Aug. 24, 1926. 1,597,218

J. TRAQUAIR

METHOD AND APPARATUS FOR COATING PAPER

Filed July 24, 1922 3 Sheets-Sheet 1

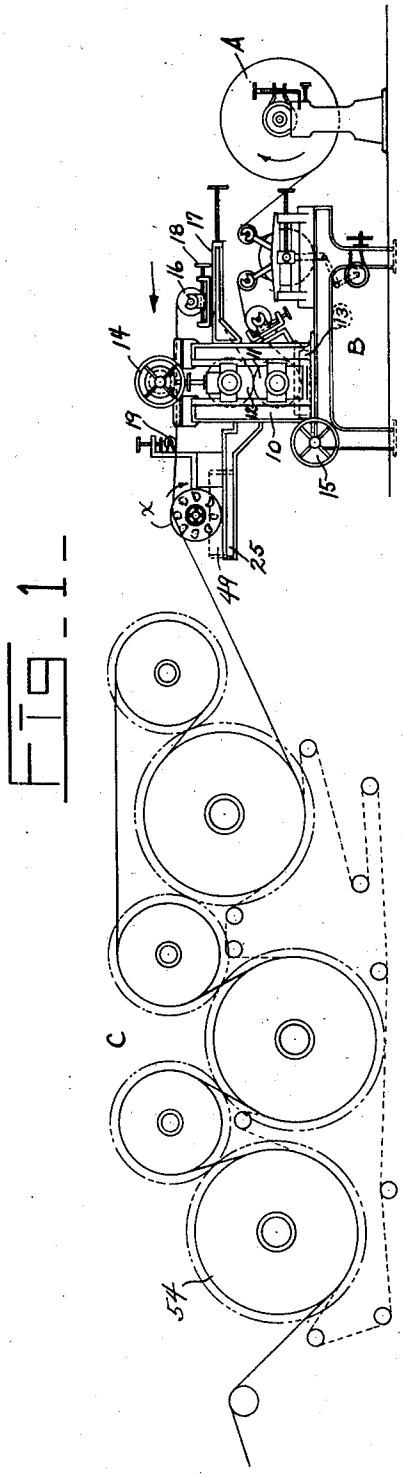


FIG. 1.

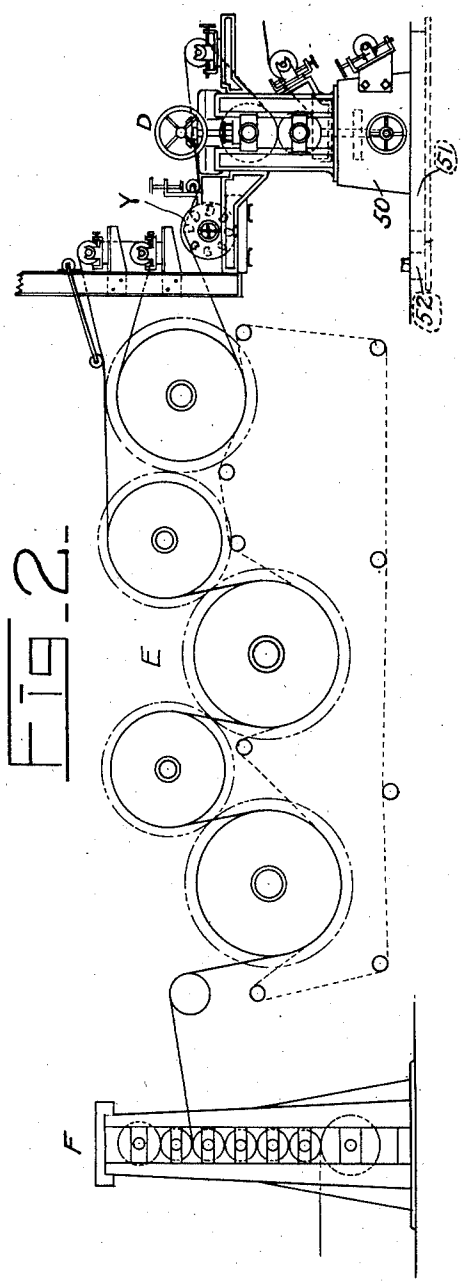


FIG. 2.

INVENTOR.
John Traquair,
BY F. K. Fassett,
ATTORNEY.

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FIG. 3.

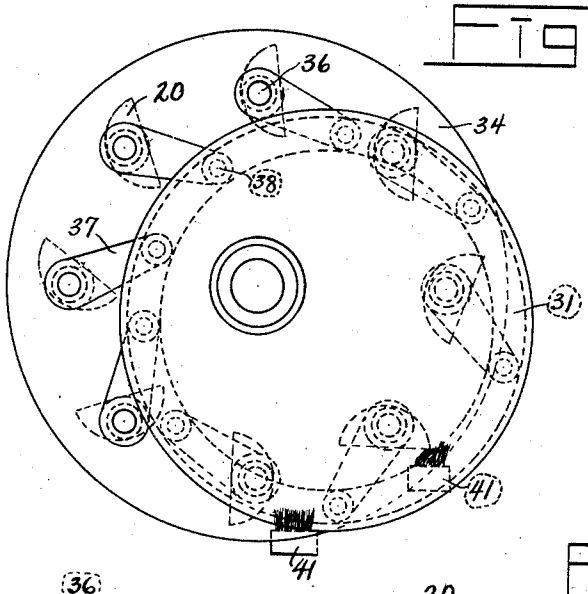
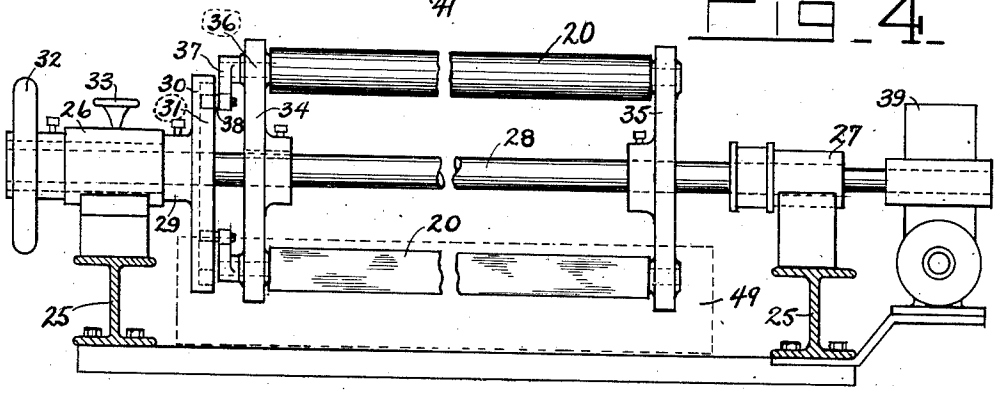


FIG. 4.



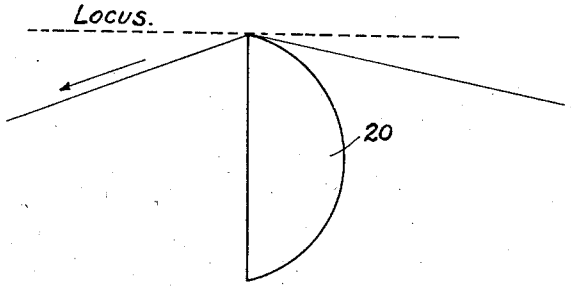


FIG. 5.

INVENTOR.
John Traquair,
BY
F. K. Fassett.
ATTORNEY.

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J. TRAQUAIR

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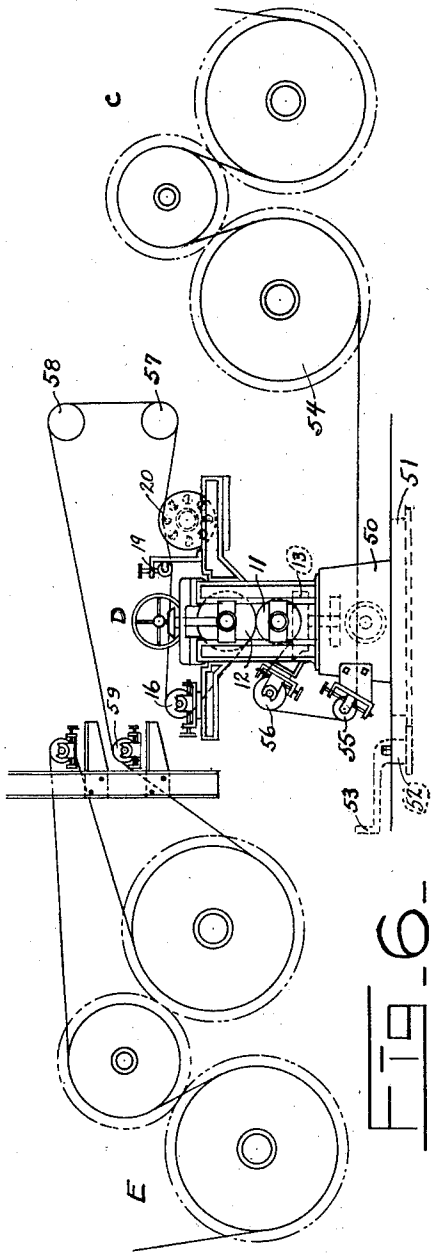


FIG. 6.

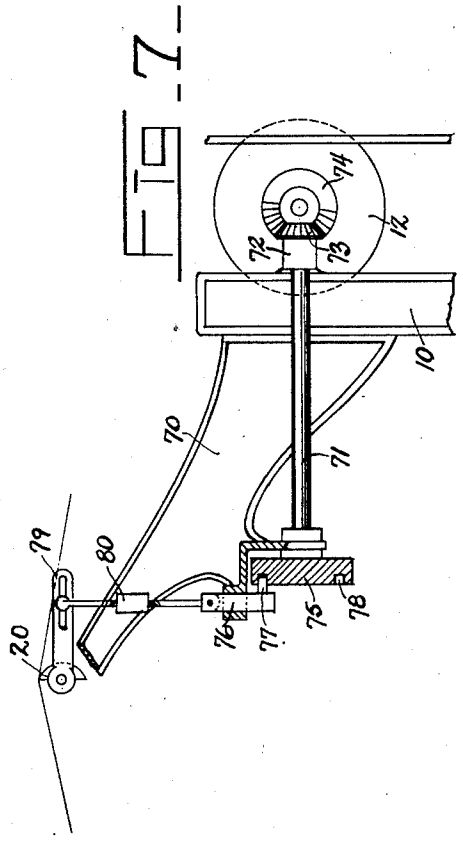


FIG. 7.

INVENTOR.
John Traquair,
BY F. K. Fassett,
ATTORNEY.

Patented Aug. 24, 1926. 1,597,218

UNITED STATES PATENT OFFICE.

JOHN TRAQUAIR, OF CHILLICOTHE, OHIO, ASSIGNOR TO THE MEAD PULP AND PAPER COMPANY, OF DAYTON, OHIO, A CORPORATION OF OHIO.

METHOD AND APPARATUS FOR COATING PAPER.

Application filed July 24, 1922. Serial No. 577,092.

My present invention relates to the art of coating paper with a suitable pigment, thereby leveling the surface and filling the pores of the paper, covering the exposed fibers and providing a good, even surface for printing.

The invention consists in a novel method of coating paper, and in improved and novel apparatus for putting the method into effect. It is related in some respects to the invention shown in my application filed December 3, 1920, Serial No. 427,934, in that certain features there disclosed are or may be used in my present invention.

The principal object of my invention is to produce a superior coated paper. Another object is to produce a paper having all the qualities desired in coated paper, but having a lighter coat than other high grade coated papers heretofore produced. Another object is to produce a coated paper whose surface has less gloss than other coated papers have. Another object is to provide means for producing a very high grade coated paper at a cost less than that of producing inferior coated papers by other methods. Another object is to provide a method by which high class coated paper, very uniform in quality, may be produced in large quantities. Another object is to provide a method of coating paper which will be practically independent of atmospheric or climatic conditions. Other objects, and advantages obtained by my process and apparatus, will appear or be particularly pointed out presently.

In the accompanying drawings—

Figure 1 is an elevational view of one-half of my improved coating machine; and

Figure 2 is an elevational view of the other half of the machine. The right hand end of Figure 2 is supposed to join the left hand end of Figure 1. This figure is in reality substantially a duplicate of the machine shown in Figure 1, and where paper is coated in a manner which requires its passage twice through the machine, it passes directly from the machine of Figure 1 to that of Figure 2. Figures 1 and 2 are diagrammatic to a very large extent;

Figure 3 is an end view of the troweling mechanism which is shown at X in Figure 1 and at Y in Figure 2, but in Figure 3 the mechanism is viewed from the opposite side of the machine;

Figure 4 is a view of the troweling machine with the observer facing in the direction of the arrow in Figure 1;

Figure 5 is a diagrammatic view of a troweling bar, illustrating the troweling process;

Figure 6 shows an arrangement for coating paper on the second side immediately after it has been coated on the first side;

Figure 7 shows a portion of one of the coating units equipped with a single troweling bar. This bar is arranged to oscillate and the figure shows means for oscillating it.

Referring now to Figure 1, it will be seen that paper from the roll A passes through the coating unit B to the drying unit C. The coating unit comprises a frame 10, in which rolls 11 and 12 are journaled. Below the roll 11 is a pan or trough 13 containing the coating material. The roll 11 dips into the coating material, or "color", as it is commonly called, and as the paper passes around the roll a layer of color is deposited on the paper. Coming around to the top of roll 11 the paper passes under the roll 12, by which the color on the paper is smoothed out and reduced to the desired thickness, the thickness being varied at will by raising or lowering the roll 12 with the hand wheel 14 and mechanism which it is not necessary to describe. Preferably, one of the rolls has a hard and the other a soft exterior. The pan 13 may be raised and lowered by mechanism operated with a hand wheel 15 to vary the depth to which the roll 11 dips in the color, and when the machine is not in operation the pan may be lowered entirely away from the roll. From between the rolls 11 and 12 the paper passes around an idle roll 16, under an idle roll 19, across the troweling device to the drier rolls.

Broadly speaking, that is, in its simplest form, the troweling device consists of a bar 20 having a curved surface which terminates in a sharp edge. The paper is drawn over this curved surface and across the sharp edge at an angle to the locus of the surface at the point where the surface meets the edge. See Figure 5. The effect of this troweling bar is somewhat like that produced by a mason or plasterer when he smooths the plaster with his trowel. The plasterer gets the smoothest and most compact surface by tilting his trowel slightly

and moving it over the surface of the plaster, at the same time applying moderate pressure to the trowel. If he tilts the trowel too much it will scrape off some of the plaster. But with a very slight tilt, or even with substantially no tilt at all, but by making the pressure on the trowel greatest at its rear edge, he is able to compact the plaster and impart to it a surface which can be obtained in no other way. And so it is with my troweling bar; the paper passes over the surface and across the edge, producing much the same result that the plasterer obtains. For this reason, and for lack of a better term, I have adopted the word "troweling" to describe the function of the bar 20. Before describing the troweling mechanism in Figure 1, I shall explain the steps leading up to the troweling operation.

I have employed the term "color" in referring to the content of the pan 13. Preferably, the "color" consists of a mixture of water, size and clay. In places I have used the term "solution" in reference to this mixture, although it is not, strictly speaking, a solution. Instead of clay, satin white, blanc fixe, or any other pigment which is ordinarily used in coating paper may be used, and these mixtures are commonly called "color", notwithstanding they may be and usually are white. I use less water than is usual in the color mixture, so little water, in fact, that the color will scarcely flow. This results in the layer of color which adheres to the paper as it passes through the pan 13 being thicker than necessary, and the function of the roll 12 is to remove the excess color, so that when finished the coat on the paper will have a predetermined weight. By the time the paper passes from between the rolls the color has become stable. That is, while it is still wet the color will not flow on the paper. Two factors contribute to this stability; first the paucity of water in the color, and second, absorption of water by the paper. As an aid to this second factor I prefer to use a soft sized paper, because of its superior absorptivity. Thus, the thickness of the layer of color is kept uniform until it reaches the troweling bar.

When the paper reaches the troweling bar the color should be sufficiently plastic to enable the troweling operation to smooth the color and compact it, without removing any of it, and this I refer to as the zone or point of critical drying. If the color be too dry the action of the bar is insufficient and unsatisfactory and if the color be too wet the bar scrapes some of it off. In order to reduce the color to the desired consistency, I provide for varying the length of time which elapses between the application of the color to the paper and its passage over the troweling bar. This is effected by the moving frame which carries the idle roll 16 one way or the other on the brackets 17, thus varying the distance traversed by the paper before it reaches the troweling bar. Minor adjustments, principally for the purpose of making the paper run properly around the rolls, are made by means of the hand wheel 18. From the troweling bar the paper passes to the drier C. As this drier consists of a series of heated drums well known in the paper making art, no description of it is necessary.

I shall now describe the plural-bar troweling device illustrated in the drawings, and refer more particularly to Figures 3 and 4. Extending from the frame 10 of the coating unit are brackets 25, each of which carries bearings, numbered respectively 26 and 27, in which a shaft 28 is mounted to rotate. The bearing 26 includes a sleeve 29, within which the shaft rotates, and this sleeve carries a circular disk 30, having an annular groove or race 31. The center of the disk and of the race is offset from the axis of the sleeve 29 and shaft, making the race eccentric to the shaft. The sleeve may be rotated to various positions in the bearing 26 by means of a hand wheel 32 and fixed in any position with a set screw 33. Keyed or otherwise fixed on the shafts are two spiders, 34 and 35, and these spiders act as supports for the troweling bars 20, the ends of the bars being turned down to form spindles adapted to rotate in the holes in the spiders in which they are held. In the interest of clarity only two bars are shown, but it is to be understood that there is a circle of bars, as in Figure 3. At the ends of the bars adjacent to the disk 30 the spindles 36 extend through the spider and carry arms 37, on the free ends of which are studs 38 arranged to travel in the race 31. At the other end of the shaft 28 a worm gear 39. driven by mechanism not shown, rotates the shaft and the parts it carries, slowly in clockwise direction as it is seen in Figure 1. I have found three revolutions per minute satisfactory, but other speeds may be used.

As I have previously stated, in its simplest form the troweling device is a single bar, as in Figure 5. But I have found in practice that occasionally a particle of foreign matter lodges on the edge of the bar and marks the coating as the paper passes over the bar, and the purpose of rotating a plurality of troweling bars in the manner just described is to bring clean bars successively into action. The purpose of the arms 37 with studs 38 sliding in the eccentric race 31 is to rock the bars gradually while they act on the paper and maintain substantially the same angularity between the paper and the locus of the curved surface of the bar at the point where said surface meets the edge. While the annular race 31 does not maintain the angularity exactly

uniform, the result is close enough for practical purposes. On the other hand, the use of an annular race, instead of a curve specially designed to preserve an invariable angularity, enables me to adjust the relation of the bars to the paper. For example, by rotating the disk 30 in the bearing 26 I can change the angularity and by raising or lowering the idler 19 I can vary the length of the arc of contact of the paper. Below the bars I place a pan 49 containing water. The troweling bars dip into this water as they move around and by means of brushes 41 are washed clean. By this means clean bars are periodically brought into action to relieve those which have been in action. Therefore, a particle of foreign matter lodged on a bar could affect but a few feet of the paper, which, in view of the rarity of such an occurrence, is negligible.

In my application previously referred to I described how to adjust the viscosity, that is, the penetrance of the liquid part of the color solution to the absorptivity of the paper. To increase the penetrance I add small quantities of silicate of soda if the color be a straight clay, or gum arabic if the color contains lime, in such a form as satin white, for example. To diminish the penetrance I add a small quantity of colloidal size. In my present method this is unnecessary, for in this method the weight of the coat on the paper is controlled by raising or lowering the roller, 12, while the consistency of the coat when it reaches the troweling bar is controlled by varying the length of time which elapses between the deposit of the color on the paper and its arrival at the troweling bar. It is quite feasible, however, to utilize the method of adjusting the penetrance of the solution along with the mechanical control provided in the present invention. It may be found advantageous, for example, to increase the penetrance if hard sized paper is being coated, or to reduce the penetrance if the paper is very soft sized.

My present invention is an improvement over that of my application referred to, among other reasons in that the time element here introduced enables me to complete the coating of paper on one side by a single pass through the machine, involving only one drying of the paper. Sufficient size may be included in the coating solution to bind the color to the paper, so that when the paper passes the last drum of the drier C it need only be calendered to make it ready for the market. I have had excellent success with this one step method, using a solution containing 20% of colloidal size. Other sizing materials, such as glue or casein, may be used.

There being so many factors entering into the time element which I have referred to, it will be readily seen that there is no particular time that can be prescribed as the best. A few figures will not be amiss, however, as an example. Running the paper through the machine at the rate of 180 feet per minute with a given color solution I have found that in traveling about 12 feet the coating attained a very satisfactory consistency for troweling. But of course this distance may be varied by changing the character of the color solution, or the thickness of the coating, or in other ways. At this rate the elapsed time is four seconds. I do not wish to be understood to limit myself to this or any similar time; on the contrary, one of the particular advantages of my present method is its adaptability to various conditions.

The purpose of my double machine, that is, two substantially similar machines operating in tandem, is to coat paper by two stages. One such use consists in coating the paper in the first machine with a mixture of water, a pigmental material, such as clay, satin white, blanc fixe, or the like, and a sufficient quantity of size to bind the pigment to the paper, then passing the paper directly from the drier of the first machine to the coating unit of the second machine, and there giving it a thin waterproof coating comprising clay and casein. While not entirely waterproof, this coating gives to the paper qualities desirable for lithographic printing. Another use for the double machine is to coat the paper first with some pigmental substance suitable for a foundation or filler, and then apply a thin second coat, using a finer quality of material. By this means a very fine grade of coated paper may be produced at a low cost.

I shall now describe the arrangement of the machines for coating paper on both sides. It will be noticed that the base of unit D, that is, the coating unit of Figure 2, is different from that of the coating unit in Figure 1. In Figure 2 the base 50 is mounted upon a revoluble sub-base 51, indicated by dotted lines. By means of a pinion 52 emmeshed with teeth on the sub-base and turned with a removable crank 53, the sub-base may be turned so that unit D faces in the opposite direction to that in which it faces in Figure 2. In Figure 6 the unit D is shown in this reversed position. The base 50 is provided with a passage for the paper, and from the drum 54 of the drier C the paper passes through the base, around idlers 55 and 56 and under the roll 11, whereby it is made to pass through the color pan 13, between the rolls 11 and 12, around roll 16, under roll 19 and across the troweling bars 20, around idlers 57, 58 and 59, to the first drum of the drier E. Thus the paper is coated on the second side, and from the drier E it passes through the calender F. See Figure 2.

It is not necessary to describe the calender, as it is no different from those well known in the art. But the fact that paper coated by the method I have described requires very little calendering is important. In fact, so far as the coated surface is concerned the paper might be used without calendering. The surface produced by the troweling operation is so good that it cannot be much improved, and since the uncalendered surface is free from gloss it is desirable to keep it that way. The principal effect desired from the calendering is to harden the paper.

I am aware that in certain classes of coating machines, principally for coating window shade and oil cloth, the fabric has been drawn across knife edges for the purpose of removing excess coating and to smooth the remainder. Not only are these knife edges of the prior art different in shape and action, but they operate under different conditions and for other purposes than my troweling bar. The description already given of the action of my troweling bar brings out these distinctions, but in connection with the method of coating paper on the second side immediately after it is coated on the first side, I desire to direct especial attention to one characteristic of the bar. It frequently happens that the paper must be spliced by lapping and pasting two ends of paper together, and while such a splice will run over a knife edge without difficulty if the paper is lapped so the leading layer is underneath, that is, toward the knife edge, if the paper is lapped the other way, the splice will catch on the knife edge as it goes over and tear the paper. But where paper is coated on first one side and then the other, as above described, running the paper across the knife edge against the splice could not be avoided. But the easy approach to the edge of my troweling bar enables the splice in the paper to run over the bar in either direction without any danger whatever of tearing the paper.

I have referred to the single troweling bar as the simplest form of this device, and in Figure 7, I show an arrangement for troweling the paper with a single bar. For the purpose of keeping the bar free from particles of foreign matter which might mark the paper I provide means for oscillating the bar as the paper runs over it. The bar is journaled in brackets 70 which are attached to the frame 10 and one of these brackets carries a bearing for one end of a shaft 71, the other end of the shaft being carried by a bearing 72 mounted on the frame 10. Only one of these brackets is shown and the outer extremity of it is broken away to expose the bar 20. A bevel gear 73 on the end of shaft 71 meshes with a gear 74 which is fixed to the end of roll 12. At its other end the shaft 71 carries a cam 75. A square rod 76 is arranged to slide in a bearing carried by the bracket 70, and carries a stud 77 which lies in the cam race 78 and as the shaft 71 rotates the rod 76 reciprocates in its bearing. An arm 79 is fixed to the end of the bar and by means of a pitman 80 this arm is connected to the rod 76. The arm 79 is slotted, enabling the distance the bar 20 oscillates to be varied, and the mean angularity of the bar may be varied by adjusting the length of the pitman. Thus the angularity at which the paper crosses the edge of the bar, with reference to the locus of the paper as it reaches the edge, may be varied at will. The oscillation is not required to be at any particular frequency, although I have obtained good results with bar oscillating once for each foot of paper running across the edge. The length of the movement is not vital, but I have found oscillations of about $\frac{1}{16}$ of an inch satisfactory. This slight disturbance has the effect of dislodging particles from the bar, and while on the whole this arrangement is less effective than the plural bar scheme, it produces very good results.

It is to be understood that the several rolls of these machines, and other moving parts where it is needed, are properly connected to rotate and operate in proper relation to one another. But these operating connections are not shown, for the reason that they do not enter into the invention, and it being well known how to provide such connections they have been omitted, so as to keep the drawings in simple form, principally diagrammatic.

From the above description it is evident that the relative movement of the traveling sheet of paper, and of the troweling device is such that a slippage of the paper with respect to the cooperating device is secured. This relative arrangement is also such that a compacting of the layer of color is secured along with this relative slippage. The result is the imparting of a smooth surface to the coating of color. Also, the practising of this method permits of greatly reducing the quantity of color needful for securing a coating comparable in satisfactory characteristics with coated paper made by heretofore practiced methods.

It is to be furthermore understood that the term "troweling" as used throughout the specification is used merely as a brief and apt term for describing the particular spreading and smoothing device which is illustrated as a preferred form of the invention; and that this term is not to be interpreted as limiting the invention to the precise form of apparatus illustrated. For while I have illustrated and described what at present I regard as the preferred apparatus for carrying out my new method, it is not to be understood that I limit my inven-

tion to the particular apparatus or other details described in this application, as modifications thereof may be made without departure from the spirit of my invention or exceeding the scope of my claims.

What I claim is as follows:

1. The method of coating paper, which comprises applying a layer of "color" to the paper, and after the color has attained a suitable consistency troweling the color to compact and make it smooth.

2. The method of coating paper, which comprises applying a layer of "color" to the paper, and after the color has attained a suitable consistency troweling the color by drawing it over a surface which terminates in a sharp edge, the paper being drawn across said sharp edge at an angle to the locus of the surface at the point where the surface meets the edge.

3. The method of coating paper comprising the application of a layer of "color" to the paper, reduction of the layer of color to a thickness which when finished will have a given weight, and after the color has attained a suitable consistency troweling the color to compact and make it smooth.

4. The method of coating paper, which comprises applying a solution of "color" to the paper, then after the lapse of sufficient time to permit absorption of water by the paper to reduce the color to a suitable consistency troweling the color to compact and make it smooth.

5. The method of coating paper, which comprises passing the paper around a roll a portion of which is submerged in a solution of "color", reducing the layer of color to the desired thickness, then after the lapse of sufficient time to permit absorption of water by the paper to reduce the color to a suitable consistency troweling the color to make it compact and smooth.

6. The method of coating paper, which comprises applying a coat of "color" of such consistency that it becomes substantially stable as soon as it is applied to the paper, then after the lapse of sufficient time to enable absorption of water by the paper to reduce the coating to a suitable consistency troweling the color to compact and make it smooth.

7. The method of coating paper, which comprises applying a solution of "color" to the paper and then troweling the color by drawing the paper over a curved surface which terminates in a sharp edge, the paper being drawn across said edge at an angle to the locus of said curved surface at the point where the surface terminates in the sharp edge.

8. The method of coating paper, which comprises applying a solution of "color" to the paper and then troweling the color by drawing the paper over a curved surface which terminates in a sharp edge, the paper being drawn across said edge at an angle to the locus of said curved surface at the point where the surface terminates in the sharp edge, the paper being advanced to the troweling means at such a rate that an interval of time will elapse between the application of the color and troweling it, to permit absorption of water by the paper to reduce the coating to the desired consistency for troweling.

9. In the process of coating paper, wherein the coating is troweled by drawing the coated side of the paper over a spreading and smoothing device comprising a plurality of troweling bars brought successively into compacting and smoothing relation with the coated side of the paper, the method of preventing injury to the coated surface by the accumulation of particles of foreign matter upon the successive troweling bars which comprises cleaning each troweling bar after it moves out of one operating contact with the coated side of the paper and before it moves into a succeeding operating contact with the coated side of the paper.

10. The method of coating paper comprising the application of a layer of "color" containing so little water that the color is practically stable, troweling the color to compact and smooth it, and then passing the paper around a series of drier drums.

11. The method of coating paper comprising the application of a heavy layer of "color", removal of sufficient color to reduce the coating to a predetermined weight, troweling the color to compact and smooth it after it has acquired a suitable consistency, and then passing the paper around a series of drier rolls.

12. The method of coating paper comprising the passage of the paper around a roll, a portion of which roll is submerged in a solution of "color", removing excess color to reduce the coating to a predetermined weight, troweling the color to compact and smooth it and then passing the paper around a series of drier rolls.

13. The method of coating paper which consists in applying a coat of "color" to one side of the paper, troweling the color, drying the paper, then immediately applying a coat of color to the other side of the paper, troweling this color, drying the paper again, then calendering the paper before rolling it.

14. In a machine for coating paper, a plurality of troweling bars, means for moving said bars successively into position which permits of the coated paper being drawn across them, and means for cleaning the bars after they have operated on the paper.

15. In a machine for coating paper, a plurality of troweling bars comprising a surface that terminates in a sharp edge, means for

moving said bars successively into position which permits of the coated paper being drawn over said surface and across said edge at an angle to the locus of the surface at the point where the surface meets said edge, and means for rocking said bars on their own axes while the paper is being drawn across them, to maintain said angle substantially uniform.

16. In a machine for coating paper, a plurality of troweling bars mounted in circular order in a revoluble frame, means for rotating said frame, means for causing the coated paper to pass across one or more of said bars, means for causing the active bar or bars to divert the paper from its path, so that the tension of the paper will cause it to press on the bars as it runs across them, and means for washing the bars after they have served.

17. In a machine for coating paper, a plurality of troweling bars mounted in revoluble frame, so that the bars lie and move in a cylindrical path, each bar having a curved surface terminating in a sharp edge, means for rotating said frame, means for passing the coated paper across the bars, means for causing the active bar or bars to divert the paper from its path, so that the tension of the paper will cause it to press on the bars, and means for rocking the bars in the frame so that the paper is made to cross the sharp edge of each bar at substantially the same angle to the locus of its curved surface at the point where it meets the edge, all the while the paper beras on the bar.

18. In a machine for coating paper, a plurality of troweling bars mounted in revoluble frame, so that the bars lie and move in a cylindrical path, each bar having a curved surface terminating in a sharp edge, means for rotating said frame, means for passing the coated paper across the bars, means for causing the active bar or bars to divert the paper from its path, so that the tension of the paper will cause it to press on the bars, and a crank on the end of each bar carrying at its end a stud and a stationary member having a race in which said studs travel as the frame revolves, whereby the bars are rocked in the frame so that the paper is made to cross the sharp edge of each bar at substantially the same angle to the locus of its curved surface at the point where it meets the edge, all the while the paper bears on the bar.

19. In a machine for coating paper, a plurality of troweling bars mounted in a revoluble frame, so that the bars lie and move in a cylindrical path, each bar having a curved surface terminating in a sharp edge, means for rotating said frame, means for passing the coated paper across the bars, comprising means for diverting the paper from its path sufficiently to cause its tension to press it against one or more of the bars, a pan for containing water into which the lower part of said frame dips and brushes for washing off the bars as they pass through the water.

20. A machine for coating paper, comprising a coating unit, a drying unit and a second coating unit, arranged in a line in the order named; said second coating unit being mounted on a revoluble base, whereby it may be rotated through an angle of 180 degrees to cause the unit to face either way with reference to the drying unit; means for conducting the paper from the drying unit to said second unit, when the latter is in one position, so that the paper will be coated again on the same side which was coated in the first unit, and means for conducting the paper to the second unit when it is in its other position, in such way that the paper will be coated on the opposite side to that which was coated in the first unit.

21. A paper coating machine comprising two coating units, so positioned with reference to each other that the paper can pass without stopping from the first unit to the second, receiving a coat in each unit; and means whereby the paper can be led into the second unit so it will coat the same side of the paper that was coated in the first unit or so the other side will be coated in the second unit.

22. In the preparation of coated paper the method which comprises applying a layer of color to the traveling sheet of paper, and subjecting the resultant coated paper to a simultaneous smoothing and compacting action after the paper has traveled a sufficient distance from the rolls to insure said smoothing action taking place beyond the non-plastic zone of the color.

23. In the preparation of coated paper, the method which comprises applying a layer of color to the traveling sheet of paper, and subjecting the resulting coated paper to a spreading and smoothing action at the zone of critical drying of the said layer of color.

24. In the preparation of coated paper the method which comprises applying a layer of color to the traveling sheet of paper, and passing the resulting coated paper over a spreading and smoothing member to secure relative slippage of the coated surface of the paper over the smoothing and spreading member, while at the same time causing compacting of said coating.

25. Apparatus for coating paper, comprising means for applying a coating of color to a traveling sheet of paper; and a smoothing and spreading member cooperating with the resulting coated paper and arranged to effect compacting of the said coating of color, while relative slippage occurs between the

coated paper and the said smoothing and spreading member.

26. Apparatus for coating paper, comprising means for applying a layer of a thick color solution to a traveling sheet of paper, and a spreading and smoothing member located at the zone of critical drying and positioned so that the traveling sheet of paper passes thereover to effect slippage of the coated side of the paper relative to the spreading and smoothing member with concomitant compacting of the layer of color.

JOHN TRAQUAIR.