Sept. 18, 1945. B. F. TERRY 2,384,857

PRINTING APPARATUS AND METHODS OF PREPARING AND USING THE SAME

Filed April 30, 1941

Fig. 1.

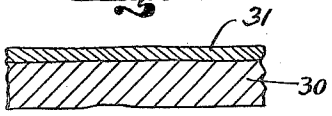


Fig. 2.

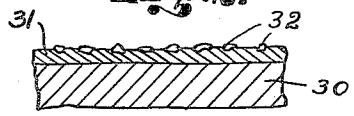


Fig. 3.

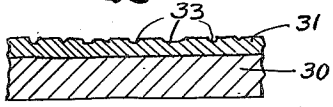


Fig. 4.

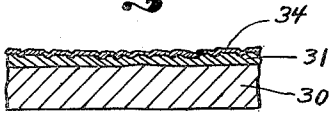


Fig. 5.

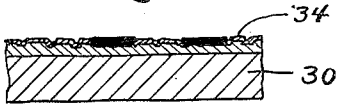


Fig. 6.

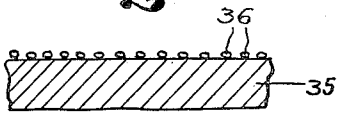


Fig. 7.

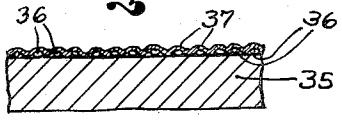


Fig. 8.



Fig. 9.

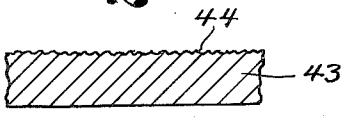


Fig. 10.

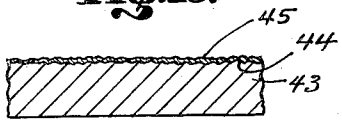


Fig. 11.

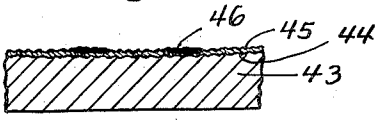


Fig. 12.

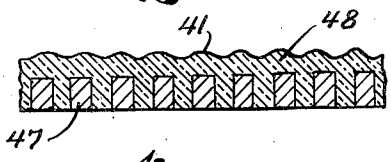


Fig. 13.

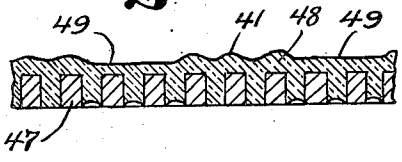
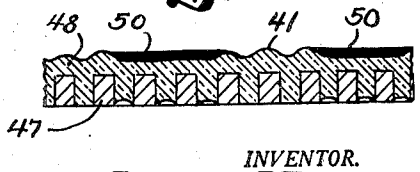


Fig. 14.



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UNITED STATES PATENT OFFICE

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PRINTING APPARATUS AND METHOD OF PREPARING AND USING THE SAME

Bennett F. Terry, Stamford, Conn.

Application April 30, 1941, Serial No. 391,101

4 Claims. (Cl. 95—5.4)

This invention relates to improvements in printing apparatus and methods of preparing and using the same, and is more particularly directed toward the preparation photographically of mediums for printing with pigmented greasy inks, greasy transparent inks, and/or liquid dyes and stains.

According to this invention the surface of the photo-image functions as the ink selecting and/or differentiating plane upon which the ink or stain is transferred from the ink or stain bearing member, and from which said ink or stain is subsequently transferred to the medium upon which the image is printed.

The ink or stain bearing member may be a roller, a flat surface, a straight edge, or any other medium for spreading the ink over the surface.

Another object of the invention is the provision of a plate or carrier having one surface thereof toothed, roughened or grained, and the application of a film of emulsion to this surface, thereby producing a toothed, roughened or grained surface on said film conforming to the configuration of the surface of said carrier.

Another object of the invention is the treatment of the film on said plate or carrier after exposure, development and fixing, to a bleaching and tanning process so as to cause the portions of the image-bearing metallic silver to shrink and harden and thereby form in said surface depressions below the normal level thereof.

A further object of the invention is to produce upon the above-described plates or carriers, after the same have been so processed as to produce the requisite surface, negative images from negatives, and positive images from positives. In other words, it is one of my objects to produce images on one plate or carrier directly from another plate or carrier. This effect is enhanced by using photographic emulsion whose digestion has been so manipulated as to produce easy reversal upon controlled original exposure. Such an emulsion reverses itself during the processing. Another means of reversal of the photographic image may be realized by a subsequent controlled exposure after the first exposure during processing.

It is another of the objects of this invention to produce direct copy images by any suitable photo-reversal means on a toothed, roughened or grained brom-silver or brom-iodo photographic film surface conforming to the toothed, roughened or grained surface of a plate or carrier or flexible sheet, whether the same be rigid, flexible, flat, or curved in character, for use in and with the greasy ink and/or stain printing methods and processes to be hereinafter described.

Another object of the invention is the provision of means for producing a superior copy in greasy ink or liquid soluble stains, or a simultaneous selective combination of both regardless of whether the user has had previous skill in the printing art or not. This means is as fully effective in the offset type of printing as it is by direct printing. Since this method eliminates the major portion of the time required for producing certain kinds of universally required copy, it is therefore more economical and expeditious.

In practicing my invention, full flexibility is realized and the copy is in no way limited to present methods; no electroplate is necessary, nor is it necessary for any other type of professional work to be done on the plate.

Since this invention employs a photographic image as the ink selective surface, the scope of the copy is equal to the range of subjects that can be photographed.

Copy from my method and process does not suffer by comparison with other printing processes, as the inked copy is made from the photo image.

Many attempts in the past have been made to reproduce copies in ink from photographic images with no very marked success either because more work and skill were involved than the results warranted or because it was difficult to keep the copy clean. In many of these attempts, the image was destructible; whereas in my process the image remains clean and apparently is not harmed under reasonable conditions of use.

In lithography the photo-images are generally formed of a bichromate gelatine or bichromate albumen composition. These mediums are slow, and not only require special and costly light sources, but also great skill on the part of the operator is necessary. The action of the light upon the bichromate coatings causes them to become insoluble, and the portions not acted upon by the light remain soluble. Developing consists in washing out the soluble portions with hot water or by means of steam, and a great deal of skill is necessary. Therefore it lies well beyond the average unskilled operator's ability, knowledge or means, to use bichromate processes.

As my method is unfolded in the specification, it will be seen that the removal of soluble portions by hot water or steam, as well as subsequent necessary artificial roughening of the surfaces, are entirely eliminated.

Referring to the drawing:

Figure 1 is a view of a backing sheet, to one surface of which has just been applied a coating of lacquer;

Figure 2 is a view of the backing sheet and lacquer of Figure 1 upon the surface of which grains of suitable chemical crystals have been sprinkled;

Figure 3 is a view of the arrangement shown in Figure 2 after the lacquer has dried and after the salt has been dissolved and removed by means of water, or other suitable solvent;

Figure 4 is a view showing the plate of Figure 3 after the same has been coated with a photographic emulsion;

Figure 5 is a view of the plate of Figure 4 after the same has been developed, fixed, cleared and processed to convert it into an ink-selecting and printing member;

Figure 6 is a view of a backing sheet or plate upon which lacquer is sprayed in droplets;

Figure 7 is a view of the plate of Figure 6 after the photographic emulsion has been applied thereto;

Figure 8 is a view of the plate of Figure 7 after the same has been exposed, developed, and processed to convert it into an ink-selecting and printing member;

Figure 9 is a view representing a sheet or plate, the upper surface of which has been ground;

Figure 10 represents the plate of Figure 9 after a film of emulsion has been applied thereto, the upper surface of the emulsion conforming to the configuration of the ground surface of the plate;

Figure 11 is a view showing the plate of Figure 10 after the same has been exposed, developed, fixed and treated to form a printing plate;

Figure 12 is a cross sectional view of a screen carrying the photographic emulsion;

Figure 13 is a view of the arrangement shown in Figure 12, after the same has been exposed, developed, fixed and processed to harden the portions which contain the metallic silver; and

Figure 14 is a sectional view of the arrangement shown in Figure 13, wherein the depressions formed by the shrinking and hardening of the gelatine in the areas which contain the metallic silver contains greasy ink, and wherein the water soluble dye or the like seeps through the unhardened surface of the emulsion. Two colors will be printed at one operation and in perfect registry with each other, one from the greasy ink selecting portions of the image and the other from the surfaces thereabout.

Referring first to Figure 1, the backing plate 30 has a coating of a medium 31, for example lacquer, applied to the surface thereof. While this lacquer is still wet, a water soluble salt, or any other material which is soluble in a medium which will not affect the medium 31, for example common salt (NaCl), is sprinkled on the surface. The salt becomes embedded in the lacquer somewhat along the lines as indicated at 31 in Figure 2.

It will be understood that where lacquer is used, the coating must be very thin or it must be allowed to thicken before applying the salt, otherwise the lacquer might completely coat some of the salt and prevent it from being dissolved out.

After the lacquer is dry, the plate 30 may be immersed in water to dissolve the salt, and after the plate is washed and dried, the surface of the lacquer 31 has indentations or depressions 33 which were formed therein by the salt. Of course, Figures 1, 2 and 3 are greatly enlarged sectional views of the plate, and the surface of the lacquer will substantially resemble in its physical appearance a matt or ground glass like surface. It may exhibit a reasonably wide range of toothed or grained surfaces between fine and fairly coarse and still work well in the printing mechanism. The base employed may be flexible, rigid, curved or flat.

After the steps shown in Figures 1, 2 and 3, the emulsion is applied and it forms a film 34 conforming to the toothed or grained surface of the lacquer 31, as shown in Figure 4. When the emulsion is exposed, developed, fixed, and thoroughly washed, it is further processed to convert it into an ink-selecting and printing member; or it may be dried and filed away for future use.

When it is to be used as a printing member, it is treated in a solution including, for example, the following chemicals:

(1)—Copper sulphate, 10% solution, 8 oz.
(2)—Potassium bromide, 10% solution, 8 oz.
(3)—Potassium bi-chromate, 20% solution, 2 oz.
(4)—Sulphuric acid, 10% solution, 20 drops.

(British Journal Photo. Almanac, 1938, pages 236, 237.)

In this bath the metal of the image undergoes a chemical change (during the clearing and fixing process after the emulsion was developed, the unexposed salts of the image were dissolved out by the action of the hypo-thiosulphate in the fixing bath).

In addition to changing the metal of the image, the solution also acts upon the gelatine where it finds the metallic image and produces a substantial tanning and hardening effect on the gelatine. All portions are tanned, hardened, and shrunk in proportion as to the relative content of the metal forming the image, thereby a relief image is formed on the plate. The plate may then be washed, and if it is desired to use it as a printing medium it may be mounted on the printing mechanism ready for the application of a suitable ink repellent (of course, if the plate is not to be used for printing immediately, it may be suitably filed away for future use).

The repellent will be understod to be of a suitable composition having the following characteristics: It will have an absorption affinity with the clear portions of the gelatine in converse relation with the amount of metal which was contained in the original photo image in any given area therein. It will maintain the image approximately indestructible by normal printing uses.

I have used a number of different formulae as repellents, and herein give by way of example, a well-known repellent which will perform the functions set forth above:

	Per cent
Glycerine	10
Water	90

A trace of acetic, phosphoric, or citric acid

After the repellent has remained on the emulsion a sufficient time to render the clear portions repellent to greasy ink, the plate may then be inked and printed from.

It will be understood that this plate operates on normal lithographic principles and a balanced, correctly maintained relationship must exist between the repellent present in and on the gelatine of the image by absorption and adsorption, and the character of the ink employed therewith.

It is my belief, and it has been my experience,

that the above relationships are much less critical in plates made in accordance with my invention than is the case in plates made in accordance with the usual commercial lithographing process, and it would therefore appear that my process and method may be comparable in ease of operation to commercial carbon-copy-on aluminum-plate printing systems so widely in use at the present time.

The toothed, roughened or grained surface to which the emulsion adheres causes a substantially duplicate roughened surface on the emulsion's outer surface, due to the fact that the emulsion, when it is applied to such toothed, roughened or grained surfaces, conforms to the configurations of such surfaces. This is of great importance in my process, as well as in lithographic processes, because it is well known that when fluids are applied to a highly polished smooth surface, they tend to gather in clumps; whereas with a toothed, roughened or grained surface the fluid applied thereto does not tend to pull together or form clumps, but instead spreads out upon such surfaces. This may be easily proven by taking two pieces of glass—one having a ground surface, and the other having a highly polished surface—and dropping a few drops of water on each piece of glass. It will be noted that on the polished glass the water will gather in clumps or pools; but on the ground glass it will spread out into a thin layer.

Likewise, the toothed, roughened or grained surface causes an even adsorption of the repellent to the selective repellent accepting surfaces, as opposed to the surfaces that bear the shrunken, tanned image portions.

The shrunken, tanned portions readily exhibit to the eye a difference in surface texture, as compared with the clearer portions, and this difference is in proportional relationship thereto. The shrunken, tanned portions of the image exhibit a much smoother appearance than the unshrunken portions, and therefore said tanned portions oppose the absorption and adsorption of the repellent and remain in a drier condition so that they readily accept the greasy ink, while the surrounding portions having the repellent both within and upon the body of the freer gelatine, repel the greasy ink with great efficiency. Therefore, plates made according to my process, produce greasy ink copy of a very acceptable order.

I am not limited to the specific kind of emulsion used, and would point out that I have obtained excellent results not only from regular soft gradation emulsions, but also from emulsions of the types used in process work.

The example of forming a toothed, roughened or grained surface described and illustrated in Figures 1 to 4, is above given by way of example as one way of forming such surfaces on a plate or carrier. However, I do not wish to be limited to this exact showing, as the herein described invention will work just as well on any surface which is equivalently roughened. The surface of the plate member or carrier may be ground, it may be formed by dipping, flowing or spraying on a sub-coating adapted to form a roughened surface; it may be etched mechanically or chemically, or the emulsion itself may be sprayed directly on to the carrier in small droplets.

For example, in Figure 6 the carrier **35** may have the lacquer **36** spread thereon in little droplets by holding the spray gun sufficiently far away from the carrier that the spray of lacquer is partially set before it hits the surface of the lacquer or plate, thereby forming little droplets. After the lacquer is dried, the emulsion **37** may be applied thereto, as shown in Figure 7.

After the emulsion is dried, it may be exposed, developed, fixed, washed, and treated in the image tanning solution in the manner previously described in connection with Figure 5, with the result that the effect shown in Figure 8 is obtained wherein the portions **38**, which were exposed and which did contain metallic silver, are shrunken below the normal surface **39** of the unexposed portions.

In Figure 9, the plate or carrier **43** is shown as having its upper surface **44** ground; and in Figure 10 the ground surface **44** is coated with the emulsion **45** which conforms to the ground surface of the plate. The emulsion mentioned may be brom silver gelatine, chloro-brom silver gelatine, or in short any type of photographic emulsion in common use today, providing that it produces a well resolved image of good over-all density and contrast and that it will conform to the toothed, roughened or grained surface of the plate, carrier or backing medium, and will exhibit on its outer surface the same configurations as those on the surface of the plate or carrier to which it is adhered.

When the emulsion coated carrier, shown in Figure 10, is exposed, developed, fixed and subjected to the tanning-shrinking bath, the developed portions **46** are shrunken and hardened, and thereby lie beneath the normal surface level **45**.

In all of these forms, the surfaces are treated with a repellent which is absorbed by the unshrunken and softer surfaces of the emulsion, and when afterwards used as printing plates, repel the greasy ink. However, the greasy ink does adhere to the shrunken and hardened portions which lie below the normal surface level, and when impressed upon the material to be printed on, effects the printing of matter identical with the exposed areas.

In Figures 1 to 11, inclusive, the carrier or plate is shown as a film, a sheet of glass, or other non-magnetic material, or it may be a metallic sheet.

As a further modification of the invention, I contemplate the use of a carrier which is perforate or porous and in carrying out this invention any material of this nature may be used, and by way of example, in Figure 12, the carrier takes the form of a fine screen or mesh **47** to which the emulsion **48** is applied. The surface of the emulsion conforms generally to the configuration of the screen or mesh.

When the emulsion **48** is exposed, developed, fixed, washed and tanned, the exposed portions **49** are shrunken and hardened, and thereby lie beneath the normal surface level **41**, just as was the case in the arrangement shown in Figures 1 to 11 inclusive.

However, since the backing member is perforate and since the unexposed portions of the emulsion are softer and more porous than the hardened portions **49**, I have found that they will absorb and adsorb the repellent even though it has incorporated therein a soluble dye or stain. The repellent containing the dye or stain is left unchanged in its nature as a repellent and acts in the dual capacity as repellent and image-forming stain.

The greasy ink, of course, will adhere only to the shrunken portions **49** of the surface which

portions are non-absorbing and non-adsorbing with respect to the repellent and/or dye, with the result that when the plate is inked and impressed upon the material to receive the record, both the image represented by the portions 49 carrying the greasy ink and the surfaces carrying the repellent and the dye will print at the same moment of contact in their respective colors; thereby I am able to print two colors simultaneously at one operation.

A further modification contemplates the formation of records from photographic images treated for the selective acceptance of greasy ink by using an emulsion receiving member or carrier on which the surface is substantially flat and having an overlay of small holes formed therein in close formation throughout the entire area of said circuits.

After applying a film of photographic emulsion to this type of plate and producing a developed image thereon, the surface of the emulsion will resemble the surface of the plate since there will be shrunken points in the surface of the gelatine corresponding to the size and general shapes of the holes.

After processing the same in the manner hereinbefore described for ink selection, the shrunken portions will be hard and relatively smooth and will therefore not absorb, adsorb or transmit the repellent, and will therefore only accept greasy ink, while the clear portions will transmit the repellent and/or stain.

With this arrangement, I find that it is practical to apply the repellent and/or dye from the back of the emulsion and transmit it through the relative freer liquid transmitting portions of the image in greater or smaller proportions as the photo-image contained more or less metal after development, clearing and fixing.

Obviously, a color may be incorporated in the repellent as outlined above to make it act as a printing medium over any areas not selected by the greasy ink.

It must be understood that any of the above described printing members, regardless of whether they have photographic images thereon or not, may be used in the same manner as aluminum and other types of plates now in wide use on the market.

Plates made according to my process may be used at any time, unexposed or after exposure and processing for printing from the photographic image, when additions may be made by means of a typewriter, greasy ink, or any other suitable means for adding matter to supplement the image thereon, or it may be used as if it were simply a metallic plate or surfaced for greasy ink and ink repellent.

It may be used unexposed, un-fixed, or it may when desired be fixed and hardened before use with non-photographic patterns, for example with carbon typewriter ribbon or hand drawn patterns.

It will be obvious that this process and method contemplates the economical production of full color motion pictures and still full color reproduction for projection by reflected or transmitted light or for normal viewing by any of the above means.

Full color light transmitting images are produced using transparent greasy inks while patterns for viewing in reflected light may use either opaque pigmented inks or transparent greasy colors on opaque supports.

In motion picture black and white and full color reproduction, the above-described method and process possesses novelty and invention in that the record is made by means of an ink printing instantaneously from the surface of one member to the surface of the other without imbibition and the subsequent absorption of the liquid dye or stain in the receiving member as is presently the case.

New and novel surfaces on the printing stock may be used as no gelatine or other liquid absorbing surface is required for the image-receiving member. This allows of much more economical production with less skill, equipment and materials.

In full color reproduction the well known light filters must be used and three color-filtered images made, upon properly surfaced emulsion bearing members, as previously described. These members are processed to render tanned images on the toothed, roughened or grained surfaces and the images are printed over one another in proper registry in transparent greasy ink or opaque greasy ink in conjunction with a repellent used with or without color, as also described in application Serial Number 256,608, filed February 15, 1939, now U. S. Patent Number 2,273,740, dated February 17, 1940.

In color motion picture reproduction, the images are registered from the required number of continuous webs bearing images on the toothed, roughened or grained surfaces of the webs, having been exposed through the proper filters and processed for selectively accepting the severally colored inks.

These images are then printed over one another in proper registry and printed according to normal lithographic practice upon a single web which is used for projection viewing.

It is obvious that in all cases, where desirable, a half tone screen may be used in taking or making the exposure, as now used in other printing processes.

It is a further object of this invention to afford a means of printing in greasy ink, by developing emulsion surfaces properly produced from the toothed surface of the emulsion bearing base, motion picture and sound track recorded photographically by well known methods presently used.

In my method, the tooth or grain does not interfere with resolution as I have produced images of sound tracks at about 900 lines per inch.

While the invention has been described in several preferred forms, I am not limited to the precise procedure or chemical combinations given by way of example, as various modifications may be made without departing from the scope of the invention defined in the appended claims.

What is claimed is:

1. The herein described method of producing a plate for ink and dye printing, which includes the step of providing a carrier with a toothed or grained surface, the further step of applying a thin film of photo-sensitive silver emulsion to said surface, whereby the outer surface of this emulsion substantially conforms to the tooth or grain on said carrier, the step of producing an image on said plate by exposure to light, the steps of developing, fixing, and washing said plate, and the step of subjecting said developed and fixed plate to the action of a tanning solution for hardening the developed image and making it receptive to greasy ink, the unexposed portions of the plate being adapted to receive and be uniformly wet by aqueous repellents.

2. The herein described method of producing a plate for ink and/or dye printing which includes, the step of forming a toothed or grained layer firmly adherent upon the surface of a carrier, the outer surface of said layer being capable of dispersing water or aqueous solutions, the further step of applying a thin film of photo-sensitive silver emulsion to outer surface of said layer, the outer surface of said film, due to its thinness, conforming to the tooth or grain on said carrier, and also being adapted to disperse water and aqueous solutions, the step of exposing said plate, the steps of developing, fixing, and washing said plate, and the step of subjecting said developed, fixed, and washed plate to a tanning solution for rendering the developed image sensitive to greasy ink.

3. In a printing device, in combination, a backing sheet carrying a toothed surface adapted to rapidly disperse water and aqueous solutions and a thin, exposed, developed, fixed, tanned and washed film of silver halide emulsion on said surface, the outer surface of said film being selectively toothed in substantially inverse proportion to the strength of the reduced silver image therein, whereby the unexposed portions retain the properties of rapidly absorbing and adsorbing water and aqueous solutions and the exposed portions being selectively receptive to greasy ink.

4. A method of producing a printing plate which includes the steps of providing a carrier having a toothed or grained surface and bearing a thin film of photo-sensitive silver emulsion the outer surface of which conforms to the configurations of said first surface, photographically impressing a latent image in said surface, reversing said image by known means and fixing and washing the same, and the step of tanning and washing the film, whereby the latter may selectively retain its toothed or grained surface in substantially inverse proportion to the density of said image.

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