LITHOGRAPHIC PLATE AND METHOD FOR MANUFACTURING SAME

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4 Claims. (Cl. 101—463)

ABSTRACT OF THE DISCLOSURE

Conventionally prepared lithographic plates are subject to several disadvantages and particularly to lack of uniformity of the printing surfaces unless the lithographic surfaces are subjected to a special treatment before use to remove surface defects. These surface defects are usually the result of the accumulation of excess adhesive on the surface of the plate, caused by migration of adhesive to the exposed surface during the drying of the lithographic coating. Applicants have discovered that by effecting drying in a manner such that evaporation of the liquid solvent for the adhesive in the coating composition is accomplished substantially within the coating in a region away from rather than at the exposed surface thereof, the migration of the adhesive to the exposed surface of the drying coating is reduced to such an extent that uniform reproductions can be obtained from the plate without the necessity of additional treatment customarily required.

This is a continuation-in-part application of U.S. patent application Ser. No. 549,061 filed May 10, 1966, now abandoned, which was, in turn, a continuation-in-part of U.S. application Ser. No. 413,057 filed Nov. 23, 1964, and now abandoned.

Field of the Invention

The present invention relates to the preparation of new and improved surfaces having lithographic properties. More particularly, it relates to lithographic plates of improved characteristics and to methods of producing same by reducing migration of adhesive used therein to the exposed surface of the coating before and during drying.

Prior art

Lithographic surfaces have previously been prepared by applying to suitable carriers, such as paper, coating compositions comprising casein and ester gum to function as a water receptive hydrophilic colloid, inert fillers such as clay, and formaldehyde. Such coatings were applied in one or more layers depending upon the number of copies to be made from the lithographic plate. Following application and drying of the coating, it was necessary for the outer or exposed surface of the coating to be then subjected to a subsequent treatment in order to render the surface suitable for the production of uniform reproductions. Such subsequent treatment usually consisted of brushing or abrading the surface to remove excessive adhesive, or the insolubilization thereof by application of a wash coat comprising a solution of a polyvalent metal, such as a solution of aluminum chloride, zinc chloride, aluminum formate, or the like.

When it was desired to produce a long run lithographic plate, it has been the custom to pre-treat the paper base in order to render it substantially water resistant by applying to the surface of the paper a resinous varnish, such as phenol-formaldehyde varnish, a urea-formaldehyde solution, a melamine-formaldehyde solution, or the like. The application of such water resistant materials to the paper base, however, makes the latter less receptive to the application of hydrophilic coatings and has thus required an intermediate coat in order to insure satisfactory anchoring of the coating to the fibrous base sheet. In producing lithographic plates by prior art processes, it has thus been necessary to apply from five to seven, or even more, coats to produce a suitable lithographic plate on paper, or the like, bases.

During printing with a lithographic plate, it is necessary to apply to the plate an aqueous etch solution. If the base of the plate is an inexpensive paper, such as kraft, the paper to swell and change dimensions as the water application of water to the plate has a tendency to cause penetrates the surface coating and reaches the paper base. Such changes cause distortion of the image, imperfect registration and deterioration of the paper base. Accordingly, when the inked lithographic plate is pressed against the rubber mat of the offset copying machine, the ink which is on the image area will come off onto the blanket while the areas in contact with the non-image areas will remain clear, since the latter areas of the plate are wet only with water and have no ink on them. The blanket is then pressed against a paper sheet to transfer the ink image to the paper.

When the aqueous etch solution added to the plate penetrates into the body of the plate, the surface of the plate may not be completely wetted by the solution because of the fact that it has been withdrawn from the surface into the plate. When this occurs, the surface of the plate may not repel the printing ink and hence areas of the surface which should be perfectly blank will show background discoloration or become darkened or "toned." This incomplete wetting of the surface of the plate may also occur during printing.

If water penetrates the surface of the hydrophilic surface coating and renders the coating soluble under the image areas, the image will no longer hold onto the plate and tends to leave the printing surface. Yet, on the other hand, if the surface is so highly resistant to the imaging material that it fails to adhere properly, the same thing occurs. The material forming the image must adhere tenaciously to the plate and not come off either wholly or in part or be destroyed by successive transfers from the image area. Attempts have been made to overcome these difficulties by interposing a resinous water barrier between the paper base and the surface coating but this does not prevent water from being drawn from the surface into the coating layers above the barrier surface. It is important that the adhesive employed for holding the coating onto the base be of such character that it
satisfactorily bonds the coating layer and at the same time is subject to a minimum tendency to migrate to the outer or exposed surface of the coating, or into the base stock during the drying operation. Migration of the adhesive to the outer surface of the lithographic plate causes an undue accumulation of adhesive on the surface and seals the latter, thereby preventing the imaging material from penetrating the surface and firmly anchoring therein. On the other hand, migration of adhesive into the base stock produces a surface layer relatively low in adhesive content and not sufficiently bonded to anchor the image.

Some of the difficulties of the prior art have been overcome by the procedure disclosed in Beatty U.S. Patent No. 2,760,431. While the method of the latter patent represents an improvement over prior processes in that satisfactory lithographic reproductions are obtained with a fewer number of coats, the Beatty method is still subject to the disadvantage of not giving consistent uniform printing results unless lithographic plates as produced are subjected to a subsequent treatment before use in order to remove excessive amounts of adhesive which have migrated to the outer surface of the plate. In order, therefore, to obtain satisfactory results when using the Beatty lithographic plates, it is necessary to subject them before use to a brushing or abrading treatment in order to remove mechanically the excess and the accumulations on the outer surface of the plate, or to wash the plates with a solution of a polyvalent metal salt. Applicant's improved process obviates the necessity for this subsequent step by effecting the drying of the lithographic plates in a manner such that substantial migration of the adhesive to the surface does not take place.

Summary and objects

Accordingly, an object of the present invention is to provide means for obviating the difficulties previously inherent in paper base lithographic plates.

Another object is to produce and to provide a method for producing a new and improved lithographic surface using high speed coating techniques.

Still another object is to produce and to provide a method for producing a lithographic plate of the type described which requires considerably fewer operational steps in its manufacture and which during use is capable of holding an ink-receptive image having the properties of immediate reproduction of copy of good quality.

Another object is to provide a method of controlling adhesive migration during application of lithographic coatings to a paper base.

Yet another object is to produce and to provide a method for producing a paper base lithographic plate of the character described which is useful either as a direct image master or as an indirect image master where the existing image produced elsewhere is transferred to a coating surface produced in accordance with the invention.

A further object is to produce an improved lithographic plate of the type described which is easy and economical to manufacture and use, is characterized by excellent stability, is capable of holding tenaciously an ink-receptive image having the properties of immediate reproduction of copy of good quality and which continues to produce such copies for a considerable period of time.

Description

The process of the present invention relates to a method for effecting the drying of lithographic plates, and particularly paper base lithographic plates, in a manner so as to substantially reduce migration of the adhesive content to the exposed surface of the coating during said drying operation. More specifically, it relates to an improvement of the product and process of Beatty U.S. Patent 2,760,431, referred to above. Applicants have disclosed that by effecting drying of the Beatty coating in the manner discovered by them and as specifically described below, consistent and uniform printing results can be obtained without resorting to the added step of brushing or abrading or washing with a solution of a polyvalent metal salt, as required when plates are produced as described by Beatty.

The Beatty product is obtained by coating a base with a composition containing an inert filler, polyacrylic acid and a metal base selected from the group consisting of the oxides and hydroxides of zinc, magnesium, calcium, barium and lead, and mixtures thereof, and present in the ratio of 1 part by weight of metal base to 2-20 parts by weight of filler and 1 part by weight of polyacrylic acid to 2-10 parts by weight filler plus metal base and with ammonium ions present in amounts in excess of that necessary to maintain the solubility of the polyacrylic acid in the presence of the metal base. The resulting composition in the form of 40-60% solids content with water was coated onto a suitable base in an amount sufficient to give a coating weight of 6-30 pounds per 3300 square feet surface and then dried by passage through an air drying oven heated to a temperature in excess of 250°F. The lithographic plates thus produced required treatment by brushing or abrasion or washing with a solution of a polyvalent metal salt before consistent lithographic printing results were obtainable.

Applicants have discovered that the subsequent brushing, abrading or washing step is not required for satisfactory lithographic printing results if the lithographic coating is subjected to a drying operation whereby the migration of the adhesive to the outer or exposed coating surface is reduced to a minimum. They have also discovered that this type of drying can be accomplished in different manners so long as the solvent for the adhesive (water plus ammonia) is evaporated substantially within the coating and principally at the coating base sheet interface rather than at the exposed surface of the coating. In other words, evaporation of the liquid solvent must be effected substantially in a region within said coating away from the exposed coating surface. In order to accomplish this, severe drying conditions must not be directly applied to the exposed surface of the coating until the drying has been effected to such a degree that the coating is non-tacky, at which point further migration of adhesive does not take place. Contact of the drying coating surface with heated drying or casting drums or hot or cold high velocity (impinging) dry air is to be avoided. After immobilization of the liquid solvent, the form of drying becomes of much less importance.

Applicants have found that evaporation of solvent in the coating composition is most satisfactorily effected by use of infra-red rays or by application of heat to the uncoated side of the coated base, such as by contacting the uncoated surface of the base with a dryer drum, Yankee dryer or impinging hot air. Since heat is generated throughout the coated paper by absorption of the infra-red rays, these rays may be applied from either the uncoated or the coated side of the base. In any event, it is highly important to the success of the present invention that heat not be applied to the outer or exposed coating surface until after the coating has dried to a substantially non-tacky state, whereby the liquid portion of the coating is immobilized. When heat is applied directly to the exposed surface, the liquid solvent and adhesive first migrate to the surface where evaporation of the solvent takes place and thereby permitting an accumulation of adhesive at the lithographic surface. Using the method of drying of this invention, evaporation takes place substantially within the coating and at the coating-base interface, thus reducing accumulation of adhesive at the lithographic surface.

The migration of adhesive to the lithographic surface is also affected by such factors as the character of the adhesive, the quantity thereof used in the coating, the coat...
weight, the solids content of the coating, as well as the method of drying. For example, migration of adhesive is reduced by using a lower coat weight and a higher solids content than customarily employed, as well as by effecting the drying of the wet coating by the method of thin film deposition. While each of these factors is important, the most satisfactory general results are obtained by the use of a combination of these factors.

The coat weight used should be sufficient to form a continuous lithographic surface but should not be so heavy as to cause cracking of the coating. In addition to providing poor coverage over the base coat, insufficient coat weight results in short copy life. Excess coat weights, in addition to causing increased adhesive migration, cause surface cracking which results in reproduction of the cracks on the copy and also in short copy life.

The proper coat weight employed will depend to some extent upon the composition of the paper base which, in turn, depends upon the desired copy life. For example, tests have shown that a paper raw stock which has been tub sized and then given two base coats should preferably use a coat weight ranging from one to five pounds per 3300 square feet. Generally, a four pound coat has given optimum results, other critical factors being the same. However, acceptable levels of lithographic surfaces have been obtained outside this range.

It has been discovered in accordance with the present invention that adhesive migration is reduced and copy life improved when the solids content of the coating is maintained at excess of 50% and preferably at from 50 to 70% by weight of the total weight of the coating composition. The upper solids content limit appears to be determined primarily by handling problems. The higher solids content reduces the drying load as well as minimizes adhesive migration and, at the same time, gives a smooth coat. The lastly provides a feature of reducing migration of adhesive, as well as the limitation of coat weight and solids content. After application of the coating composition, the latter must be dried in a manner so as to inhibit adhesive migration during drying or the beneficial results of the specified coat weight and solids content will be largely lost. It has been found in accordance with the present invention that evaporation of the liquid portion of the coating must be effected without direct contact of the drying means to the surface of the coating. Drying from the coated side of the base, either by means of contact with heated surfaces or heated air should be avoided as such means tend to increase the adhesive migration and increase accumulation of adhesive on the exposed surface of the lithographic plate. Excellent results with substantially no adhesive migration to the lithographic surface have been obtained by allowing poring of the coated base (1) applying heat to the uncoated side thereof or by (2) radiant energy driers from either or both sides of the coated base, by (3) dielectric heat energy (high frequency) driers, or by (4) any combination of (1), (2), and (3).

The use of radiant energy driers, such as for example, infra-red driers, preferably located above the upper surface of the coating on a suitable base, used either alone or in combination with heated drum driers located on the uncoated side of the coated base are preferred for the method of this invention. Where a series of heated drum driers is used, it is essential that the wet coating be dried to a substantially non-tacky condition before the outer surface of the coating comes into contact with the heated drum. When this stage is reached, adhesive migration can no longer take place and completion of the drying can be effected by any conventional means.

The following examples are given to further illustrate the claimed invention. However, it will be evident that numerous modifications and changes can be made in these examples without materially modifying the results obtained. Any such modifications and changes which do not depart from the basic concept of the invention disclosed herein are intended to fall within the scope of the appended claims.

Example 1

A lithographic coating was prepared using the following composition:

<table>
<thead>
<tr>
<th>Parts</th>
<th>62</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating clay</td>
<td>62</td>
</tr>
<tr>
<td>Zinc oxide</td>
<td>26</td>
</tr>
<tr>
<td>Ammonia neutralized polyacrylic acid</td>
<td>12</td>
</tr>
<tr>
<td>Sodium hexametaphosphate</td>
<td>0.13</td>
</tr>
<tr>
<td>Zinc acetate</td>
<td>4.6</td>
</tr>
<tr>
<td>Ammonium hydroxide (26° Baumé)</td>
<td>10.8</td>
</tr>
</tbody>
</table>

In the above composition, as well as in the examples to follow, the ingredients are designated in parts by weight of dry solids, except where indicated to the contrary.

The above lithographic coating composition was prepared by mixing of pigments (clay and zinc oxide), dispersing agent (sodium hexametaphosphate) together with about one-third of the polyacrylic acid and enough water to produce a thick paste. The polyacrylic acid was added slowly as a 27% solution of the acid in water allowing sufficient time for the acid to react completely with the zinc oxide pigment. The remaining polyacrylic acid solution was then added to the composition. The zinc acetate was dissolved in the ammonium hydroxide and the resulting solution mixed with the above composition, the resulting mixture then diluted with water to about 48% solids content.

The above composition was then applied by a blade coater at a speed of approximately 700 feet/minute onto a high wet strength paper base sheet with a coating weight of about 6 pounds per 3300 square feet of surface. Thereafter, the coated paper was dried by infra-red heat as above described and subsequently calendared. Upon drying, the hydrophilic colloid became highly insoluble, possibly by reason of the fact that upon elimination of the
ammonia by volatilization, an insoluble zinc salt of polyacrylic acid was formed. The
resulting surface was highly receptive to water so that it substantially immediately wet out and yet without
further treatment was capable of receiving and holding an ink-receptive, oleophilic imaging material, applied by
various means, commonly used in the imaging of conventional lithographic materials. The lithographic surface formed on the paper base sheet did not cause excessive stiffening or embrittlement of the base sheet so that the composite structure could be readily used in a typewriter or the like for imaging in the usual manner for office duplication. As noted here-
before, the drying of the coating composition was insoluble and yet was readily wet out by water in the non-imaging areas and became ink receptive in the areas imaged with the greasy composition or the like. Unlike prior art lithographic surfaces made by other
methods, the lithographic surface prepared in accordance with the present invention required no brushing and/or
under the coated surface with a polyvalent metal salt before it would give satisfactory lithographic repro-
ductions.

Example 2

A 50 pound per 3300 square feet high resina sized wet strength paper was tub sized with a starch-polyvinyl
alcohol. Example size, dried and machine calendered to form a paper coating rawstock. The above rawstock was
then coated by means of a blade coater with 6-9 pounds per 3300 square feet of dry solids of the base coating
composition shown below:

<table>
<thead>
<tr>
<th>Coating composition</th>
<th>Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coating clay</td>
<td>55</td>
</tr>
<tr>
<td>Zinc oxide</td>
<td>2.2</td>
</tr>
<tr>
<td>Sodium hexametaphosphate</td>
<td>0.5</td>
</tr>
<tr>
<td>Starch</td>
<td>2.3</td>
</tr>
<tr>
<td>Melamine resin</td>
<td>9.2</td>
</tr>
</tbody>
</table>

Approximately 4 pounds per 3300 square feet of dry solids of the lithographic coating composition of Example
1 was then applied over the base coat by means of a blade coater and subsequently dried as described in Example
1 with the exception that a combination of infra-red heating rays and heated drum driers was used to
the coating surface not being permitted to come in contact with the drum driers until after being dried to a
non-tacky condition.

After calendering, the sheet prepared as described was coated with a coating composition, type of coating
characters, were consistent and reproduced in excellent detail without background discoloration in excess of 300 copies in each test, and easily readable copies were obtained even after the 2500th copy.

Examples 3, 4, 5

Paper base masters were prepared as described in Example 2 and then coated with the following lithographic
coeating composition:

<table>
<thead>
<tr>
<th>Coating clay</th>
<th>3 4 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc oxide</td>
<td>62</td>
</tr>
<tr>
<td>Sodium hexametaphosphate</td>
<td>0.13</td>
</tr>
<tr>
<td>Starch</td>
<td>2.6</td>
</tr>
<tr>
<td>Ammonium hydroxide (20° Beame)</td>
<td>10.8</td>
</tr>
</tbody>
</table>

45-5 pounds per 3300 square feet of each of the above compositions were added to the paper base stock of
Example 2, dried as described in Example 2 and tested as described therein. The lithographic sheets thus pro-
duced gave results similar to those described in Example 2, the sheet produced with the composition shown in
Example 3 being of a quality slightly lower than that of Example 2 but better than that of Example 1. That of
Example 4 was slightly lower than that of Example 2 but better than that of Example 3. That of Example 5
was approximately equal in quality to that of Example 2. All masters of Examples 2, 3, 4 consistently reproduced
in excellent detail at least 300 copies and had no observable background discoloration. As in Example 2, easily
readable copies were obtained even after the 2500th copy. It is to be noted that when adhesive content was reduced
to 9 parts, the image was lifted after a relatively few copies and when adhesive content was increased to 13
parts, a typed image did not bond well to the lithographic surface.

Examples 6-13

Using the process of Example 2, drying of the lithographic coating on the paper base master was accom-
plished using (1) infra-red heat applied directly on the coated surface of the paper, (2) drum driers contacting the uncoated side of the base, and (3) high velocity air applied to the coated or exposed lithographic surface of the sheet. The relative results, as determined by the num-
er of satisfactory copies produced, were as follows:

<table>
<thead>
<tr>
<th>Infrared dry</th>
<th>Drum temp.</th>
<th>High velocity air</th>
<th>Copy results</th>
<th>Ink smear tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example 6... Off...</td>
<td>75 300</td>
<td>NA...</td>
<td>77.8</td>
<td></td>
</tr>
<tr>
<td>Example 7... On...</td>
<td>75 150</td>
<td>NA...</td>
<td>78.4</td>
<td></td>
</tr>
<tr>
<td>Example 8... On...</td>
<td>75 150</td>
<td>NA...</td>
<td>78.4</td>
<td></td>
</tr>
<tr>
<td>Example 9... On...</td>
<td>75 150</td>
<td>NA...</td>
<td>78.4</td>
<td></td>
</tr>
<tr>
<td>Example 10... On...</td>
<td>200 300</td>
<td>NA...</td>
<td>78.4</td>
<td></td>
</tr>
<tr>
<td>Example 11... Off...</td>
<td>200 300</td>
<td>NA...</td>
<td>78.4</td>
<td></td>
</tr>
<tr>
<td>Example 12... Off...</td>
<td>200 300</td>
<td>Off Fair to good</td>
<td>63.4</td>
<td></td>
</tr>
<tr>
<td>Example 13... Off...</td>
<td>200 300</td>
<td>Off Excellent</td>
<td>46.4</td>
<td></td>
</tr>
</tbody>
</table>

1 An ink smear test was made by rubbing a standard offset ink on the lithographic surface of the test paper from Examples 6 through 12. The ink was diluted 1 pound of ink to 4 parts of ink varnish to reduce the ink viscosity. After removing the excess ink by wiping with a cloth, the test surface was wiped with a cloth wetted with standard lithographic ink solution, and the page before applied to the test surface. The results are relative to the lower brightness readings indicating better anchorage of the offset ink images.

NA—Not acceptable.

Example 14

High sized wet strength paper having approximately 50% long fiber and 50% short fiber, tub sized to seal
the paper surface, was given a base coating comprising melamine formaldehyde, starch, clay, and zinc oxide
applied to paper. The components of the base coat were mixed and thereafter applied by means of a blade coater.
The base first coat was applied with a coat weight of about 8 pounds of dry solids of coating ingredients per
3300 square feet and thereafter a second coating of the same composition and having a coat weight of about
3-4 pounds of dry solids of coating ingredients per 3300 square feet was applied over the first base coat. The litho-
graphic coating composition of Example 1 was then applied by a blade coater over the second base coat in a coat
weight ranging between 1 and 5 pounds of dry solids of coating ingredients per 3300 square feet. After drying as
described in Example 13, the dried coated paper was machine calendered. The results with this paper were com-
parable to those obtained in Examples 2-5.

What is claimed is:
1. In the process of producing improved lithographic plates by reducing the accumulation of multivalent metal
polyacrylic adhesives at the exposed surfaces of lithographic printing plates during drying on a paper base,
the improvement which comprises applying to said paper base an aqueous coating composition of 50-70%, by
weight, solids content, and a rate such as to give a dry coat weight of the order of 1 to 6 pounds per 3300
square feet, comprising inert filler, polyacrylic acid, and a metal base selected from the group consisting of oxides
and hydroxides of zinc, magnesium, calcium, lead and barium, and mixtures thereof, and ammonium ions in an
amount in excess of that required to maintain the solubility of the polyacrylic acid in the presence of the metal
base used, the ratio of polyacrylic acid to metal base being of the order of 1 to 1–4 and the ratio of polyacrylic acid to metal base plus inert filler being of the order of 1–2 to 10, and drying said applied coating composition by evaporating the water content thereof within the body of said coating away from the exposed surface thereof.

2. The process of claim 1 wherein said evaporation is effected by means of infra-red heat.

3. The process of claim 1 wherein said evaporation is effected by heating means contacting the uncoated side of said base sheet.

4. The process of claim 1 wherein said evaporation is effected by infra-red heat followed by drum dryers contacting the uncoated side of said base sheet.