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PROCESS OF PRODUCING PRINTING PLATES

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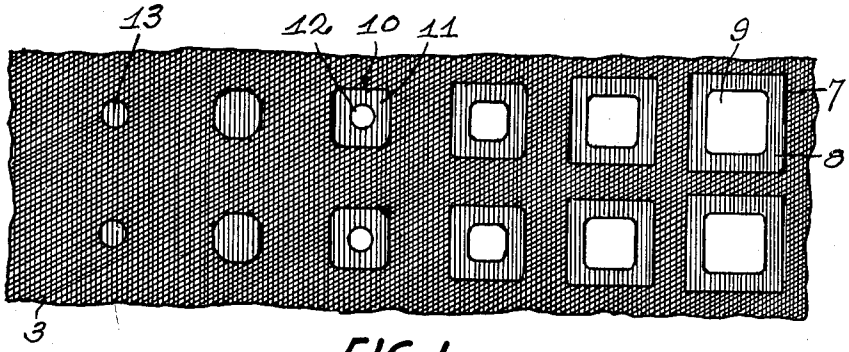


FIG. 1.

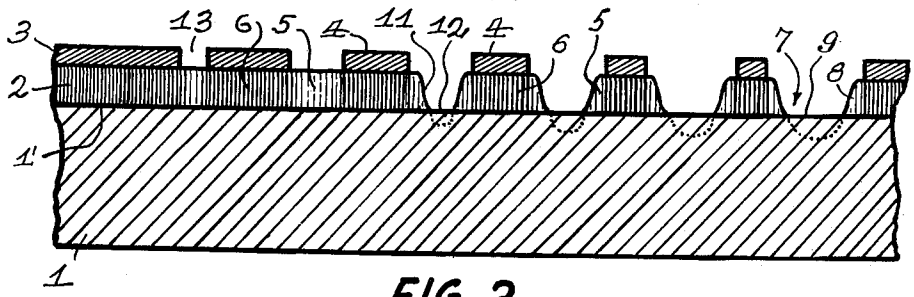


FIG. 2.

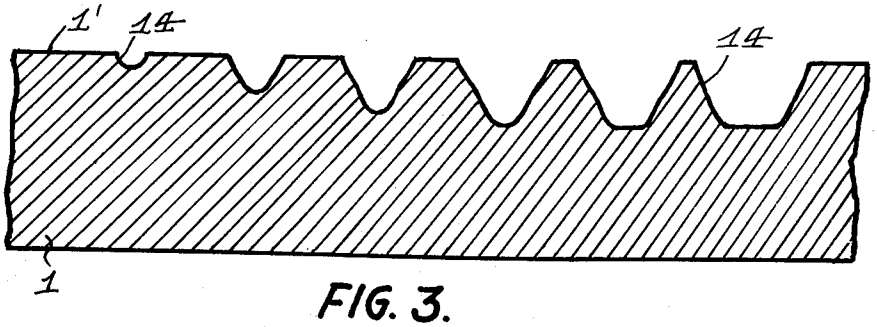


FIG. 3.

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PROCESS OF PRODUCING PRINTING PLATES

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It is well known that both intaglio and letterpress printing surfaces are generally prepared by means of etching, this etching being controlled by means of a stencil copied photographically onto the surface of the roller or plate. Two different groups of stencils may be used for the control of etching. The first group comprises the acid resistant, impermeable types of layer, which, after being photographically printed down from a photographic positive or negative and developed, protect those parts of the surface which are not to be deepened by etching. These layers are resistant to all acids, used in the etching of metals and are commonly employed in the preparation of letterpress (and more rarely intaglio, generally for use on textiles) printing surfaces.

To prepare a plate for the reproduction of a picture containing shading by means of etching controlled by a totally acid resistant stencil, the process must be combined with the so-called "halftone" process. The "halftone" photographic process is such that positives or negatives can be produced, in which the tones in the picture being reproduced are represented by "dots," whose centres are equidistant from each other, but which vary in area. The tone value, therefore, is governed by the ratio of dot area to the distance between the dot centres, or more simply, by the size of the dots. The etching of a picture produced by the "halftone" process, however, is not a straightforward matter, as the areas deepened by the etching tend to become enlarged as the process goes on. This phenomenon is generally known as "undercutting." The changes in dot size (and thus in tone values) due to undercutting, are one of the considerations taken into account in the production of the "halftone" photograph, and compensation can be achieved at this stage but only to a limited extent. For this reason, the etching has to be performed in stages, the etching being periodically stopped, and those parts of the picture where no further diminution of the dots is permissible, being covered with an acid resistant varnish. The etching is usually carried out in 3–5 stages, but this can be reduced by the use of an etching machine. In this machine, the fast and vigorous circulation of the etching fluid (the acid) over the etched surface is ensured, which reduces the extent of undercutting relative to the depth achieved.

The other group of stencils used for the control of etching, the semi-permeable layers (e.g. carbon tissue), are generally used for the preparation of surfaces for intaglio printing. Such a layer covers the whole area of the plate or roller (both those parts which are to be etched, and those which are not). Its thickness, however, or its permeability to liquids, varies over its entire area according to the picture, having been controlled by means of a photographic exposure to a continuous-tone photographic positive image of the picture. For etching, a viscous aqueous solution of ferric chloride is used, partly because the semi-permeable coating is attacked by stronger acids, and also because, by the regulation of the viscosity of the ferric chloride, close control of its rate of permeation can be achieved. The thinner or the more permeable the layer, the more quickly will the solution penetrate: conversely, the thicker or the less permeable the coating, the more slowly will it penetrate. Thus, the time at which the metal starts to be etched, and consequently the depth achieved at the finish will vary over its area according to the picture, having been controlled by the semi-permeable

photographically printed coating and the viscosity of the etching fluid. Thus, in a picture printed from a surface prepared by this method, the tone values are obtained from the varying quantities of printing ink carried by the varying depths of etching.

The regulation of depth of etching by means of a semi-permeable layer, however, is a delicate operation, and not always a satisfactory one, because the procedure is affected by too many variable factors; and as the semi-permeable coating is saturated with ferric chloride solution, the periodic interruption of the etching, and procedure by stages as carried out with impermeable coatings, is impossible. Consequently, the "halftone" process has lately come into use for intaglio printing as well as it is the most certain method of controlling tone values in the pre-etching stage, but this method is combined with the tone control obtained from variable-depth etching. In these newer processes, a "halftone" and a continuous-tone diapositive of the picture to be reproduced are in turn printed photographically onto a semi-permeable coating. In etching, therefore, both the dot size, controlled by the "halftone" positive, and the etched depth, controlled by the continuous-tone positive will have effect. The tone-values are thus controlled by the combination of these two factors, and the process embodies the greater certainty of the "halftone" method together with the greater tone-range of variable-depth etching.

One of the faults of the process described in the preceding paragraph is the need of two diapositives (a "halftone" and a continuous-tone one) which increases the expenses and brings new difficulties into the process. The tone rendering depends now on two factors, controlled by the two diapositives which have therefore to be kept very closely balanced with respect to each other and no one of the two diapositives has the true characteristics (tone values) of the image to be reproduced by etching. So the control of tone values in the pre-etching stage is still uncertain and complicated. A further difficulty is the perfect registration of both diapositives in successively printing them down on top of each other. The etching is still controlled by a semi-permeable coating, and the accompanying difficulties and uncertainties, already described, cannot therefore be completely eliminated. The inconsistencies in the speed of permeation of the etching fluid still cause (although to a lesser extent) variations in the tone-values, and make the achievement of the desired depth uncertain. For instance, if the permeation occurs too quickly, etching must be stopped before the prescribed time has elapsed, as even the most resistant parts of the semi-permeable coating, those parts enclosing the dots, will not resist the ferric chloride for long. If a semi-permeable coating is employed in the described known way, an etching machine cannot be successfully used either, because the coating prevents the vigorous circulation of the etching fluid on the surface of the metal.

In order to overcome or decrease the difficulties associated with etching controlled by a semi-permeable coating, the following method was suggested (see U.S. Patent No. 1,901,468 of March 14, 1933). A halftone-diapositive is first printed on an impermeable light sensitive layer of a plate or roller, developed as usual and coated again with a semi-permeable light sensitive layer. Now the continuous tone diapositive of the same image is printed in perfect register with the previous print and the semi-permeable layer is developed, so, upon etching, the penetration of the etching fluid is controlled by the semi-permeable coating, and the size of the dots is controlled by the underlying impermeable coating. This method cuts down some of the difficulties of etching controlled by a semi-permeable layer only, but it still requires two diapositives, and two prints in perfect register, and the two prints have to be developed separately.

Beside this, the adhesion of the two layers is uncertain, because the impermeable layer is water repellent by its nature and so when the overlying semi-permeable layer is being developed or etched and is thus saturated by water, it often becomes separated from the lower layer thus ruining the plate.

In the course of my experiment I have found that the desired progress of etching can be simply, successfully and flexibly controlled, when the surface of the metal-plate or roller is coated with a semi-permeable, then with an impermeable-light sensitive layer overlying the semi-permeable layer and then printed with a halftone diapositive (or negative) only. By a semi-permeable layer is meant a layer of a coating of a light sensitive material which hardens when exposed to light and which is semi-permeable to etching fluid and water, as it can be impregnated therewith even when hardened by light so as the etching fluid may etch the underlying initial plate. By an impermeable layer is meant a layer of light sensitive material which when light hardened is impermeable to etching fluid and water, and cannot be removed thereby. The image has to be developed in a developer for the impermeable coating and rinsed by water. Water rinsing usually only serves to clean the surface from the rest of the developer, but in this case the water also develops and simultaneously desensitizes these parts of the semi-permeable layer, which were uncovered by the first developing. After development, the plate is etched preferably in an etching machine as will be described hereinafter by an etching fluid which consists for instance of an aqueous solution of ferric chloride.

The annexed drawings will clarify the process of the present invention and the results attained thereby.

In the drawings:

FIGURE 1 is a partial plan view of a printing plate in accordance with the present invention, after development of the sensitized layers and prior to etching;

FIGURE 2 is a cross-section of the plate of FIGURE 1; and

FIGURE 3 is a cross-section of the printing plate after etching is completed and the layers removed.

In the drawings, like reference characters indicate like elements throughout.

In accordance with the present invention, the plate **1** made of copper or other suitable metal, the top face **1'** of which is first coated with a light sensitive semi-permeable layer **2** and immediately thereafter with a light sensitive impermeable layer **3** which overlies the layer **2**, both layers being continuous and covering the plate. Semi-permeable layer **2** may be made for instance of gelatin sensitized with a water soluble chromium salt. The impermeable layer **3** may consist of the material known under the trade-name of "Blue Top" which consists of a shellac suspension in ammonia water sensitized with a water soluble chromium salt; both layers are of the light hardening type, that is, they harden when exposed to light. The light sensivity of the semi-permeable layer is selected greater than that of the impermeable layer **3**. Similarly, the semi-permeable layer **2** is made thicker than the impermeable layer **3**. Once the plate is prepared, it is photographically printed with a halftone diapositive, that is the pre-sensitized plate is exposed to light passing through the halftone diapositive of the image to be reproduced. The plate is then developed in a developer for the impermeable coating whereby the latter is removed except the areas **4** which have been exposed to light and become hardened. The plate is then rinsed in water whereby the semi-permeable layer **2** is developed and removed as indicated at **12** in FIGURE 2 in the areas which have not been light hardened. The light hardened areas are indicated at **6** by closer section lines. Due to the obliquity of the light rays during exposure and due to the fact that the thickness and light sensitivity of the semi-permeable

layer are greater than that of the impermeable layer, "undercutting" by light takes place and after development, we obtain an image in which the areas (dot-areas) surrounded by the impermeable layer have a fringe consisting only of the semi-permeable layer, and the dot-centers are free of both layers (FIGURES 1 and 2). In the case of big dots **7**, the semi-permeable fringe **8** covers a small area in proportion to the area **9** of the uncovered dot-centers. In the case of smaller dots such as **10**, the fringe **11** covers a bigger area in proportion to the now smaller dot areas **12**, and in the case of very small dots **13** their whole area is covered by the semi-permeable layer **2**. Beside this, because the undercutting light fades in a direction towards the dot-centers the degree of hardening of the said fringes decreases from their borders surrounded by the impermeable layer, toward the free dot-centers as indicated at **5** by more spaced section lines than at **6**. The amount of the undercutting itself can be controlled by the kind of light source used in the printing. A "pinlight" gives practically no undercutting at all, whereas a big or a diffuse, or a moving (i.e. rotating) light source gives a big undercutting, and so broad fringes. The etching controlled by the above described double-stencil or layer, starts on the uncovered dot centers (FIGURE 2), and only later on the fringes covered by the semi-permeable layer, progressing from their free edges near the dot centers, toward the surrounding impermeable layer, according to the degree of light hardening of the fringes, described above. The smallest dots, covered entirely by the semi-permeable layer, start to etch last. So the progress of the etching process is very similar to the case in which two diapositives (a halftone—and a continuous tone) are used, and so is the result, as illustrated by the etched depressions **14** of varying depth and size as shown in FIGURE 3. Only the process of the present invention is much more certain, much quicker, more economical and flexible. Provided there was sufficient exposing light during printing of the halftone diapositive, lifting of the impermeable layer on top of the semi-permeable layer cannot occur because the light hardened parts **6** of the semi-permeable layer become uniformly and sufficiently hardened as to not absorb any more water during water rinsing and are also protected from water by the overlying impermeable layer.

So far, however, a certain amount of uncertainty, caused by the not fully controllable factors, involved in etching controlled by a semi-permeable layer, would have been still remained in my process. But even this amount of uncertainty can be avoided in the following way. The etching has to be done in an etching machine, that is with vigorous circulation of the etching fluid. The machine, in case of rollers, consists for example of a container for the etching fluid, and the partly immersed roller to be etched rotates at an adjustable speed.

An etching fluid of such a low density is used, that it can penetrate the semi-permeable layer within a very short time. During etching, the etching fluid circulates on the uncovered areas (dot centers) more or less fast and vigorous, according to the speed of rotation of the roller, producing a more or less intensive etching, mainly depthwise. But the intensity of etching on the free dot centers is not uniform, because the scale of the halftone screen is of such a small order of magnitude, that the walls of the coatings surrounding the free dot centers define capillary tubes or holes at the smaller dot centers and the circulation of the etching fluid is hindered by the capillary forces, whereas in the bigger dot centers the speed of circulation remains unhindered. On those areas which are protected by the semi-permeable layer (fringes and smallest dots), the speed of circulation has very little effect, even after full penetration of the etching fluid. On these areas the progress of etching is very slow, compared with that on the free areas. So the ratio of etching between the uncovered areas and those

covered with the semi-permeable layer depends practically on the speed of the etching machine only. Thus, by using this method for etching, the speed of penetration through the semi-permeable layer, is no longer an important factor.

The etching of an intaglio-roller can be finished in this way, within 5–6 minutes, while the etching controlled by a semi-permeable layer in the already known ways, lasts 20–25 minutes.

From the description of the process in accordance with the present invention, it will be seen, that not only a halftone etching, consisting of different dot sizes and depths can be produced in a very simple and certain way, but because of the protecting action of the "fringes," the desired depth of etching can be reached, practically without any effective increase of the dot areas. That means, that the etching becomes automatically a true image of the halftone diapositive, and so the control of tone rendering in the pre-etching stage becomes a reality. The importance of this factor, especially in the case of colour-reproduction, is so clear, that it needs no explanation.

The above described process is suitable both for intaglio and process engraving, for rollers and plates, and for many other purposes.

In the annexed claims, the term "plate" is meant to include printing rollers as well as plates.

What I claim is:

1. The process of producing a printing plate comprising the steps of applying on a metal plate, a first layer of a light sensitive material which is semi-permeable to etching fluid and water, as it can be impregnated therewith even when hardened by light, and a second layer overlying said first layer and of a smaller thickness than

said first layer and made of a light sensitive material which has a smaller light sensitivity than that of the first layer, said second layer being impermeable to etching fluid and water and cannot be removed thereby when light hardened, exposing the pre-sensitized plate to light passing through a half-tone photograph of the image to be reproduced, developing said plate in a developer for the impermeable layer to thereby remove the non-hardened areas of said second layer, subsequently rinsing said plate in water to thereby remove the non-hardened areas of said first layer, whereby the plate obtained has uncovered metal areas surrounded by an uncovered fringe of light hardened first layer in turn surrounded by a zone of light hardened second layer, and then etching the printing plate with an etching fluid to obtain a plate with etched depressions of varying depth and size.

2. The process as claimed in claim 1, wherein the etching is carried out with vigorous circulation of the etching fluid.

3. The process as claimed in claim 1, wherein etching is carried out with circulation of the etching fluid in an etching machine, the ratio of etching between the uncovered plate areas and those covered with said first semi permeable layer depending practically only on the speed of circulation of the etching fluid, the speed of penetration of the etching fluid through said first semi-permeable layer being no longer an important factor.

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