April 13, 1943. E. WARNER 2,316,202

METHOD FOR COATING PAPER

Filed July 31, 1940 2 Sheets-Sheet 1

Fig. 1,

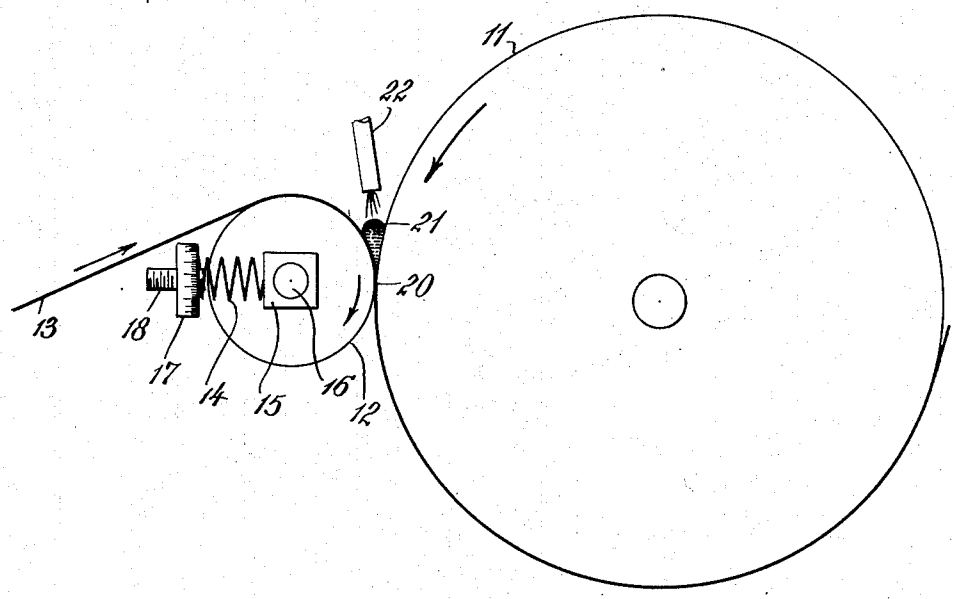
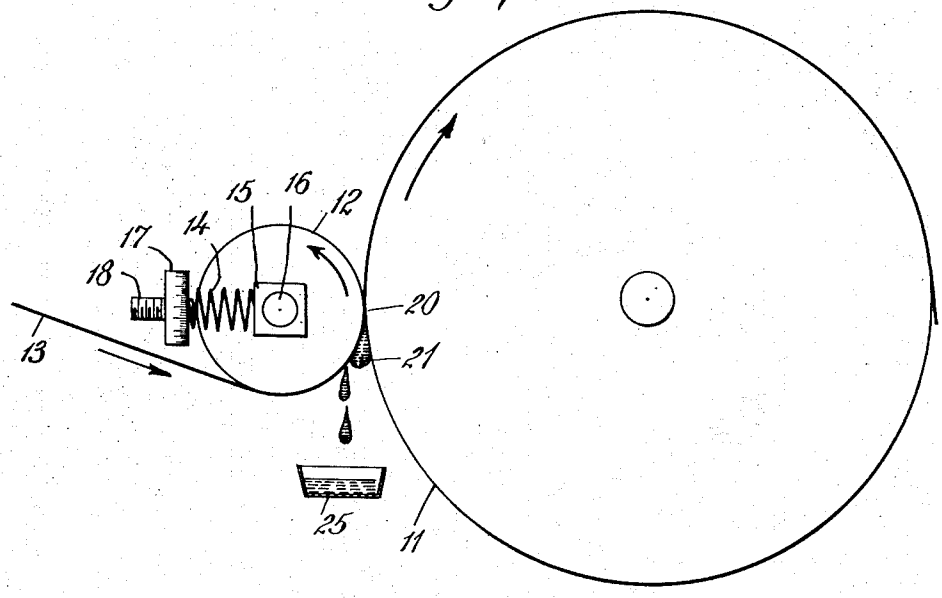


Fig. 2,



INVENTOR
EDGAR WARNER

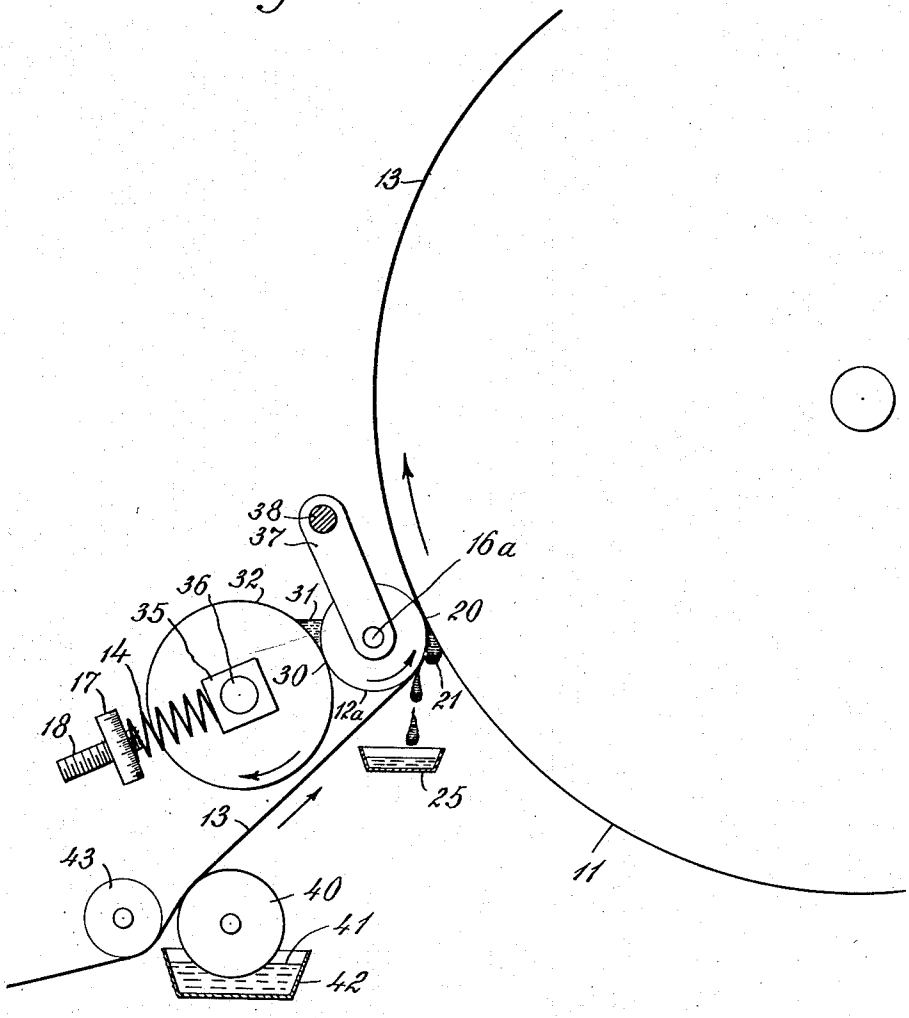
BY
Pennie Davis, Marvin Edmonds
his ATTORNEYS

April 13, 1943. E. WARNER 2,316,202

METHOD FOR COATING PAPER

Filed July 31, 1940 2 Sheets-Sheet 2

Fig. 3.



INVENTOR
EDGAR WARNER
BY
Pennie Davis Marvin, Edmonds
his ATTORNEYS

Patented Apr. 13, 1943 2,316,202

UNITED STATES PATENT OFFICE

2,316,202

METHOD FOR COATING PAPER

Edgar Warner, Dayton, Ohio, assignor to The Champion Paper and Fibre Company, Hamilton, Ohio, a corporation of Ohio

Application July 31, 1940, Serial No. 348,951

8 Claims. (Cl. 117—102)

This invention relates to methods of application of coatings to paper in the production of cast surfaced paper such as described in Patent No. 1,719,166, granted to Donald B. Bradner on July 2, 1929.

According to said patent, after the desired amount of coating has been applied to one side of a paper web and before the surface of the coating has hardened, it is pressed into intimate contact with a finished casting surface, where it is allowed to harden by cooling, drying, or the like. The character of the casting surface and the character of the coating used are so related to each other that when the coating has hardened it will not adhere to the surface and can therefore be cleanly separated therefrom. The form of the casting surface is a replica of that desired on the finished coated paper and is, in a preferred embodiment, mirror smooth. The surface is advantageously formed on an endless belt or revolving drum to permit continuous operation. The surface of the unhardened coating on the paper web is advantageously pressed into contact with the casting surface by means of one or more rolls which press against the opposite side of the paper.

According to Patent No. 1,719,166, the coating material is applied to the paper by any usual type of coating device such as a roll or brush coater of known construction, which is adapted to apply and smooth out an even, uniform layer of coating of the exact weight required, on the surface of the paper. Although, as stated in the patent, the process is adapted to smooth out small irregularities such as brush marks, etc., in the surface of the coating, the coater used must not only be adapted to accurately and uniformly control the weight of coating applied, but must apply the coating in a substantially uniform and evenly distributed layer with a fairly smooth surface, if a product of high quality is to be produced. This requires large and cumbersome types of coating devices which are complicated and expensive both to install and to operate, and which therefore render the production of cast surfaced paper more difficult and more costly than would be the case if less precision were required in the coating applying devices.

It has also been found that when exactly the required amount of coating is applied to the paper, as described in the patent, before the coated paper is pressed into contact with the solid casting surface, small amounts of air are apparently unavoidably carried through under the press roll and between the surface of the coating and the solid casting surface. This entrapped air holds the coating away from the casting surface in spots, which therefore do not receive the desired cast finish, and also tends in its effort to escape, to form holes in the still plastic coating composition, which holes may be in or below the surface of the coating material. In either case they form defects in the finished paper, since the coating overlying subsurface holes is almost sure either to be broken through and carried away in printing or to change the absorptivity to printing ink. The damage done by entrapped air is more serious when the casting surface is heated to assist in the drying or setting of the coating, due to the consequent expansion of the air and to the reduction in viscosity due to heat, which is characteristic of many of the coatings used.

Furthermore paper webs coated by the usual types of coating devices tend to carry a slight bead of coating at the edges, which coating tends to build up on the casting surface and the press roll at the edges of the web and to become the cause of more or less serious operating difficulties. Attempts to overcome this trouble by leaving the edges of the web uncoated have not been successful due to the tendency of the paper to stick to the casting surface where the coating feathers out at the edge.

The primary object of the present invention is, therefore, to eliminate imperfections in the printing surface of paper produced in accordance with the patent hereinbefore mentioned. An allied object is to eliminate various operating difficulties encountered in the practice of the process. A further object is to provide a simpler, more economical, and more satisfactory method of applying coating to the paper and of controlling the weight and uniformity of the applied coating, which is particularly adapted for use in connection with the patented process. Other and more detailed objects of the invention will be apparent from the following description.

I have discovered that it is possible to largely prevent the passage of air under the press roll and the consequent formation of the defects mentioned in the finished paper. Contrary to the previous belief that the accurately gaged and levelled layers of coating on the paper must not be disturbed either before or at the time it is being pressed into contact with the casting surface, I now provide that the paper with its coating is rolled into contact with the casting surface while at least part of the coating is in a fluid condition so that the roll pressure in the nip

causes some of the fluid to flow backwards relative to the movement of paper web and casting surface, and to form a pool immediately in advance of the nip. The flow being in a backward direction against the oncoming paper and casting surface, the liquid flows into and fills any holes or surface depressions, displacing and pushing back any air which might have been present therein. I find that in this way it pushes back substantially all adherent air which might otherwise be entrapped and cause defects in the cast surface. Furthermore, I have discovered that it also carries back air which is entrapped in the liquid coating material itself in the form of foam, thus largely eliminating one of the difficulties which has heretofore prevented the use of coating compositions of high viscosity and solids content. I have, by this means found it possible to successfully use coating compositions of such viscosity that they retained more than 50 per cent of air by volume, without carrying through air bubbles to form defects in the cast coat on the paper surface.

I have also found that in addition to preventing the passage of air bubbles through the nip, the backward flowing pool in the nip serves to carry back particles of dirt and foreign matter which would otherwise go through and mar the cast surface of the finished paper.

Instead of the anticipated damage to the accuracy, uniformity, and smoothness of the coating layer, I find that the disturbance and partial removal thereof not only does not deleteriously affect these qualities, but also positively improves the surface characteristics of the coated paper by largely preventing the formation of some of the most serious defects to which cast surfaced paper has heretofore been subject.

The coating material may be applied to the paper by conventional types of coating devices as described in Patent No. 1,719,166, or applied to the casting surface as described in Patent No. 2,029,273, or to both so long as precautions are taken to make certain that at the point where the coated surface of the paper is pressed against the casting surface by the press roll there is an excess of coating material sufficiently fluid to flow backward and form a pool in the nip between the roller and the casting surface to thereby accomplish the results described. When excess coating composition is so supplied, the rolling pressure in the nip where coating and paper are rolled onto the casting surface furnishes the final control of the weight and uniformity of the layer of coating on the surface of the finished paper. This is particularly advantageous for there is no necessity for any accuracy in the control of the amount of coating applied, or the uniformity of its distribution by the coating applying devices so long as sufficient coating composition is supplied to give adequate coverage over all parts of the surface of the desired weight of coating and to permit the necessary backward flow in the nip. I therefore find it advantageous to omit the expensive precision coaters heretofore required and use simple coating applying devices such as dipping rolls, etc., or, with the more viscous types of coating, to simply feed the coating directly into the nip under the press roll which then serves as the sole coating device and permits carrying out the process of the patent without the need for the separate coating device which has heretofore been necessary to that process.

The method of the present invention will be better understood by reference to the accompanying drawings in which:

Figure 1 is a diagrammatic view illustrating one manner of carrying out the method of the present invention;

Fig. 2 is a similar view illustrating an alternative manner of carrying out the method; and

Fig. 3 is a similar view illustrating another manner in which the method may be practiced.

Referring to the drawings, in Figs. 1 and 2, 11 is the casting surface, here shown as the cylindrical surface of a rotating drum. The press roll 12 serves to press the coating material into intimate contact with the paper web 13 and the casting surface 11. An adjustable pressure between press roll 12 and casting surface 11 is maintained by any suitable means such as springs 14 which press against bearing blocks 15 for the journals 16 on roll 12, and may be adjusted by any suitable means such as graduated nuts 17 on screws 18 which may be fixed to the framework of the machine, not shown.

As illustrated in Fig. 1 the paper web 13, which has been freshly coated on its upper side by any suitable type of coating device, not shown, is led over and around roll 12 which presses the coated side against the finished casting surface 11. The distance of the coating device from roll 12 is such, in relation to the speed of operation and to the characteristics of the paper stock and coating composition used, that when the coated paper enters the nip 20, at least the surface of the coating on the paper is in such a fluid state that the pressure between roll 12 and surface 11 forces some of the coating material to flow backward in the nip 20 and form a pool 21 which washes back air and foreign matter from the nip and prevents them from going through the nip, and marring the surface of the finished coated paper. After passing through the nip 20, the coating adheres to the paper and the casting surface 11 and holds the paper thereon until the coating has been hardened as described in Patent No. 1,719,166, after which the finished cast surfaced coated paper is cleanly removed therefrom.

Instead of or in addition to applying the coating to the paper as described it may be applied to the surface 11 as described in Patent 2,029,273, but at such a distance from the nip that coating is brought to the nip in a sufficiently fluid condition that a portion of it flows backward as described.

Alternatively part or all of the coating may be introduced to the nip directly by any suitable means such as a pipe or series of pipes 22. In any event the amount of coating applied or the inflow of coating into the nip can be manually or automatically regulated in order to maintain the pool 21 approximately constant in size and uniform across the width of the web.

Regardless of the location at which the coating is applied, it must in accordance with the present invention be sufficiently fluid when it reaches the nip and the pressure exerted through the press roll 12 must be sufficient, with relation to the fluidity, to cause the backward flow and the formation of the pool as described.

When practicing the process in accordance with the present invention the pressure applied through the press roll 12 serves as the final control by which the amount of coating on the finished paper is determined. The total amount of coating on the paper is, of course, composed of any non-liquid coating present on either the

paper or the casting surface in addition to the liquid coating material carried through the nip, and the effect of the pressure applied through the roll 12 is dependent upon the viscosity of the coating as it enters the nip. By regulating the pressure with relation to the viscosity of the coating composition and the amount of non-liquid coating on the paper at the time the paper reaches the pressure roller, the weight of the finished coating may be accurately determined.

When carried out as illustrated in Fig. 2 the coating may be applied either to the paper web 13 or to the casting surface 11 as described. With this arrangement, however, the coating may more readily be applied in considerable excess and the excess squeezed out in the nip 20. In this case the pool 21 increases gradually in size, and when it increases beyond the limit of stability the excess coating material drops backward into pan 25, as shown, from which it may be returned to the supply.

In the modification illustrated in Fig. 3 the pressure, instead of being applied directly to the journals of the press roll, is applied to the press roll by means of a backing roll 32 having journals 36 turning in bearing blocks 35 to which pressure is applied by the springs 14 and is adjustable by turning nuts 17 on screws 18 as described in connection with Figs. 1 and 2. The press roll 12a is held in place by any suitable means such as arms 37 which carry the bearings for journals 16a and are in turn mounted on pivots 38 fixed to the machine frame, not shown. With this arrangement the press roll 12a is freed from bending stress and may be made smaller and lighter. It is also possible to remove roll 12a for regrinding, or replacement with a roll of different density (hardness) without changing the pressure adjustment.

With the backing roll arrangement illustrated in Fig. 3 it is possible to take care of coating material which gets on the press roll 12a beyond the edges of the web when pool 21 spreads laterally, or intermediate the edges of the web due to any holes, tearouts, etc., which may occur in the web. I have found that by maintaining in the nip 30 between press roll 12a and backing roll 32, a pool 31 of water, any coating material present is washed off of the press roll 12a. The washing may be aided by brushes (not shown) if desired, but I have found the water alone usually to be adequate. Water may be introduced into nip 30 by a shower pipe, not shown, and the overflow at the ends of the rolls caught in suitable pans, not illustrated in the drawings. The pressure in the nip 20 prevents more than a thin layer of coating from passing around roll 12a, while the pressure in nip 30 prevents the water in pool 31 from passing through and wetting the paper web 13, below.

Baking roll 32 is preferably made of metal and press roll 12a is provided with an impervious, more or less yielding, resilient covering of rubber or the like.

In Fig. 3 is also shown a simple coating roll 40 rotating in a pool of coating material 41 which is maintained in pan 42. Roll 40 may be positively rotated, by a driving means not shown, in either direction desired, at a speed which may be regulated to bring up the desired amount of coating material from pool 41. It then deposits this coating material on the surface of paper web 13. So long as a sufficient amount of coating is applied, no harm is done if it is drawn into ridges or stipples where the paper web parts from the surface of roll 40, as the coating is levelled off and the excess is removed by the pressure in nip 20, leaving a smooth, substantially uniform layer of coating material on the surface of the paper web. A fly roll 43 is located to maintain any desired angle of contact between paper web 13 and the coating roll 40.

In the practice of the processes described in the hereinbefore mentioned patents, much trouble has been encountered and much waste has been caused in the past by wrinkling and tearing of the paper web under the press roll 12, which difficulties often became extremely troublesome in case of lighter weight papers, e. g., those below 60 or 70 pounds per ream of 500 sheets 25 x 38 inches. This trouble is apparently influenced, if not caused, by such factors as tension on the web, alignment of rolls, pressure on press roll and consequent deformation of its resilient surface, etc.; but whatever the cause, it has been found that practically all wrinkling and tearing can be avoided and the operation can be otherwise facilitated by applying a positive drive of accurately controlled speed to the press roll.

An accurate and delicate speed adjustment is advantageously provided between the drive for the press roll and that for the casting surface whereby the speed of the press roll surface may be adjusted from somewhat below to somewhat above that of the casting surface, and whereby, when the adjustment has been made, the speed of the one will bear a fixed relation to that of the other. The press roll may be driven directly, or with the device illustrated in Fig. 3, the drive may advantageously be applied to the roll 32 which then drives roll 12a by friction in the nip 30. This adjustment may be accomplished by the use of known devices which themselves form no part of the present invention and are therefore not further described nor illustrated in the drawing. In operating, the press roll drive speed is adjusted by the operators to compensate for changes in pressure, paper tension, paper characteristics, paper weight, etc. by varying the drive adjustment until wrinkling ceases and results are found to be most satisfactory.

It will be apparent from the foregoing description that the pool of coating material which is maintained immediately in advance of the nip, in accordance with the present invention, need not be large or uniform, but must be continuous across the width of the web. The backward washing action of the coating material in the pool then washes air and foreign matter back from the nip and thus permits a more perfect contact of the coating with the casting surface, and gives a smoother, cleaner, and more perfect cast surfaced coating. The uniform excellence of the surface obtained is superior to any which has heretofore been obtainable on cast surfaced papers in continuous production.

The maintenance of a pool of coating in the nip combined with the washing of the press roll as described further eliminates the troubles formerly encountered at the edges of the web on the casting surface and press roll.

It will also be apparent that, according to the present invention, in place of the complicated and expensive coating machines heretofore necessary, the coating supply pipes 22 (illustrated in Fig. 1), for the more viscous coatings, or the simple coating roll 40 and pan 42 (illustrated in Fig. 3), for the less viscous coatings, are the only coating devices required. Construction of apparatus and operation of the process are thus much

simplified and reduced in cost, while the product is greatly improved by the use of my improved methods. These improvements also make possible the use of coatings having much higher (up to 60% or more) percentages of solids than could heretofore be used.

I claim:

1. The process of making coated paper which consists in pressing a traveling web of paper against a traveling casting surface with an interposed layer of paper coating composition, continuously maintaining a surplusage of liquid coating composition at the point of contact of the web and the casting surface and holding the web against the casting surface until the interposed layer of coating composition is set sufficiently to release itself from the casting surface.

2. In the process of making cast surfaced coated paper by roll-pressing a moving web of paper against a moving casting surface with a layer of coating material interposed therebetween, the improvement which consists in continuously washing back air bubbles and foreign matter, from the nip where the pressing occurs, by means of a backwardly flowing pool of liquid coating material maintained in contact with the paper and the casting surface immediately before said nip.

3. Process of making coated paper which consists in pressing paper and coating between two cylindrical surfaces, maintaining a backwardly flowing pool of coating material immediately in advance of the nip between said surfaces, and maintaining the coating material in contact with one of said surfaces until it is substantially hardened.

4. Process of making cast surfaced coated paper which comprises pressing a freshly coated paper web onto a casting surface by a resilient cylindrical pressing surface, maintaining a substantial pool of fluid coating composition immediately in advance of the nip between said casting and pressing surfaces where the freshly coated paper makes contact with said casting surface, limiting, by said pressing operation, the weight of coating which is to have a cast surface, and rendering the coating on the paper substantially non-plastic while in contact with said casting surface and subsequent to said pressing operation.

5. Process of making cast surfaced coated paper wherein coating material is roll-pressed between paper and a finished casting surface, characterized by applying coating material to the paper, bringing the coated paper to the nip where the pressure is applied while the surface of the coating is still fluid, and applying sufficient pressure through the press roll to cause some of the coating to flow backward and form a pool immediately in advance of the nip where the pressure is applied.

6. Process of making cast surfaced coated paper wherein coating material is roll-pressed between paper and a finished casting surface, characterized by the introduction of fluid coating material immediately in advance of the nip where the pressure is applied, the backward flowing of some of the fluid coating material in the form of a pool immediately in advance of the nip, and the passage of some of the fluid coating material through the nip to form a part of the coating on the finished paper.

7. Process of making cast surfaced coated paper which comprises applying coating composition to a casting surface, pressing, by means of a press roll, a paper web against the coating on said casting surface, maintaining a backward flowing pool of coating composition in advance of the nip between the casting surface and the press roll, cementing the paper to the coating on the casting surface and removing the coated paper from the casting surface after the coating has become substantially non-plastic.

8. In the process of making cast surfaced coated paper by pressing a moving web of paper, by means of a press roll, against a moving casting surface with a layer of at least partially fluid coating material interposed therebetween, the improvement which comprises the continuous washing back of air bubbles and foreign matter from the nip where said pressing occurs, by means of a backwardly flowing pool of coating material maintained immediately in advance of said nip where it continuously washes over the moving web and casting surface, and the continuous washing of the press roll by means of a pool of water maintained in contact with said roll and out of contact with the paper web and the casting surface.

EDGAR WARNER.