nip between the latter and the metering roll.

One object of the present invention is to provide apparatus for and a method of coating paper wherein the foregoing objections are overcome and a film-like coating of uniform and predetermined thickness free of surface tension ridges and all other objectionable markings may be continuously applied to either or both sides of a traveling web of paper. The invention may be incorporated in a paper making machine at any selected point in the travel of the web through such machine either in the press section or in the dryer section or at any intermediate station without in any way retarding or interfering with the regular production capacity of the machine, or the invention may be employed for the coating of finished paper as an entirely separate operation and quite apart from a paper making machine.

While susceptible of a number of modifications as hereinafter pointed out, our invention in its preferred form is broadly characterized by the use of a smooth surfaced metering roll in engagement with a coating roll and minutely adjustable so that a film of any desired thinness may be applied to and measured upon the coating roll in the nip between said rolls in combination with a distributing roll having a heterogeneous surface pattern to break up the surface tension ridges in the film and distribute the coating uniformly over the surface of the coating roll, and

a smoothing roll to obliterate the pattern imparted to the film by the distributing roll, the smoothing roll only lightly engaging the film and running at a different speed either in the same or in the opposite direction. In this manner a perfect film is formed on the coating roll before contact with the paper, transfer from roll to roll before contact with the paper is eliminated, the need for smoothing the coating after contact with the paper is avoided, surface tension ridges and pattern and all other objectionable markings are avoided in the finished paper, and the many other drawbacks and disadvantages and defects and limitations in paper coating as heretofore practiced are overcome and superior results obtained.

The objects and advantages of the present invention will appear more fully as the description proceeds, reference being had to the accompanying drawings, wherein:

Figure 1 is a diagrammatic view in side elevation of a coating press embodying the present invention;

Figure 2 is a view similar to Figure 1 showing a slightly different adaptation of the invention;

Figure 3 is a view similar to Figure 1 of a modified form of the invention;

Figure 4 is a view similar to Figure 3 showing a slightly different adaptation of the form of the invention shown in Figure 3;

Figure 5 is a view similar to Figure 3 of another modified form of the invention; and

Figure 6 is a similar diagrammatic view in side elevation of a still further form of the invention.

Fig. 7 is an enlarged fragmentary view in perspective, showing in somewhat diagrammatic form, the arrangement of the accessory rollers shown in Fig. 1.

Fig. 8 shows diagrammatically a duplication of the accessory rolls shown in Fig. 1, as used for coating both sides of the paper.

Fig. 9 shows diagrammatically a duplication of the accessory rolls shown in Fig. 3 as used for coating both sides of the paper.

Referring more particularly to the drawings, the coating rolls are designated at 10. A web of paper 11 to be coated is shown engaged by and passing between said rolls. In Figures 1 and 2 the accessory rolls for metering, distributing and smoothing the film of liquid coating upon the surface of the coating roll with which they cooperate are designated respectively 12, 13 and 14. Air pistons and stops indicated at 15 are provided for individual adjustment of these various accessory rolls towards and from the associated coating roll and each roll is driven preferably with a variable speed drive. The metering roll 12 is smooth surfaced so that through its adjustment a film of any desired thinness may be measured onto the coating roll.

In Figure 1 the accessory rolls are shown associated with the coating roll on the ascending side thereof, the metering roll 12 being the lowermost of the tier and the smoothing roll 14 being the uppermost. The coating liquid is supplied to a pan or trough 16 in Figure 1 and the metering roll dips into the liquid coating in the pan and conveys a film thereof to the nip between the metering roll and the coating roll where the coating is metered or measured onto the latter roll. In Figure 2 the accessory rolls are shown associated with the coating roll on the descending side thereof. This necessitates an arrangement of the accessory rolls the reverse of that shown in Figure 1, the metering roll being the uppermost of the tier and the smoothing roll

the lowermost. In this adaptation of the invention the liquid coating is supplied directly to the nip between the metering roll and the coating roll so as to form a slight pool which continuously supplies the measured film onto the surface of the coating roll as the metering roll rotates in engagement with the coating roll. The accessory rolls in each of Figures 1 and 2 are shown in full lines in association with the upper of the two coating rolls for coating one side of the paper. When it is desired to coat the paper on both sides the accessory rolls in any of these embodiments are merely duplicated in association with the other of the coating rolls as shown in Figs. 8 and 9 in connection with the modifications illustrated in Figs. 1 and 3, respectively. In Figs. 8 and 9, the same reference numerals employed in connection with Figs. 1 and 3 to designate the accessory rolls, have been employed, modified only by the use of a prime character, thus 12', 13', 14', etc. It is obvious that any of the modifications shown in Figs. 1 to 6 inclusive may be employed for coating the paper on both sides by duplicating the accessory rolls after the manner suggested in Figs. 8 and 9.

The smoothing roll 14 in each instance is a smooth surfaced roll engaging quite lightly with the coating roll and for best results is rotated at a speed such as to provide a differential surface speed with respect to that of the coating roller 10, either in the same or in the opposite direction, preferably the latter. The distributing roll 13 is provided with a heterogeneous surface pattern, as distinguished from a uniform or geometric pattern, such as heretofore employed. The pattern is preferably constituted of closely arranged uneven and irregular markings with no uniformity and assuming varied and disordered relationships one to the other. Such a surface pattern may be imparted to the distributing roll 13 by mechanical cutting, photoengraving, etching, electro-deposition or other process, or it may be provided by covering or jacketing the roll with sponge rubber or cloth, preferably wool. A suitable endless belt of some such material running in engagement with the coating roll may be employed in lieu of a roll. A wool blanket jacketed roll has been found very satisfactory in actual practice and very effective in freeing the film of liquid coating on the coating roll from surface tension ridges while imparting a pattern thereto which is readily and completely obliterated by the smoothing roll so that a perfect, smooth, even, uniform film is established on the coating roll prior to transfer to the paper. The transfer to the paper of the film thus formed occurs in the nip of the coating rolls.

Referring to Figures 3 and 4, a slightly modified form of the invention is shown wherein the smooth surfaced metering roll is dispensed with and the distributing roll with the heterogeneous surface pattern as aforesaid is employed for both metering and distributing. The smoothing roll is retained in this embodiment and is operated and functions in the same manner as in the arrangements shown in Figures 1 and 2. In Figure 3, as in Figure 1, the accessory rolls are shown associated with the ascending side of the upper coating roll in full lines for coating one side of the web of paper. This arrangement is repeated for the other roll, as shown in dotted lines, when it is desired to coat both sides of the web. Figure 4 shows the accessory rolls of Figure 3 associated with the descending side of the upper coating roll. Where simultaneous coating of

both sides of the paper is desired another set of accessory rolls may be used in association with the other coating roll as shown in dotted lines. With certain types and range of weights of coating, it has been found that the modifications illustrated in these Figures 3 and 4 produce entirely satisfactory results.

In Figure 5 another modification of the invention is shown wherein only the smooth surfaced metering roll 12 and the smoothing roll 14 are employed, the distributing roll with the heterogeneous surface pattern being dispensed with. In this form of the invention which has been found to produce very satisfactory results with certain types and range of weights of coating, surface tension ridges which are formed in the film of coating as it is metered upon the surface of the coating roll by the metering roll 12 are broken up in the nip of the smoothing roll 14 to produce a perfectly smooth uniform film on the surface of the coating roll as it leaves the smoothing roll prior to contact with the paper.

Thus while the form of the invention shown in Figures 1 and 2 will produce satisfactory results throughout the entire present commercial range of weights and types of coating, a lesser number of accessory rolls will be found entirely satisfactory in operating with coatings of certain types and weights within such range. In some instances the distributing roll with the heterogeneous surface pattern may be used with the smoothing roll and the smooth surfaced metering roll dispensed with, as shown in Figures 3 and 4, whereas with coatings of certain other types and weights within said range the smooth surfaced metering roll and the smoothing roll may be employed and the distributing roll with the heterogeneous surface pattern dispensed with, as shown in Figure 5. It will be understood that the accessory rolls shown in Figure 5 may be associated with either the ascending or descending side of either or both coating rolls in the manner illustrated in Figures 3 and 4 and arranged for the coating of either or both sides of the web of paper as desired.

Referring to Figure 6, a further modification is illustrated wherein a transfer roll 17 is interposed between the metering roll 18 and the coating roll. In other respects the arrangement and operation may be the same as shown in any of the other figures of the drawings. As is well known in the paper making and paper coating arts, the surface of one of each pair of cooperable press or coating rolls is metal, the other rubber. The reasons for this are well known and for the same reasons it is desirable to have the same material surface differences in a metering roll-coating roll relationship. In some instances it is preferred to provide a differential surface speed between the metering roll and the coating roll for closer control of the amount of coating applied. To avoid undue wear and abrasion it may be preferred not to slip a metal surfaced metering roll on a larger rubber covered coating roll. The modification of Figure 6 is proposed, therefore, to avoid the disadvantage of such an operation in cases where a differential speed at the metering nip is desired. In this modification the transfer roll would be a metal roll rotating at a speed such as to provide the same surface speed as that of the coating roll and the differential surface speeds or slippage would be employed between the transfer roll and the metal metering roll. Thus, the slippage is confined to the nip between the transfer roll and the me-

tering roll, metal to metal, while the surface speed at the point of contact between the transfer roll and the coating roll, metal to rubber, would be the same and wear and abrasion avoided.

It will be understood that the invention may be applied in a paper making machine at any selected point in the travel of the web of paper therethrough, or it may be employed for the coating of finished paper as an entirely separate operation and quite apart from a paper making machine. When applied at the wet end of a paper making machine the accessory rolls can be associated directly with a pair of the press rolls, thus utilizing them as the coating rolls and avoiding the necessity of adding separate coating rolls. When employed in the dryer section of such machine it is proposed to add a set of rolls to constitute the coating rolls and associate the accessory rolls therewith.

It is to be understood that the particular examples indicated above are illustrative rather than restrictive and that various changes may be made without departing from the spirit of the invention or the scope of the appended claims.

We claim:

1. An apparatus for coating paper comprising a pair of cooperable rolls between which a web of paper is adapted to pass, means for applying a film of liquid coating to one of said rolls, a smoothing roll for re-working said film on the surface of said one roll, and a cloth jacketed distributing roll for breaking up the surface tension ridges in said film intermediate said smoothing roll and said means.

2. An apparatus for coating paper comprising a pair of cooperable rolls between which a web of paper is adapted to pass, means for applying a film of liquid coating to one of said rolls, a smoothing roll for re-working said film on the surface of said one roll, and a distributing roll for breaking up the surface tension ridges in said film intermediate said smoothing roll and said means and provided with a heterogeneous surface pattern.

3. An apparatus for coating paper comprising a pair of cooperable rolls between which a web of paper is adapted to pass, means for applying a film of liquid coating to one of said rolls, a smoothing roll for re-working said film on the surface of said one roll, and a distributing roll for breaking up the surface tension ridges in said film intermediate said smoothing roll and said means and provided with a heterogeneous surface pattern, said smoothing roll lightly engaging said film and rotating at a speed such as to provide a different surface speed from that of said one roll.

4. An apparatus for coating paper comprising a pair of cooperable rolls between which a web of paper is adapted to pass, means for applying a film of liquid coating to one of said rolls, a smoothing roll for re-working said film on the surface of said one roll, and a distributing roll for breaking up the surface tension ridges in said film intermediate said smoothing roll and said means and provided with a heterogeneous surface pattern, said smoothing roll rotating in a direction such as to provide at the point of contact with said one roll, surface movement in a direction opposite to that of said one roll.

5. An apparatus for coating paper comprising a coating roll in engagement with the paper, a smooth-surfaced metering roll engaged with the coating roll and adapted to supply a measured

film of liquid coating thereto, a smoothing roll in engagement with the coating roll for re-working said film, and a fabric covered roll intermediate the smoothing roll and metering roll for breaking up surface tension ridges formed in the film.

6. An apparatus for coating paper comprising a coating roll rotating in engagement with a web of paper, a roll jacketed in cloth provided with a heterogeneous surface pattern for applying a measured film of liquid coating to said coating roll, and a smoothing roll in engagement with the coating roll for re-working the film.

7. An apparatus for coating paper comprising a coating roll rotating in engagement with a web of paper, a cloth covered metering roll provided with a heterogeneous surface pattern for applying a measured film of liquid coating to said coating roll, the surface of said metering roll traveling in the same direction and at the same speed as the surface of the coating roll at its point of contact therewith, and a smoothing roll lightly engaging the coating roll following the metering roll and rotating at a speed such as to provide a differential surface speed with respect to that of the coating roll.

8. An apparatus for coating paper comprising a coating roll rotating in engagement with a web of paper, a cloth covered metering roll provided with a heterogeneous surface pattern for applying a measured film of liquid coating to said coating roll, the surface of said metering roll traveling in the same direction and at the same speed as the surface of the coating roll at its point of contact therewith, and a smoothing roll lightly engaging the coating roll following the metering roll and rotating in the same direction as said coating roll to provide at the point of contact therebetween, oppositely moving roll surfaces.

9. An apparatus for coating paper comprising a coating roll, a metering roll adapted to apply a metered film of liquid coating to the coating roll, a smoothing roll operatively engaging the film on the coating roll and rotating in the same direction as said coating roll to provide at the point of contact therebetween, oppositely moving roll surfaces, and an intermediate distributing roll cooperatively engaging the coating roll and provided with a heterogeneous surface pattern.

10. The method of coating paper which consists in applying a measured film of an aqueous suspension of solids upon the surface of one of a pair of rolls running in engagement with a web of paper, simultaneously imparting to said film a heterogeneous surface pattern to prevent the formation of surface tension ridges therein, and thereafter and prior to engagement of the film with the paper re-working the film to remove the pattern marks and other irregularities therefrom.

11. The method of coating paper which consists in applying a measured film of an aqueous suspension of solids upon the surface of one of a pair of rolls running in engagement with a web of paper, simultaneously imparting to said film a heterogeneous surface pattern to prevent the formation of surface tension ridges therein, thereafter and prior to engagement of the film with the paper re-working the film to remove the pattern marks and other irregularities therefrom, and finally transferring said film to the paper by pressure of said first named pair of rolls in the nip thereof.

12. The method of coating paper which consists in applying a measured film of aqueous sus-

pension of solids on the surface of one of a pair of rolls running in engagement with a web of paper and thereafter imparting to said film a heterogeneous pattern to break up the surface tension ridges therein, and finally re-working said film to obliterate said pattern.

13. The method of coating paper which consists in applying a measured film of aqueous suspension of solids on the surface of one of a pair of rolls running in engagement with a web of paper, thereafter imparting to said film a heterogeneous surface pattern to break up the surface tension ridges therein, then re-working said film to obliterate said pattern, and finally transferring said film to the paper by pressure of said first named pair of rolls in the nip thereof.

14. An apparatus for coating paper comprising a coating roll, means to apply a film of liquid coating to the surface thereof, a smoothing roll for re-working the film on the coating roll and having a differential surface speed with respect thereto, and film distributing means including a roll disposed intermediate said first named means and said smoothing roll adapted to engage the film on the coating roll, said distributing roll being provided with a heterogeneous surface pattern.

15. An apparatus for coating paper comprising a coating roll rotating in engagement with a web of paper and adapted to receive and transfer to the latter a film of coating material, means including a cloth covered roll coacting with said coating roll in advance of such engagement for imparting a heterogeneous surface pattern to said film, and means following said first-named means and also coacting with said roll for re-working the film to remove the pattern marks and other irregularities therefrom prior to the application thereof to said web.

16. The method of coating paper which consists in applying a measured film of an aqueous suspension of solids upon the surface of one of a pair of rolls running in engagement with a web of paper, imparting to said film a heterogeneous surface pattern to prevent the formation of surface tension ridges therein, and thereafter and prior to engagement of the film with the paper re-working the film to remove the pattern marks and other irregularities therefrom.

17. An apparatus for coating paper comprising a coating roll in engagement with the paper, means cooperating with the coating roll for metering a measured film of liquid coating upon the surface thereof for transfer to the paper, and a roll having a heterogeneous surface pattern intermediate the metering means and the point of transfer of the film to the paper for breaking up surface tension ridges present in the film.

18. An apparatus for coating paper comprising a coating roll and a cooperating press roll rotating in engagement with a web of paper, a coating applying roll in advance of such engagement for applying liquid coating to said coating roll, said applying roll being jacketed in cloth having a heterogeneous surface pattern for preventing the formation of surface tension ridges in the coating as the latter is applied to the coating roll, and a smoothing roll engaging the coating roll intermediate the applying roll and said engagement and acting upon said coating to remove the pattern marks and other irregularities therefrom prior to the application thereof to said web.

GERALD D. MUGGLETON.
ALBERT F. PIEPENBERG.