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## ENGRAVING PLATE

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This invention relates to an engraving plate, and more particularly it relates to a metal photo-engraving plate of novel characteristics for use in the usual processes. This application is a continuation-in-part of my copending application Serial No. 264,037, filed March 24, 1939.

In engraving, metal plates are employed, upon one surface of which the desired configuration is etched by a suitable agent. In photoengraving, for example in the reproduction of a photograph, a light-sensitive solution is placed upon the surface of the metal and the photograph printed thereon. The plate is then developed by immersion in a suitable solution by means of which portions unaffected by the light are removed from the surface of the plate so as to permit attack by the etching agent. In another engraving method, the metal sheet is coated with a film of wax or the like and the matter to be reproduced drawn on the surface of the wax film by a stylus, the stylus creating exposed portions of the plate. In order to protect the back of the plate from the action of the etching agent, the plate is then coated on the reverse surface with an asphaltum composition, or similar acid resist, by means of an ordinary paint brush. The coating applied is relatively thick, and it will be clear that it is impossible to obtain a coating of uniform thickness on the plate by this method. In the preparation of a photoengraving plate, the plate is heated to a temperature of approximately 250° F., and the asphaltum coating is then applied. The heat causes the asphaltum to dry rapidly so that the succeeding operations in the etching of the plate may be carried out immediately.

The plate is placed in a solution of the etching agent and given a preliminary bite or etch. In the event the plate is zinc or a zinc alloy, nitric acid is the usual etching agent employed, while with a copper plate, iron sulphide is a satisfactory agent. If brass is used, the plate may be placed in a suitable bath which is energized by an electric current. In this case, the exposed surfaces are etched by the electrolyte. Usually, irrespective of the nature of the metal plate, the plate after preliminary etching is rinsed with water and dried, and a finely divided resinous material, commonly known as dragon's blood, is usually brushed onto the surface of the plate in four directions by means of a camel's hair brush. The plate is then heated to a temperature of approximately 280° F. to 300° F., causing the dragon's blood to melt slowly and to adhere to the sides of the surfaces extending above the already etched face of the plate. This operation must be performed from two to five times to obtain the required depth of etch necessary in the printing or reproduction process. During this procedure, the asphaltum or other acid resist coating, when subjected to the temperature men-

tioned, tends to soften and is or may be scratched or rubbed off in places which permits the etching agent to attack the back of the engraving plate, thereby destroying the even surface of the plate, which is exceedingly detrimental in the printing process.

The plate is then subjected to the final etching step and thereafter, but prior to its use in the printing machine, the asphaltum is removed since, as before pointed out, the surface thereof is irregular and the asphaltum coating has increased the thickness of the plate to such an extent that unless removed difficulties are encountered during the use of the plate in printing. The removal of the asphaltum is accomplished by immersing the plate in a solvent such as benzol which is highly inflammable and presents a fire hazard in engraving plants. The solvent is relatively expensive and, since the solution of asphaltum and benzol is discarded, a substantial loss of materials, involving a corresponding expense, is represented by this treatment.

One object of the present invention is to provide an engraving plate which has a synthetic resinous coating tenaciously held on the back thereof, which coating is a permanent part of the plate, and is not attacked by any of the solvents which may come in contact with the plate during the engraving process, and is not softened at temperatures encountered in said process.

Another object of the invention is to provide an engraving plate which obviates the application and removal of asphaltum and the like to and from the back of the engraving plate by the engraver as is now required, and which consequently may be employed with a substantial saving in material and labor costs.

Another object of the invention is to provide a rolled metal engraving plate with a permanent coating of heat-cured synthetic resin on the reverse side thereof, the metal of which is capable of withstanding the temperatures required in the conversion of the resin into the infusible, insoluble state without complete recrystallization and the loss of hardness and other desirable properties.

Other objects will be apparent from a consideration of the specification and claims.

The engraving plate of the present invention is characterized by the presence of a relatively thin uniform coating or film of heat-cured synthetic resin on the back of the metal plate. Urea-formaldehyde resins have been found to serve very satisfactorily for the purpose. Such a film is not attacked by the etching agent, such as nitric acid or iron sulphide, by the alcohol associated with the developer, or by the caustic soda or benzol employed in removing the dragon's blood from the plate. The film also is capable of withstanding the temperatures encountered

in the photoengraving process without softening. Other synthetic resins possessing similar properties may be employed in place of the urea-formaldehyde type. The film is of uniform thickness and impervious, and only a relatively thin film is needed to protect the plate from the etching agents. For this reason, the film does not interfere with the reproducing or printing process, and the plates are employed in precisely the same manner as the plates of the prior art from which the asphalt coating has been laboriously removed. The steps heretofore described involving the application of asphaltum to the back of the plate and its subsequent removal with the accompanying wastes of materials are entirely eliminated when a plate of the present invention where the film or coating is a permanent part thereof is employed. For these reasons, a substantial saving is afforded not only in labor but also in materials. In addition, the film is heat-resistant so that there is no tendency of the film to soften during the heat treatment of the plate following the application of the dragon's blood.

The rolled metal plate to which the coating is applied may be of any composition that is capable of withstanding the temperature required in the conversion of the resin to the infusible, insoluble state, without complete recrystallization, and loss of hardness or other desirable properties of the rolled metal plate sufficient to render the metal sheet unsatisfactory for use in the engraving industry. Metallographically, the recrystallization of the metal is noted when twinning of the crystals caused by the rolling process is eliminated, and physically, it is determined by a loss of hardness as indicated by any suitable testing machine such as a Shore scleroscope. Copper, brass, and suitably alloyed zinc sheets are applicable for use.

In the case of relatively pure zinc or the usual zinc of commerce, sufficient recrystallization occurs at the temperatures required for conversion of the synthetic resin to result in an appreciable reduction in hardness of the sheet as well as in undue grain growth, so that such a sheet is rendered unsatisfactory by the heat treatment for photoengraving purposes. Furthermore, with such zinc sheets, the grain growth and recrystallization are sufficiently excessive to cause "stretch" or increase in dimensions of the sheet, rendering it unsatisfactory for use in multicolor reproductions.

It has been found that if a relatively small amount of an alloying element is added to pure zinc or to the usual zinc employed in the photoengraving industry which contains not less than .1% of cadmium and lead (generally .25% cadmium and .25% lead), a plate is obtained whose hardness is raised sufficiently so that the plate may be subjected to the temperatures required for the conversion of the synthetic resin without causing excessive and detrimental grain growth and loss of hardness of the rolled metal plate. Examples of the alloying elements which may be employed are aluminum, copper, nickel, iron, magnesium, silicon, and manganese, but it is to be understood that any alloying element which is capable of raising the hardness to the extent required may be employed—of the alloying elements mentioned, manganese is generally preferred. Usually the alloying element will range from .002% to 1.75% when employed in a pure zinc plate, and from .001% to 2.00% when used with the usual zinc employed in the photo-

engraving industry. These percentages are given by way of example and the specific figures are not to be taken as limiting; for example, the upper limit is not critical and the figures given have been found to serve the purpose, any increase of alloying element moreover not being necessary for satisfactory results. Obviously, more than one alloying element for the purpose of raising the hardness may be present if desired, for example, aluminum with copper, magnesium, or manganese; and, in addition, elements imparting other properties to the zinc may be used.

As before stated, the heat-cured synthetic resin employed as the coating for the back of the metal plate may be any compound which is capable of adhering to metal in the form of an impervious film and which is capable of withstanding the action of the etching agent, solvents, and heat used in the engraving process. As previously pointed out, synthetic resins such as urea-formaldehyde resins are particularly applicable for use. The synthetic resin in its initial and soluble stage dissolved in a suitable organic solvent is applied to the back of the plate which has been treated to render it in a condition suitable to receive the coating. The solution may be applied by painting or spraying or by any other suitable means. After the solution has been applied, the organic solvent is evaporated and the plate thereafter treated in the manner customary with solutions of the type in question, for example by subjecting the plate to a heat-treatment, to complete the reaction of the components of the resin and to convert the resin to the infusible, insoluble state. In the case of the urea-formaldehyde resins, the plate may be heated to 250° F. to 325° F. for a sufficient time, usually twenty minutes, to render the synthetic resinous film substantially infusible and insoluble in the usual organic solvents.

In a typical case, where manganese was selected as the alloying element, the series of experiments set forth in the following table illustrate the effect of the alloying element on the hardness determined by a Shore scleroscope on a rolled zinc sheet containing .25% cadmium and .25% lead. In the experiments, the sheet was heated to 300° F. which corresponds to the overage temperature employed in converting the urea-formaldehyde resin, and the time of treatment was varied as is shown in the table so that it more than covered the usual time of heat treatment required in the conversion.

| Percent Mn=0 |    | Percent Mn=.085% |    | Percent Mn=.148% |    | Percent Mn=.221% |    |
|--------------|----|------------------|----|------------------|----|------------------|----|
| A            | B  | A                | B  | A                | B  | A                | B  |
| 0            | 25 | 0                | 27 | 0                | 28 | 0                | 29 |
| 1/2          | 23 | 1                | 27 | 1                | 28 | 3                | 22 |
| 1            | 17 | 2                | 25 | 2                | 27 | 5                | 22 |
| 2            | 17 | 5                | 20 | 5                | 21 | 10               | 21 |
| 5            | 15 | 10               | 19 | 10               | 20 | 15               | 20 |
| 10           | 15 | 15               | 18 | 15               | 19 | 30               | 20 |
| 15           | 15 | 30               | 18 | 30               | 19 | 45               | 20 |

A is time in minutes which zinc sheet is heated at 300° F.

B is hardness as determined by Shore scleroscope.

Experience has shown that a hardness of 18 or more as determined by the Shore scleroscope is satisfactory in an engraving plate, and it is to be noted from the foregoing table that in all cases where the alloying element was present a satisfactory hardness was maintained after the heat treatment, as contrasted with the rolled zinc

sheet containing no alloying element. In accordance with the present invention, therefore, an alloying element is added to the zinc so that the rolled zinc plate used in the production of the engraving plate has a hardness on a Shore scleroscope of not less than 18.

The thickness of the photoengraving plates normally is .065 inch in thickness and if a metal plate of such a thickness is employed, the thickness of the resin film is usually from .0005 to .00025 inch thick, since it is only necessary that the thickness be sufficient to protect the metal plate during the engraving process. The thickness of the metal sheet and the resin film will, of course, in any given instance be of the standard required by the engraving process.

Considerable modification is possible in the selection of the synthetic resin coating applied to the back of the metal engraving plate and in the composition of the metal plate employed, as well as in the methods of applying the coating, without departing from the essential features of the invention.

I claim:

1. A metal engraving plate having a permanent impervious coating of a heat-cured synthetic resin adhered to the back thereof, which coating is capable of withstanding the heat and the action of the etching agent and solvents used in the process, the metal of said plate being capable of withstanding the temperature required in the conversion of the resin into the infusible, insoluble state without excessive and detrimental loss of hardness and other desirable properties.

2. The metal engraving plate of claim 1 wherein the heat-cured synthetic resin is a urea-formaldehyde resin.

3. A metal engraving plate having a permanent impervious coating of heat-cured syn-

thetic resin adhered to the back thereof, which coating is capable of withstanding the heat and the action of the etching agent and solvents used in the process, the metal of said plate comprising zinc and a relatively small amount of at least one alloying element capable of raising the hardness of the zinc to permit conversion of the synthetic resin without causing excessive and detrimental grain growth and loss of hardness of the zinc plate.

4. The metal engraving plate of claim 3 wherein the heat-cured synthetic resin is a urea-formaldehyde resin.

5. The metal engraving plate of claim 3 wherein an alloying element for the zinc is manganese.

6. The metal engraving plate of claim 3 wherein the alloying element for the zinc is present between approximately .001% and 2.00%

7. A metal engraving plate having a permanent impervious coating of heat-cured urea-formaldehyde resin adhered to the back thereof, which coating is capable of withstanding the heat and the action of the etching agent and solvents used in the process, the metal of said plate comprising zinc and a relatively small amount of at least one alloying element thereof capable of raising the hardness of the zinc to permit conversion of the synthetic resin without causing excessive and detrimental grain growth and a loss of hardness of the zinc plate below 18 as determined by the Shore scleroscope.

8. The metal engraving plate of claim 7 wherein the zinc contains small amounts of cadmium and lead not less than .10% of each thereof, and an alloying element is manganese.

9. The metal engraving plate of claim 7 wherein the alloying element for the zinc is present between .001% and 2.00%.

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