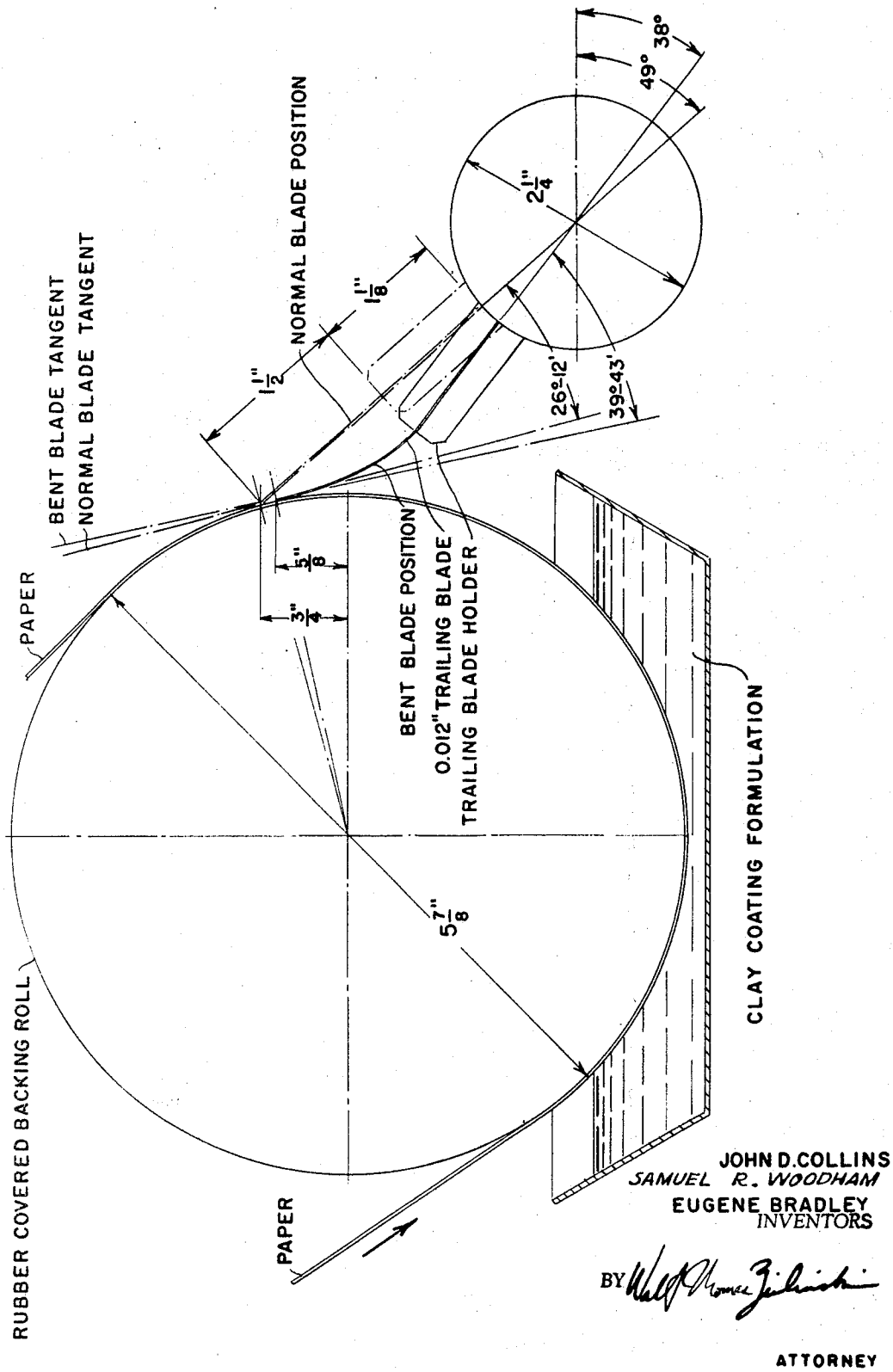
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BENT BLADE CLAY COATING

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# BENT BLADE CLAY COATING

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## ABSTRACT OF THE DISCLOSURE

Method and apparatus for forming an improved clay coating on a paper substrate. The clay coating is applied with a doctor blade, specifically a bend portion of such doctor blade.

This invention relates to the application of clay coatings to substrates of paper and the like by means of an improved trailing doctor blade method and apparatus. More particularly, it relates to the production of clay coatings which are remarkably free of streaks and which permit heavier coating weights per unit area of substrate.

It is known that a major problem in applying water-based clay coatings to paper surfaces by conventional trailing blade methods is that the edge of the relatively straight blade traps particles from the coating or the paper sheet or web, resulting in surface streaks. Streaking becomes increasingly severe as the base sheet becomes smoother. Again, maximum coat weights possible in most cases with the straight blade are limited to about 6 to 8 pounds of coating solids per 3,000 square feet of material coated.

It has now been found that a trailing blade can be so modified to overcome the disadvantages of conventional equipment, so as to achieve smoother coatings in the range of 3 to 15 pounds of coating solids per 3,000 square feet of paper stock, and, further, to enable a superior application of a second clay coating (over a previously dried first clay coating) in a double coating process. This modification includes bending or flexing the trailing blade and bringing the bent portion thereof into contact with the backing roll over which the coated stock is passed on the way to a drying oven or to another coating application station. The coated stock or substrate is then passed between the backing roll and the blade with the coated surface of substrate impinging against the bent surface rather than the edge of the blade.

Preferably—and sometimes, depending on the equipment available, critically—the portion of the trailing blade which is unbent or straight and secured in a rigid



holder is disposed at an angle of from about 25° to 50° with the tangent of the backing roll at the blade's trailing edge. Again, it is preferable that the blade be of spring steel or other flexible material, that it have a caliper in the range of from about 0.008 inch to 0.015 inch when it is spring steel (as in the examples hereinafter), and that it extend in its bent portion for from about 0.75 to 1.75 inches.

For a better understanding of the present invention, reference should be had to the following examples and the attached schematic diagram wherein paper is shown being traveled around a rubber covered backing roll and through a clay coating formulation bath before passing a trailing doctor blade set alternatively in a normal blade position and in a bent blade position in accordance with the present invention.

### Example I

A conventional straight trailing doctor blade system and a bent trailing doctor blade in accordance with the present invention and as suggested by the attached drawing were to apply two different clay coating formulations to both the top and wire sides of different samples representing the same 0.008 inch Bristol board paper stock under similar operating conditions. The conditions and the resulting coat weights and coat characteristics are summarized in Table I.

All the ingredients of the coating formulations are commercially available and act in the manner suggested below:

Hydrasperse clay is a medium particle size kaolin clay with which a dispersing agent and a deflocculant are mixed and which serves as a pigment;

Dow Latex 630 is a styrene-butadiene emulsion and serves as a coating adhesive;

National Starch Resyn 25–1103 is vinyl acetate emulsion and serves as a coating adhesive;

Penford Gum 280 is a low viscosity hydroxyethylated corn starch and serves as a coating adhesive;

Kelgin LV is a low viscosity sodium alginate and serves as a penetration control agent;

Calgon is sodium hexametaphosphate and serves as a dispersing agent;

Nopco ESI is a calcium stearate and serves as a lubricant and leveling agent;

Solar blue is a dyestuff; and

Ammonia serves as a protein solubilizer and pH control.

The work reported in Table I indicates that both the physical quality and the printing of bent blade coated stock are equal to or better than those achieved with conventional equipment.

TABLE I

| Run number | A | A | B | B | C | C | D | D |
|---|---|---|---|---|---|---|---|---|
| Side coated | Top | Wire | Top | Wire | Top | Wire | Top | Wire |
| Blade position during application | Straight Blade | | Bent Blade | | Straight Blade | | Bent Blade | |
| Coating Formulation Data: | | | | | | | | |
| Formulation ingredients, parts (solids basis): | | | | | | | | |
| Hydrasperse clay | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Dow Latex 630 | 17.2 | 17.2 | 17.2 | 17.2 | | | | |
| National Starch Resyn 25-1103 | | | | | 14.4 | 14.4 | 14.4 | 14.4 |
| Penford Gum 280 | 2.0 | 2.0 | 2.0 | 2.0 | 4.8 | 4.8 | 4.8 | 4.8 |
| Kelgin LV | 0.434 | 0.434 | 0.434 | 0.434 | 0.434 | 0.434 | 0.434 | 0.434 |
| Calgon | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| Nopco ESI, lb | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| Solar blue, g | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Ammonia, cc | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Viscosity, Brookfield, 12 r.p.m. and 110° F | 15,750 | 15,750 | 10,500 | 10,500 | 3,650 | 3,650 | 3,650 | 3,650 |
| Solids, percent | 63.0 | 63.0 | 62.0 | 62.0 | 55.5 | 55.5 | 55.5 | 55.5 |
| Coating temperature, ° F | 105 | 105 | 105 | 105 | 105 | 105 | 105 | 105 |
| Coating pH | 8.7 | 8.7 | 8.7 | 8.7 | 8.3 | 8.3 | 8.3 | 8.3 |
| Machine Operating Data: | | | | | | | | |
| Machine speed, f.p.m | 500 | 500 | 500 | 500 | 500 | 500 | 500 | 500 |
| Applicator roll speed, f.p.m | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Blade setting: | | | | | | | | |
| Angle with roll tangent, degrees | 50 | 50 | 40 | 40 | 50 | 50 | 40 | 40 |
| Extension, inches | 1 | 1 | 1¼ | 1¼ | 1¼ | 1¼ | 1¼ | 1¼ |
| Drying oven temperature, ° F.: | | | | | | | | |
| First zone | 300 | 300 | 300 | 300 | 230 | 230 | 230 | 230 |
| Second zone | 300 | 300 | 300 | 300 | 230 | 230 | 230 | 230 |
| Coat weight, lb./ream | 7.4 | 8.0 | 9.0 | 7.0 | 6.5 | 7.0 | 7.1 | 7.5 |
| Physical Test Data: | | | | | | | | |
| Basis weight, lb (24 x 36-500) | 120.7 | | 124.2 | | 124.0 | | 126.3 | |
| Caliper, 0.001-inch | 8.5 | | 8.5 | | 8.3 | | 8.3 | |
| Apparent density, lb./0.001 inch | 14.2 | | 14.6 | | 14.9 | | 15.1 | |
| Sheffield smoothness, units* | 20 | 12 | 39 | 25 | 38 | 27 | 33 | 20 |
| Wax pick | 10 | 10 | 7 | 10 | 9 | 10 | 8 | 9 |
| I.G.T. pick, f.p.m., No. 4 ink | 595 | 595 | 520 | 562 | 368 | 645 | 456 | 506 |
| Gloss, 75° | 16 | 18 | 18 | 11 | 7 | 13 | 10 | 13 |
| I.G.T. strike in, mm | 108 | 120 | 106 | 118 | 92 | 113 | 102 | 114 |
| Vanceometer: | | | | | | | | |
| Base | 12 | 20 | 12 | 14 | 10 | 16 | 13 | 18 |
| 20 seconds | 89 | 77 | 90 | 90 | 85 | 91 | 78 | 86 |
| 60 seconds | 89 | 71 | 89 | 88 | 65 | 86 | 70 | 78 |
| 360 seconds | 37 | 29 | 22 | 25 | 14 | 21 | 17 | 24 |
| Printing Date—Gloss ink printing, percent gloss at 10 lb. ink/10,000 sq. ft.: | | | | | | | | |
| 75° | 84.2 | 85.9 | 85.5 | 88.0 | 80.2 | 88.3 | 85.9 | 89.2 |
| 20° | 13.4 | 16.1 | 14.4 | 20.0 | 9.4 | 14.4 | 12.7 | 20.4 |

* The lower the figure, the greater the smoothness.

## Example II

A number of runs were made using the bent trailing doctor blade system of the present invention and the top or felt side of different paper stocks to establish whether variations in coating formulations, and operating conditions such as blade extensions, calipers, and angles with backing roll tangents at the trailing edges of the blades affected the coating weights. The results of such runs are summarized in Table II.

All the ingredients of the coating formulations are commercially available and act in the manner suggested in Example I or below:

Hydrafine clay, Ultrawhite 90 clay, and Lustra clay are small particle size kaolin clays with which a dispersing agent and a deflocculant are mixed and which serves as a pigment;

Rhoplex B–15 is an acrylic latext and serves as a coating adhesive;

Ethylex 2095 is a low viscosity hydroxyethylated corn starch, and serves as a coating adhesive;

Delta protein is a soya protein;

Parez 613 is a melamine-formaldehyde resin and serves to insolubilize the coating;

Nopco C–104 is a calcium stearate and serves as a lubricant and leveling agent;

Colloid 581–B is a protective colloid which serves to keep the clay in suspension; and,

Ivory soap flakes serve as a lubricating and leveling agent.

As indicated in Table II, the coating weights developed by the present system are greater than would have been achieved by conventional means.

TABLE II

| Run number | E | F | G | H | I |
|---|---|---|---|---|---|
| Side coated | Top | Top | Top & Wire | Top | Top |
| | Blade bent during applications | | | | |
| Coating Formulation Data: | | | | | |
| Formulation ingredients, lbs.: | | | | | |
| Hydrafine clay | 100 | 100 | | | |
| Hydrasperse clay | | | 2597 | | |
| Ultra white 90 | | | | | 100 |
| Lustra clay | | | | 100 | |
| Rhoplex B-15 | 8 | 8 | | 15.1 | 10.7 |
| Resyn 25-1103 | | | 468 | | |
| Ethylex 2095 | 2 | 2 | | | |
| Penford Gum 280 | | | 52 | 1.9 | |
| Delta protein | | | | | 6.3 |
| Calgon | 0.6 | 0.6 | 5 | 0.3 | 0.3 |
| Ammonia | 1.1 | 1.1 | 8 | 0.3 | 1.2 |
| Kelgin MV | | | | | 0.25 |
| Parez 613 | | | | | 0.63 |
| Nopco C-104 | | | 45 | | |
| Nopco ESI | | | | 3.5 | 2 |
| Colloid 581-B | | | 1 | | |
| Ivory soap flakes | 0.17 | 0.17 | | | |

TABLE II—Continued

| Run number | E | F | G | H | I |
|---|---|---|---|---|---|
| Side Coated | Top | Top | Top & Wire | Top | Top |
| | Blade bent during applications | | | | |
| Viscosity, Brookfield, 12 r.p.m. and 100° F.: | | | | | |
| 1st station | 11,000 | 11,000 | 400 | 780 | 3200 |
| 2nd station | | | 420 | | |
| Solids, percent: | | | | | |
| 1st station | 64 | 64 | 58.7 | 58 | 52.7 |
| 2nd station | | | 59.8 | | |
| Coating pH: | | | | | |
| 1st station | 8.2 | 8.2 | 7.9 | 8.4 | 8.5 |
| 2nd station | | | 8.0 | | |
| Machine Operating Data: | | | | | |
| Machine speed, f.p.m | 375 | 360 | 900 | 450 | 700 |
| Blade angle, degrees with roll tangent | 25 | 25 | 36 | 37 | 40 |
| Blade extension, inches | 1¾ | 1¾ | ¾ | 1¼ | 1⅜ |
| Blade caliper, inches | 0.015 | 0.015 | 0.008 | 0.010 | 0.010 |
| Coat weight, lb./ream | 19.1 | 34.4 | [1] 13.9 | 12.0 | 12.6 |
| Oven temperature, ° F.: | | | | | |
| 1st zone | 500 | 475 | Down | 500 | 400 |
| 2nd zone | 500 | 475 | 275 | 180 | 400 |
| 3rd zone | | | 200 | | |
| 4th zone | | | 200 | | |
| 5th zone | | | 265 | | |
| 6th zone | | | Down | | |
| Blade Operation: Streaking | None | None | [2] | None | None |
| Chrome Calender Data | Off | Off | Off | | Off |
| Dryer condensate temperature, ° F | | | | 350 | |
| Steam pressure, p.s.i | | | | 150 | [3] |
| Top nip roll pressure, p.l.i | | | | 700 | [4] |
| Bottom nip roll pressure, p.l.i | | | | 600 | |
| Test Data: | | | | | |
| Basis weight, lb./ream | 183.8 | 200.8 | 128.4 | 134.2 | 59.5 |
| Caliper, inch | 0.0123 | 0.0131 | 0.008 | 0.0084 | 0.0033 |
| Pick, I.G.T., f.p.m., No. 4 ink | | | 744 | 349 | 489 |
| Porosity, Sheffield | | | | 15.9 | 3 |
| Smoothness, Sheffield | | | | 15 | 12 |
| Gloss | | | | 62 | 69 |
| I.G.T. strike-in | | | | 133 | 137 |

[1] Total coat weight on both sides.
[2] Much less than straight blade.
[3] Super-calendered.
[4] 3 nips, 660 p.l.i.

The method and apparatus herein described are particularly, but not solely, adapted for use in improving the technique described in co-pending Ser. No. 159,610, filed Dec. 15, 1961.

What is claimed is:

**1.** In the formation of an improved clay coating on a paper substrate, a process comprising the step of applying an aqueous slurry of the coating to the substrate, the step of moving the coating on the substrate between a rubber coated backing roll and a flexible spring steel doctor blade comprising a trailing edge, a bent portion in contact with the backing roll and disposed to impinge only the bent surface of the doctor blade against the coating on the substrate, and a straight portion secured in a rigid holder and disposed at an angle of from about 25° to 50° with a line tangential to the backing roll at the trailing edge.

**2.** The process of claim **1** wherein the blade has a caliper of from about 0.008 inch to 0.015 inch and the bent portion is from about 0.75 to 1.75 inches long.

**3.** In an apparatus for forming an improved clay coating on a paper substrate, in combination, a rubber covered backing roll and a flexible spring steel doctor blade comprising a trailing edge, a bent portion in contact with the backing roll and disposed to impinge only the bent surface of the doctor blade against the coating on the substrate, and a straight portion secured in a rigid holder and disposed at an angle of from about 25° to 50° with a line tangential to the backing roll at the trailing edge.

**4.** The apparatus of claim **3** wherein the blade has a caliper of from about 0.008 inch to 0.015 inch and the bent portion is from about 0.75 to 1.75 inches long.

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