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C. F. BOYERS

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MAKING FILLED SURFACE PAPER

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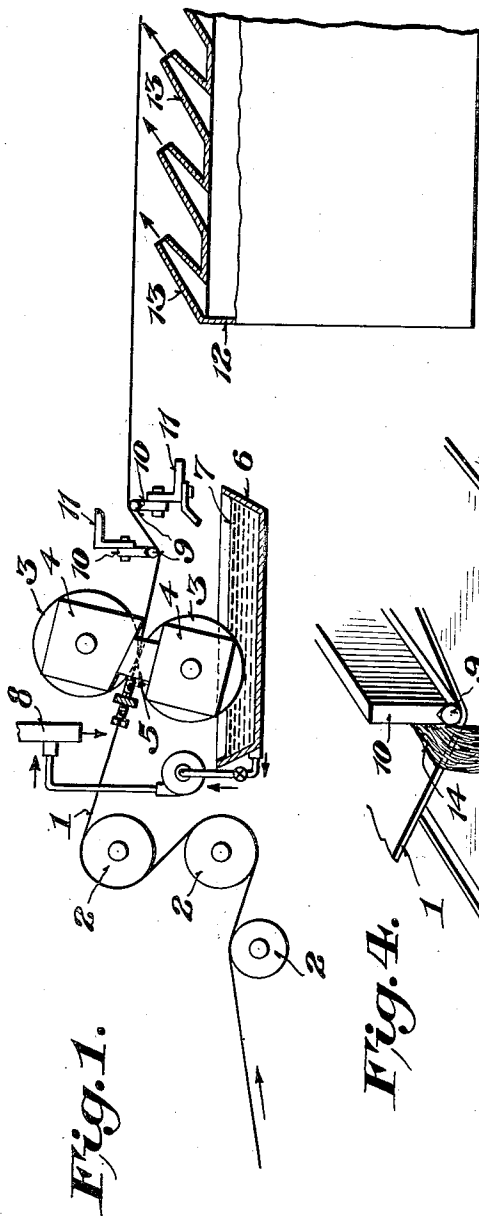


Fig. 1.

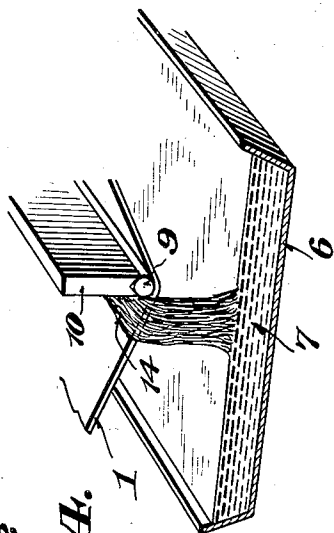


Fig. 4.

Fig. 3.

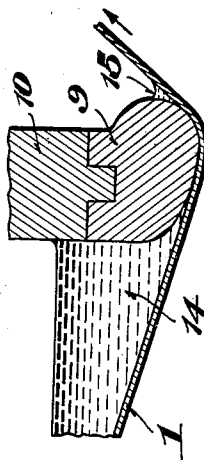
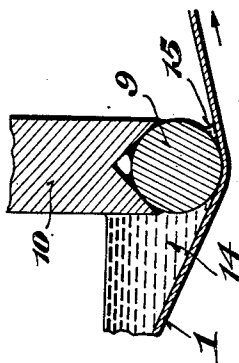


Fig. 2.



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MAKING FILLED SURFACE PAPER

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Application March 22, 1933. Serial No. 662,175

7 Claims. (Cl. 91—68)

This invention relates to making filled surface paper, and it comprises an improvement in methods of producing paper and paperboard, the surface pores of which are substantially filled with mineral matter, said improvement comprising applying aqueous composition of mineral matter and binder to a traveling web in excess and leveling off the composition to the general fiber plane by regulated pressure of an arcuate faced wiping member, the arc having a radius at the point where the web leaves the wiping member of the order of $2/32$ to $5/32$ inch, all as more fully hereinafter set forth and as claimed.

In one method of producing this filled surface paper, the paper is coated on one or both sides without particular regard to uniformity and while the coating is still wet the excess is scraped or blown off and returned to the coating device for reuse.

In using a scraper in the form of a knife edge or blunt blade for this purpose there is, among other difficulties, considerable danger of breaking the wet web, especially on light weight paper. Cracked edges, holes, splices and similar imperfections in the web are especially liable to cause breakage at the scraper edge.

I have found that a better method of producing filled surface paper is to distribute on a traveling web aqueous mineral coating composition in excess and pass the web against a tool having a round cross section of controlled radius, engaging the web under some pressure. The tool may be a transverse round rod, or a stiff transverse bar having an arcuate working face. Under these conditions a pool of coating composition accumulates against one side of the working face and the oncoming web, ensuring good transverse distribution of the liquid. A second pool is formed between the other side of the working face and the leaving web. This pool comprises liquid which has been carried under the rod or bar and it is maintained in place more or less by capillary forces which apparently draw the coating composition out of the surface pores of the paper. The size of this pool depends upon the radius of the leveling member at the point where the paper leaves the working face. For my purposes I use a rod of fairly small radius. With a large radius and slight curvature there will be a narrow space of considerable area between the rod and the leaving web, and a large amount of liquid will be held therein. A large pool of coating composition is undesirable, for as the web moves the pool tends to be drawn out into a series of saddle-shaped bulges, large enough to give rise to stip-

ples or ridges on the web. In the case of materials like varnishes, tars, waxes and the like this stippling does not have serious consequences, because the material is fluid enough to flow out, but in the case of aqueous mineral coating compositions there is little or no tendency for stipples to flow out, and their occurrence must be prevented.

I have found that if the leveling tool be a rod of sufficiently small radius of curvature, no stippling takes place; the bulges, if they exist at all, being too small to give rise to ridges or stipples. With most of the usual coating compositions having the usual viscosity, the best results are obtained with a round working surface having a curvature representing a radius somewhere between two thirty-seconds and five thirty-seconds of an inch. Arcuate surfaces within this range are well adapted to compositions containing calcium carbonate, satin white, clay and other usual types of mineral matter; and to compositions containing starch, casein, etc. as a binder. One good composition for the present purposes consists of a composition carrying 85 parts by weight of finely divided calcium carbonate, 15 parts by weight of satin white, 100 parts by weight of a 25 per cent starch solution and enough additional water to give a total solid content of about 35 per cent. The amount of this composition to be applied to the paper depends upon the texture of the paper and upon other conditions; there being enough, however, to give a plane surface including fiber. It is practical to produce a good printing surface with ordinary types of paper by the use of about 1.2 pounds dry weight per 1000 square feet per side. By the present method, as much as a pound or a pound and a half per 1000 square feet per side can be applied with good results.

It will be understood that the surface filled paper produced in the present invention is not a "coated paper" in the ordinary sense of the words; that is, the fibers in the finished paper are not buried under a comparatively thick layer of coating composition.

In practicing the present invention the leveling rod is allowed to exert a neither too low nor too high pressure against the paper. If the pressure were too low, the rod would simply level off or smooth out a comparatively thick layer of coating over the sheet, defeating the present purposes. While paper is an extremely thin material it can be regarded as having a surface full of minute hills and valleys and the pressure exerted by the rod on the paper in the present invention must be above a certain minimum value all across a sheet. Otherwise, the rod will ride on the higher

hills leaving the intermediate portions flooded with coating and giving rise to an undesirable streaky appearance. On the other hand, excessively high rod pressures leave the more shallow surface pores unfilled and the printing qualities suffer.

In using a leveling device under the present invention having a working face of arcuate contour, the paper may be held against the device by the tension of the web; or the paper may be supported on a resilient support such as a rubber covered roll and pressed against the rod. Using the web tension alone, it has been my experience that working faces with a curvature radius much less than about 2/32 inch require impractically low tensions. However, with the paper supported by a resilient backing member, rods even smaller than those mentioned may be employed.

The radius of curvature of the face exposed to the leaving web should be made small, to avoid stippling. Instead of a cylindrical rod, a rod may be used which has a radius at the point where the paper leaves the tool sufficiently small to prevent stipples but which has larger radii at other points. The use of a rod of changing curvature rather than a circular one, allows of greater latitude, for the curvature of the face exposed to the leaving web, and the total area in contact with the web, can be selected independently.

In the accompanying illustration I have shown, more or less diagrammatically, apparatus within the purview of the present invention and applicable in practicing the process described. In this showing,

Fig. 1 is a longitudinal vertical section, certain parts being shown in elevation, of an apparatus filling both sides of a web of paper;

Fig. 2 is a detail view showing a rod suitable for my purposes, and showing the entry pool and the exit pool described;

Fig. 3 is a similar view of another type of rod shaped member; and

Fig. 4 is a view in perspective of a leveling edge, a portion of a web, and a pan, showing the pool formed between the edge and the web.

In this showing, a web of paper 1 coming from a supply roll or other apparatus (not shown) is carried by rolls 2 to a surface-coating machine comprising coating rolls 3, mounted in bearing blocks 4 and provided with wedge adjusting means 5 for regulating the clearance between the rolls. The rolls are spaced sufficiently far apart to prevent impregnation of the body of the web by the coating composition, which is undesirable. A pan 6 is positioned below the lower coating roll and holds a pool 7 of coating composition. Composition is supplied to the paper by a pipe 8. A pool of coating composition is formed in the nip between the web and the upper coating roll, and some composition flows down into the pan; where it is picked up by the lower coating roll and applied to the under side of the web. The coating rolls are advantageously of metal. They serve to apply coating, in excess, across the full width of the web.

Adjacent the coating rolls I provide my leveling members, comprising rods 9, one acting on each side of the web as shown. Each rod is mounted on a metal strip 10 bolted to an angle iron member 11. The rod is advantageously fixed in a V-shaped groove in the metal strip (see Fig. 2) by soldering or the like. The rod has a radius of 2/32 inch to 5/32 inch. It may be a length of music wire, drill rod or the like; or it may be glass. It should be hard, smooth and straight. My level-

ing rod is advantageously so adjusted in position that it contacts the web for about 40 degrees of arc, but a larger or smaller wrap than this may be used.

A pump 16 carries coating material from the pan back to the inlet pipe.

After leaving the leveling rods, the web goes on to a "float line" 12 of the usual type, in which hot air is delivered through a series of nozzles 13 to the web, buoying up the paper during drying. Beyond the float line is a suction apron or suction roll, or other means, not shown, to exert a controllable tension on the web.

In the operation of the machine, coating composition is supplied to the web through pipe 8 and is applied to the top surface of the web by the upper coating roll. Some of the composition falls into the pan, where it forms a pool. Composition is picked up from the pool and applied to the lower surface of the web by the lower coating roll. The quantity of coating supplied need not be accurately regulated, but it should always be in excess. After leaving the coating rolls, the web is engaged by the two leveling rods in succession. The coating on the paper is leveled or evened off to the outer plane of the fibers by the rods. Excess coating returns to pan 6. The quantity of composition allowed to remain on the web is in general from 0.5 to 1.5 pounds per 1000 square feet per side.

Fig. 3 shows a modified form of leveling rod, having a bearing surface of changing curvature. The form shown has a relatively wide surface in contact with the oncoming web, and a sharply curved surface in the direction of the leaving web, permitting only a small pool of coating composition to be formed between the rod and the leaving web. This form of rod presents certain advantages. A surface of large radius of curvature and of large area of contact is afforded the oncoming web while the radius of curvature of the surface in the direction of the leaving web is small.

Fig. 4 is an enlarged view of a portion of Fig. 1, showing the upper leveling rod 9 mounted on metal strip 10 bearing on the web 1 and a pool 14 of liquid coating composition dammed by the rod and overflowing into the pan 6. Figs. 2 and 3 show the pool in cross section, and also the pool 15 formed between the rod and the leaving web. There will be a pool 14 between the lower rod and the web; this pool is much smaller.

For the proper carrying out of my method in the apparatus shown, it is desirable that the paper be subjected to sufficient tension to ensure firm and uniform contact of the leveling rods across the width of the web. The tension may be regulated by adjusting the speed and the suction of the suction apron or suction roll; or a suitable brake may be put on the paper behind the rods.

I obtain paper having a surface filling of coating composition substantially free from ridges, stipples, or other inequalities. There is no substantial penetration of coating composition into the body of the web.

What I claim is:—

1. Process which comprises applying excess aqueous mineral coating composition to a moving web of paper and removing the excess coating composition and leaving the residual coating in the surface pores of the paper, by a smooth, rounded surface having a radius of curvature not exceeding 5/32 inch at the point where the paper leaves said surface.

2. Process which comprises applying excess aqueous mineral coating composition to a mov-

ing web of paper and removing the excess coating composition and leaving the residual coating in the surface pores of the paper, by contacting the freshly coated side of the paper with a smooth, rounded surface having a radius of curvature not exceeding $5/32$ inch at the point where the paper leaves said surface.

3. Process which comprises applying excess aqueous mineral coating composition to a moving web of paper, removing the excess coating composition and leaving the residual coating in the surface pores of the paper, by contacting the freshly coated side of the paper with a smooth, rounded surface having a radius of curvature not exceeding $5/32$ inch.

4. Process which comprises applying excess aqueous mineral coating composition to a moving web of paper, removing the excess coating composition and leaving the residual coating in the surface pores of the paper, by contacting the freshly coated side of the paper with a smooth, rounded surface having a radius of curvature between $2/32$ and $5/32$ inch.

5. Process of treating paper which comprises applying excess of aqueous mineral coating com-

position to a traveling web of paper and contacting the freshly coated side of said paper with a smooth, rounded surface having a radius of curvature not exceeding $5/32$ inch at the point where the paper leaves said surface, at a pressure sufficient to leave not more than 1.5 pounds of coating on the dry basis per 1000 square feet per side.

6. The process of claim 1 wherein the rounded surface is held against the traveling paper by the tension of said paper.

7. In paper treating apparatus, means for applying an excess of aqueous mineral coating composition to a web of paper, means for moving the paper longitudinally and a rounded leveling device to contact with the coated side of the paper to remove excess coating composition and leave residual coating composition in the surface of the paper, said leveling device having a radius of curvature of not more than $5/32$ inch at the point where the paper leaves the scraper and a greater radius of curvature at the point where the paper first contacts the leveling device.

CHARLES F. BOYERS.

DISCLAIMER

1,944,835.—Charles F. Boyers, Hillsboro, Ohio. MAKING FILLED-SURFACE PAPER. Patent dated January 23, 1934. Disclaimer filed May 29, 1935, by the assignee, *The Champion Coated Paper Company*.

Hereby enters this disclaimer to claim 7 which is in the following words, to wit:

"7. In paper treating apparatus, means for applying an excess of aqueous mineral coating composition to a web of paper, means for moving the paper longitudinally and a rounded leveling device to contact with the coated side of the paper to remove excess coating composition and leave residual coating composition in the surface of the paper, said leveling device having a radius of curvature of not more than $5/32$ inch at the point where the paper leaves the scraper and a greater radius of curvature at the point where the paper first contacts the leveling device."

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