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RELIEF ENGRAVING

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My invention relates to improvements in relief engraving, and it more especially consists of the features pointed out in the claims.

The purpose of my invention is to produce printing plates of pictorial subjects; that eliminates the use of acids as commonly employed in etching engraved plates; that provides means for translating tone values of pictorial subjects into areas having unitary characteristics which change in accordance with the varying pictorial tonalities of the subject; that may utilize a direct contact medium for producing the pictorial units without the cooperation of well known camera expedients; that instead of using an optical method in the camera which comprises placing a ruled screen in front of the sensitive plate any desired form of screen directly in contact with the sensitive surface may be used; that through the development of the exposed sensitive surface there is produced a relief consisting of unitary areas varying in accordance with the lights and shades of the subject; and that from such relief surface a reverse impression is made from which a replica suitable for relief printing is made.

With these and other ends in view, I herein describe such instances of adaptation as will disclose the broad underlying features of the invention without limiting myself to the specific details referred to herein.

In carrying out my invention I may use whatever alternatives of materials or equivalence of steps that the exigencies of varying interpretative conditions of different pictorial subjects may demand without departing from the broad spirit of the invention.

In producing an engraving for relief printing in the ordinary manner a negative is first made in a camera from the subject through a cross ruled or other form of screen. Then a piece of metal is covered with a light sensitive material which is exposed under the half tone negative. Where the light freely passes through the transparent portions of the negative the coating becomes hardened, and where it is protected by the picture elements of the negative it remains soft and is easily removed by warm water or otherwise. The unremoved portions of the coating are then "burnt in" by heating the plate, after which it is placed in an etching bath. In this bath the uncovered metal is eaten away, producing hollows or depressions corresponding to the unitary pictorial elements of the negative. From such an etched plate subsequent duplicates may be made by relief printing in the usual way.

With my simplified process I may coat a suitable smooth surface with a layer or film of gelatin, shellac, synthetic resin, or other material, which may be made light sensitive in any desired manner. Upon this sensitized surface, directly in contact with it, I place a so-called half tone negative of the pictorial subject and expose it to light which passes through the negative. The portions acted upon by the light become hard and insoluble. The parts that have been shaded from the light remain soft. These are washed away in any suitable solvent so as to leave the remaining portions on a common plane, which in a later step becomes the printing surface. When dry a paper mat may be impressed thereon and a cast made from the mat in the usual manner ready for relief printing.

Or I may coat a transparent sheet of celluloid, etc., with a similar coating and place a half tone positive against the opposite surface of the sheet and expose it to light. This will in a similar manner cause the coating to become insoluble where it is acted upon by the light, and leave it soluble where the light has not penetrated. These soluble portions are then completely washed away. As soon as dry a mat impression may be taken from it and a cast for subsequent printing made in the usual manner.

When an opaque material having a smooth surface is covered with any kind of light sensitive coating, its surface represents the ultimate printing face, which may be made smooth in any desired manner before it receives the imprint of the half tone negative. On the contrary, when a transparent celluloid is coated, its polished face under the coating represents the ultimate printing face. Obviously the smoothness of this face will

be retained in the mat and the cast made from it.

As an instance of adaptation, I may cover any suitable smooth surface with a coating including the following materials:—

Wax free orange shellac, twenty-nine ounces; water, one gallon; aqua ammonia, twenty-five ounces. These are brought to the boiling point which is continued for about twenty minutes or until it reaches the desired consistency when it is allowed to cool before being sensitized. The sensitizer may be one ounce of bichromate of potash dissolved in forty ounces of water added to the coating solution. It may stand for an hour before it is used. The coated plate may be whirled upside down over moderate heat to hasten the drying. It is exposed under the negative for about five minutes to the rays of an arc lamp, after which it may be developed by any desired alcoholic solvent that may include an analine dye such as malachite green. The color brings out the image and makes the development more certain.

The plate is immersed in the solvent for a minute or two, withdrawn for examination under an amber light, and if needed returned to the developing bath. As soon as the development is completed the plate is washed in cold water. A tuft of cotton may be used to remove the scum after which the plate is dried. The portions of the coating which were rendered insoluble now stand in relief. They correspond to the usual acid etched depressions, and the smooth surface of the plate between the raised portions represent the ultimate printing face. A mat impression is then made and a metal cast from it.

In the alternative form I may coat a suitable surface with pigmented gelatin sensitized with bichromate of potash, expose it to an arc lamp under a direct contact screen placed between the surface and a pictoral negative of the subject. The unacted areas are removed by means of hot water. An alum bath may be used to harden the coating which remains. The depressed portions represent the hollows corresponding to the etched depressions of well known zinc etchings. A mat impression and a metal cast from it completes the production of a relief printing plate. The sensitizer and time of printing may be about the same as in the previous adaptation.

When a transparent sheet of celluloid polished on both sides is used instead of an opaque support or base it is coated on one side with pigmented photographer's gelatin, sensitized in bichromate of potash and exposed through the negative or positive which is in contact with the other side of the celluloid, similar to the other adaptations. The light, as stated, hardens the gelatin opposite the transparent portions of the negative or positive and leaves it soluble everywhere else. This soluble portion is washed away entirely. An alum bath may be used to further harden the remaining gelatin and a reversed impression made. From this a mat may be formed and a final metal cast made in the flat or curved to fit the radius of the printing cylinder on which it is to be used. The raised portions of the coating represent the usual hollows of an acid etched zinc plate. When a gelatin coating is used it may be sensitized in a 2 per cent solution of bichromate of potash or any cooperating variants of this and exposed to an arc lamp under the time control of an actinometer or otherwise.

It will be seen that in the use of these expedients all of the many steps inevitably associated with the acid etching of printing plates are eliminated, and when same sized reproductions are required the usual camera and screen may be dispensed with by using a replica of any desired screen formation and a film of the subject for direct printing onto the sensitized surface, similar to metzograph screen technique or otherwise. As an alternative, a transparent sheet of the required thickness to secure a cooperative "screen distance" may be placed in contact with the sensitized coating between the film and the screen replica to translate the tones of a subject into pictorial units which vary in accordance with the lights and shades of a subject.

I may in addition to the expedients described use a light sensitive coating of rubber which changes its solubility when exposed to the rays of ultraviolet light projected thereon. By using this expedient instead of bichromated gelatine or sensitized shellac I am also able to produce insoluble pictures which comprise fixture elements formed in geometric dots, or lines or irregular grains by means of half-tone screens of the type described herein, or otherwise. The portions of the coating not acted on by the light are removed by benzene, the same solvent used in the preparation of the coating. Such a coating of rubber is vulcanized under the action of ultraviolet light rays. After vulcanization it remains insoluble in its original solvent, but any unvulcanized areas will, however, be removed by the same solvent.

In addition my invention is operable with a new and unique method of making dot separation screens for use in making direct contact exposures without a camera or the well known four step and flash exposures, common in photoengraving. Such a screen comprises pattern of constant density and variable area, constituting middletone values of variable outline or variable proximity secured by photoengraving processes, so as to constitute a faithful rendition by photography of the screen pattern that may be imparted in the customary process.

Various types of crosslined screens in use today include the diagonal cross line screen, the sixty degree angle cross line screen, the diamond screen. Others include the grain screen and the metzograph screen.

In my use of contact screens which work, without change of stops for highlight, middle tone, and shadow, there is imparted, with contact printing at a single exposure with negative film or positive paper and a suitable positive or negative subject, a constant density dot formation of variable area, shape and separation to conform to that of any of the above type screens when used in the usual method of process photography, and it consists in using a screen pattern that will conform to the screen pattern of the middletone dot formation cast by the particular type of screen desired when made with the desired type of stop.

For instance the dot formation of a right angled diagonal cross lined screen used with a standard shape half tone stop consists when viewed in a positive print of small, widely separated white round dots in the deep shadows, the dots growing larger and approaching each other in the lighter shadows to the middle tone. There are seen at this point as alternating square dots touching at the corners at an angle to correspond with the angle of the cross lined screen, and again appearing in the highlights as round black dots decreasing in size and separation toward high light infinity. The use of camera stops of square, round, star pointed or other shapes will impart a distinct character to the dot shape of high light, middle tone and shadow with any screen and these patterns may be multiplied by various combinations of stops and screens. In the use of a screen with a pattern to conform to the middletone dot formation cast by light transmitted through any type of screen with any shape of stop desired, I am enabled with contact printing or approximate contact printing to set up a photographic pattern to conform to the dot pattern gamut of the original screen and stop of the process camera from shadow through middle tone to highlight.

This may be done without a camera by placing a screen of my middletone type in contact or approximate contact with photosensitized paper, film, or plate, or sensitized metal or substance for engraving, and placing a continuous tone negative of a suitable subject in contact or approximate contact with the screen and simply exposing the three to light so that the light will pass through the negative, the screen and on to the sensitive surface. The order of negative and screen may be reversed without department from the spirit of the invention.

Another manner in which I use this middletone type of screen, for positive copy, is to mount the copy for reflected light and place the screen between the copy and a negative film or plate in approximate contact with the same. This, preferably is done in a process or copying camera, and is particularly adapted to the strip film camera, which, when used with an approximate contact cross line diagonal screen, does not give the wide pattern gradation of the wet plate process camera.

Another manner in which I use this middletone type of screen is to supplant the retouching system commonly known as "veloxing," in the operation of which it has been the custom to make a positive print from a wet or dry plate screen negative, sometimes with enlargement, or to make a proof from an engraved cut, retouching the same in any manner desired by the artist, and then to make a line cut negative from the retouched copy and engrave the cut from this line cut negative. By my process a positive print may be made with or without camera by exposing a negative of the subject in approximate contact with my middletone type of screen, and positive printing paper, ready for the retoucher and a line cut negative may be made from it after retouching.

A great advantage of the middletone type screen is in connection with the process herein described of using a continuous tone camera negative, the screen, and a plate of any desirable soluble substance or composition, sufficiently thick to permit of proofing, printing or dry matrix pressing, with which is incorporated a bichromate of ammonium, potassium, sodium, or other light sensitive media having the property of making a soluble composition insoluble in a suitable solvent under the influence or action of light, of thereafter exposing the three plates to the action of light while in approximate contact, and of subs quently subjecting the exposed plate to the action of a suitable solvent.

A relief cut with a dot formation of constant density printing surfaces of variable area, separation and shape to give the illusion of tonal highlights, middle tones and shadows corresponding with the tonal values of the subject desired for reproduction will be formed without recourse to process photography, variably timed stops and flashing, burning in, rolling up, powdering, or stage etching with acids and built up resists—a multiplicity of more than one hundred manual operations which at their highest efficiency take forty minutes time for four men, photographers, strippers, engravers and routers to accomplish and which, at the high cost, has limited the number of photoengraving plants to less than three hundred newspapers in the United States.

In the carrying out of this process by "contact or approximate contact," is meant a "screen distance" from screen to sensitized plate or film or paper that is less than the

screen distance customarily used in process camera photography with wet negatives and which is sufficient to provide for the rapid formation of correct highlight, middletone and shadow dots in rapid order with one or more exposures through the wide angled "pin hole lens" openings of extremely short focus that are formed by my middletone process type of screen patterns herein described. I am aware that metzograph contact prints have been made heretofore with rays of parallel light. With my process herein described the use of parallel light is not necessary, nor would it be with a metzograph type screen if constructed of uniform middletone separation values. I am aware that films of a composition and nature such as bichromated glue and gelatin have been used in collotype and offset.

Such processes are in no way akin to my invention which provides for a light sensitized surface for relief half tone dot impressions of sufficient thickness to permit of dry matrix pressing with all the characteristics of a half tone engraving of copper or zinc, except that the engraving is done by a solvent instead of an acid, and which is of sufficient strength and toughness to withstand the required pressure customary in dry matrix pressing and to withstand the friction and pressure of direct high speed press printing.

What I claim is:

1. The process of producing a replica of a screen interpreted pictorial subject for relief printing, which consists in coating a transparent support with a sensitive material capable of being insolubilized under the action of light, in subjecting the coating to a source of light through a transparency having variable sized opaque and inverse transparent areas whose characteristics vary in accordance with the lights and shades of a pictorial subject said transparency being in contact with the transparent support whereby the areas of the coating opposite the transparent areas become hardened, and the areas opposite the opaque areas remain soluble, in removing the unhardened portions by means of a suitable solvent applied to the face of the coating, in drying the remaining portions, in taking an impression therefrom, and in subsequently translating the impression into a printing plate.

2. A direct engraving process which eliminates the well known acid etching of metallic plates, consisting in coating a base with a sensitive material capable of being insolubilized under the action of light, in translating a continuous tone pictorial subject into unitary variable sized elements which vary in accordance with the lights and shades of the subject onto the light sensitive material to form raised and depressed portions by development in a solvent, in drying the result, in taking an impression from it, and in subsequently translating it into a printing plate.

3. The process of producing a replica of a pictorial subject for relief printing, which consists in making a composition plate consisting of a soluble coating and a light sensitive agent, in exposing the same to a source of light through a transparency having variable sized opaque areas whose characteristics vary in accordance with the lights and shades of a pictorial subject to selectively harden portions of the plate, in removing the unhardened portions by means of a suitable solvent to a depth sufficient to permit of relief half tone printing or dry matrix pressing.

4. A direct relief engraving process which eliminates the well known acid etching of metallic plates, consisting in a plate coated with a soluble composition and a light sensitive substance, in subjecting the same to a source of light modified by an interposed screen of middle tone characteristics, in placing a pictorial subject between the light and the sensitized plate in close relation to both, and in developing the image.

5. A direct engraving process, which consists in utilizing a screen having isolated areas of middle tone characteristics secured by ordinary screen separation, in coating a suitable surface with a sensitive material capable of being insolubilized under the action of light, in subjecting the surface to a source of light projected through a pictorial subject and the screen in close proximity to each other and in developing the exposed surface.

6. A direct engraving process which consists in forming a middle tone screen by ordinary screen separation in a camera, in coating a suitable surface with a sensitive material insolubilized under the action of light, in placing the screen in approximate contact with such surface, in placing a pictorial subject and opposite the screen, in projecting luminous rays through the subject and the screen onto the sensitive surface, and in developing the image so formed.

7. An engraving process which consists, in projecting a pictorial subject through a screen having isolated middle tone characteristics, in placing a sensitive surface capable of being insolubilized under the action of light in close contact with the screen adapted to receive the projected image, and in subsequently developing the image.

In testimony whereof I affix my signature.

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