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METHOD OF WATERMARKING COATED PAPER

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This invention relates to coated paper and to the manufacture thereof and particularly to the marking of such paper for identification purposes. In the case of uncoated papers this marking is accomplished by the familiar watermarking process. In making coated paper, however, that process of marking cannot ordinarily be used because it has been found that under normal conditions the coating material applied by the usual brush or roll coating devices fills in, covers, and almost if not completely obliterates any watermarks which may be provided in the base paper. This is particularly true in those cases where the paper has been coated on both sides. Coated paper being used almost exclusively as a base for the better grades of printing, identification marks printed or stamped on, or pressed or embossed into the paper surface could not be used without impairing the value of the paper for its normal use. There has thus in the past been no completely satisfactory manner in which coated paper could be marked for identification purposes.

The term "coated paper" is used herein as commonly understood in the paper and printing industries, to define a fibrous paper base coated on one or both sides with a layer of pigment such as china clay, satin white, calcium carbonate, or the like, bonded together and to the paper by a water soluble adhesive such as starch, casein, glue, or the like, in order to provide a smoother, more uniform surface to receive high grade printing.

There is no limit to the number and variety of markings which may be desired for identification of the maker, grade, etc., of coated paper. Certain foreign tariff and import restrictions, however, require that coated paper in some classifications be marked with a series of spaced parallel lines. In order that the marked paper may retain its value as a base for printing, it is highly desirable that these lines shall be plainly visible by transmitted light but relatively inconspicuous by reflected light, and that they shall not mar the printing surface of the paper to any material extent.

It is one of the primary objects of the invention to provide a type of coated paper characterized by identification marks which are plainly visible by transmitted light but relatively inconspicuous on the printed and unprinted parts of the surface of the paper when viewed in the normal manner by reflected light. A further object of the invention is to provide coated paper in which these identification marks are in the form of a series of parallel lines spaced at predetermined intervals. Another of the primary objects of the invention is to provide a method by which such identification marks can be applied to coated paper. Another object is to provide a method of applying sufficiently plain marks which shall, however, have only a relatively small effect on the printing surface of the paper. A further object of the invention is the adaptation of the method so that marks of the character described may be applied in the form of a series of parallel lines on the paper. A further object of the invention is to provide methods for this purpose which can be applied as a part of usual paper coating processes and which shall be simple, effective, and easy to use and control. Other more detailed objects of the invention will be apparent from the following description.

I have found that, if a steam jet is allowed to impinge on the wet coating substantially immediately after the applying and smoothing operations but before any drying operation in the paper coating process, a mark is made in the coating which remains after the coated sheet is dried and supercalendered. Examination shows that this mark is due to the force of the jet carrying away the coating material from before it, and either removing it completely from the web or depositing it on the adjacent parts of the surface. This leaves a more or less roughened surface on the finished paper and thereby seriously impairs its value as a base for halftone and some other types of fine printing.

I have found, however, that by suitably reducing the force of the jet and properly choosing and controlling its diameter, the angle at which it impinges on the paper, and the distance from the formation of the jet to the surface of the paper, it is possible to prevent any actual physical displacement of the coating material due to the blowing action and yet secure a mark which is clearly visible by transmitted light, though scarcely noticeable either on the printed or unprinted portions of the surface when viewed by reflected light in the normal manner.

Marks made in this manner, though not believed to be due to any actual blowing away of coating material from the mark, nevertheless appear to be due to a slight local reduction in thickness of the coating layer brought about by obscure and little understood causes. Among these causes are thought to be local reduction in surface tension due to a local increase in temperature where the steam contacts the wet coating,

a local dilution of the coating material by condensation thereon of steam from the jet, a local reduction in viscosity, or other local disturbance due to properties of the jet other than its velocity.

The velocity of the jet, where it strikes the surface of the wet coating, should be low enough not to rupture the surface film and physically displace the still more or less fluid coating material. The term "low velocity," as hereinafter used to describe the jets, is accordingly to be understood as defining jets having a velocity insufficient to rupture the surface film, significantly displace the coating therein, and destroy the smoothness or continuity of the surface of the coating. The maximum safe velocity is found to vary with the character of the coating material used. Different types of coating compositions have been used with the process and require different jet velocities for optimum results. In some cases steam pressures as low as one-half pound gage gave what appeared to be the optimum jet velocity, while with other coatings pressures of two pounds were most desirable, and in exceptional cases pressures as high as five pounds could be used. Although jet velocities low enough not to rupture the surface film are ordinarily desirable, the marking action described is not dependent on velocity and higher jet velocities may be used in cases where the slight surface irregularities resulting therefrom are not objectionable.

In order to prevent marring of the coating surface by water droplets or foreign matter, precautions should be taken to have the steam clean and dry. This does not mean, however, that the steam need be free from any admixture of air.

In order to make the mark clear and distinct the jet is advantageously of small diameter such, for example, as is formed when steam escapes through an orifice of one millimeter or less in diameter, orifices of approximately 0.75 millimeter diameter having been used with good effect.

The greater the distance from the point of formation of the jet to the point where it strikes the surface of the wet coating, the broader, fainter and fuzzier the mark obtained. The smaller this distance, on the other hand, the more the mark becomes narrow and sharp or "hard" and the more probable it is to be too conspicuous on the surface and to visibly affect the printing results. I have found in practice that one-half inch is a good distance though it may advantageously be more or less according to the type of paper and coating used and the sharpness and depth of the mark required.

The direction in which the jet strikes the surface of the wet coating on the web is also important. If the jet is directed perpendicularly against the surface, the mark on the paper is wide and fuzzy, i. e. indistinct at the edges, due presumably to mushrooming of the jet where it strikes the surface. A narrower and much more clean-cut mark is secured if the jet is directed towards the surface at an acute angle. The magnitude of this angle is not critical. I have found angles from 60 to 65 degrees with the surface to give excellent results, though considerable variations from this value are permissible.

In order that a mark, other than a spot, be obtained it is necessary that there be relative movement between the jet and the surface of the wet coated paper. I have found it to be advantageous that the angularity of the jet be so related to the direction of this movement that the steam in the jet tends to travel along the surface of the paper in the same general direction in which the paper is moving relative to the jet. That is, the steam advantageously moves with, rather than against, the travel of the paper past the jet, and the velocity of the steam relative to the paper is less than it would be if there were no relative movement between paper and jet.

In making the straight parallel-line markings hereinbefore mentioned it is convenient to have jets—one for each line—mounted where the paper leaves the coating device, e. g. after the last of the smoothing brushes on the usual brush coater, and allow the paper to travel over the jets on its way to the dryer. For making curved lines or patterns it may be desirable to move the jets independently while the paper is either stationary or in motion, or to coordinate simultaneous movements of jet and paper.

If uniformity of marking is desired, care should be taken to maintain the uniformity of all conditions of operation. The jets should be protected against extraneous air currents. The size, angularity and jet velocity, as well as the distance from the point of formation of the jet to the web, should be maintained at constant values which should be the same for all jets which are desired to give markings of the same character and intensity.

As an illustration of successful operation of the process the following examples are given. In each case the required markings were to be in the form of parallel lines approximately 4 centimeters apart. In one case the paper was a fibrous coating stock weighing about 43 pounds per ream (500 sheets 25 x 38 inches). This was coated on both sides in a conventional coating machine in which the final smoothing given to the wet coating was accomplished by laterally reciprocating brushes. From the coater the paper passed in a continuous web to a dryer of conventional construction. The paper when coated and dried weighed about 67 pounds per ream. The coating composition applied contained:

	Parts dry weight
China clay	80
Precipitated calcium carbonate	20
Casein	10

with enough water to bring the whole to 40 per cent total solids. Within about 2¼ inches of the point where the paper leaves the final smoothing brushes, a steam pipe was laid transversely of and about ⅜ inch below the web. Holes about 0.75 millimeter in diameter were drilled every 4 centimeters in a straight line along the length of this pipe. The pipe was turned so these holes pointed at an angle of about 62½ degrees toward the web and in the direction of its movement. Conventional screens, separators, traps, and drains were installed in a steam line leading to this pipe, in order to insure only clean dry steam being blown against the paper. This line was then connected to a live steam line by means of a needle valve which facilitated accurate control of the steam pressure and resulting jet velocity. In this case optimum results were secured when the steam pressure was regulated to about ¾ pound. The coated paper, after being dried and supercalendered, was found to show distinct lines which appeared translucent by transmitted light. The apparent width of the lines was about two millimeters but their edges were not sharp and conspicuous but shaded off gradually into the body

of the sheet. The lines were, however, scarcely noticeable either on the printed or unprinted parts of the surface when viewed by reflected light in the normal manner. The paper served to satisfy both the customs regulations as to marking and the customer's requirements as to printing quality.

In another case a paper stock weighing about 43 pounds per ream before coating and about 69 pounds per ream after coating and drying, was coated on the same type coater with a coating containing:

	Parts
China clay	70
Precipitated calcium carbonate	20
Satin white	10
Casein	15

with enough water to bring the whole to about 36 per cent total solids. The size and arrangement of the steam jets was the same as before but in this case a steam pressure of about 1¾ pounds was required to give a mark of suitable depth and character.

I claim:

1. Method of marking two-side-coated paper with a plurality of substantially parallel lines which shall be plainly visible by transmitted light but relatively inconspicuous on both printed and unprinted parts of either surface of the paper when viewed in the normal manner by reflected light, in which the paper, as it passes from the final operation in the coating process on its way to the drying operation, passes over a plurality of small-area, low-velocity steam jets spaced the same distance apart as the required parallel lines, said steam jets being located in close proximity to the path of the paper, all jets being formed at substantially the same distance from the paper surface, and directed against the wet surface of the coating at an acute angle and in the general direction of the paper travel.

2. Method of marking coated paper with lines which shall be plainly visible by transmitted light but shall have a relatively small effect on the printing surface of the paper, in which the paper, after the application and final smoothing of the wet coating material thereon, and before it reaches the dryers, passes by a small-area, low-velocity steam jet corresponding to each line, said jets being in close proximity to the paper and directed at an acute angle thereto such that the steam contacting the paper moves in substantially the same direction as the paper.

3. Method of watermarking coated paper in which, after the coating material has been applied to the paper and the smoothing of the wet coating has been completed but before the coating has been subjected to a drying operation, a small-area, low-velocity steam jet is directed against the surface of the wet coating at an acute angle with said surface, and in which the jet and coated paper are moved relatively to each other in a path to cause the jet to trace the desired pattern on the surface of the coating, the angularity of the jet relative to the paper being at all times such that the relative velocity of steam and paper is less due to said relative movement between the jet and the paper than it would be without said relative movement.

4. Method of watermarking coated paper in which, after the coating material has been applied to the paper and the smoothing of the wet coating has been completed but before the coating has been subjected to a drying operation, the paper passes in close proximity to a small-area, low-velocity steam jet which is directed against the coated paper surface at an acute angle and in the general direction of the paper travel.

5. Method of watermarking coated paper in which, after the coating material has been applied to the paper and the smoothing of the wet coating has been completed but before the coating has been subjected to a drying operation, a small-area, low-velocity steam jet is directed against the surface of the wet coating wherever a mark is to appear on the finished paper.

6. Method of watermarking coated paper in which, after the coating material has been applied to the paper and the smoothing of the wet coating has been completed, but before the coating has been subjected to a drying operation, a mark is traced on the paper by the movement, relative thereto, of a steam jet directed against the wet surface of the coating at a velocity insufficient to rupture the surface film on said coating.

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