Dec. 10, 1935. E. S. BALLARD 2,024,086

PROCESS FOR PRODUCING A PRINTING PLATE

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Fig. 1.

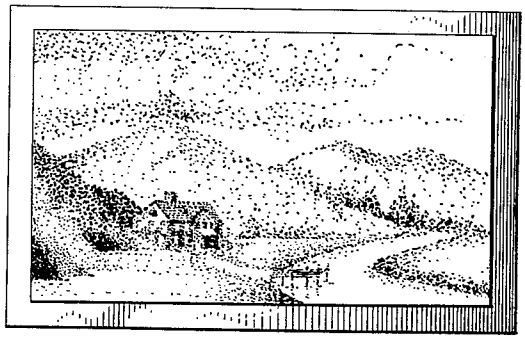


Fig. 3.

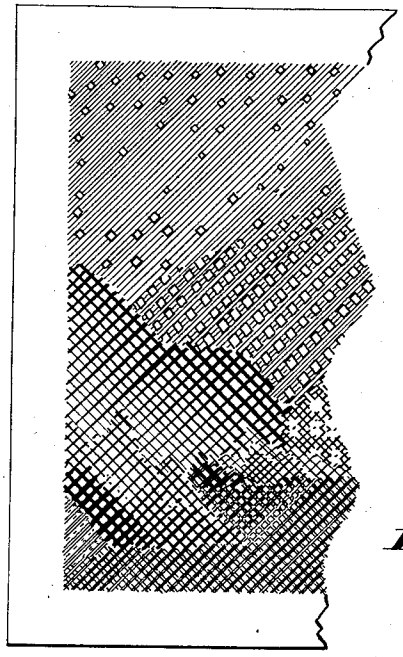


Fig. 2.

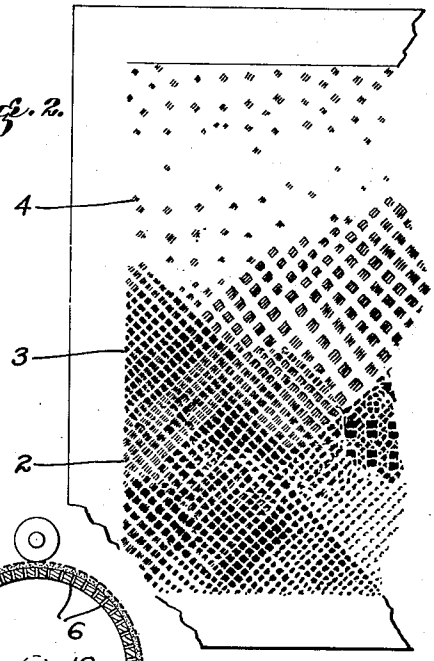


Fig. 5.

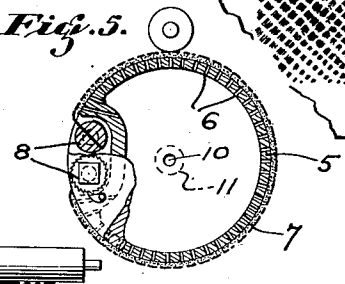
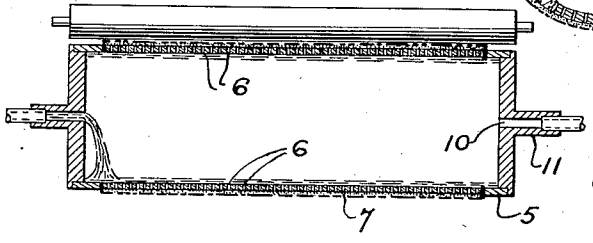


Fig. 4.



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PROCESS FOR PRODUCING A PRINTING PLATE

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4 Claims. (Cl. 41—25)

Typographic and pictorial printing processes as now operated have one common characteristic in that the ink is applied to the printing form from without, either by means of distributing rollers passing over the printing forms or by revolving in contact with the printing cylinder. Or the printing cylinder, as in the case of intaglio machines, may revolve in a trough of ink, the surplus ink being removed from the cylinder by a flexible steel scraper known as a "doctor blade."

Application of the ink by exterior means involves difficulties and complications, as well as waste of material and labor. Where a "doctor blade" is employed, the constant friction against the cylinder frequently damages the printing surface.

This wearing of the printing surface is especially objectionable where large jobs are under way. The worn printing surface has to be replaced in the middle of the job, and there is no certainty that it will conform exactly to the initial surface.

The object of my invention is to overcome all these troubles by bringing the ink from behind the plate, and directly through it, using minute ducts or holes in the plate to allow a percolating effect to occur. These extremely small ducts are graduated in size, where pictures are to be printed, and by virtue of these varied sizes produce shadows, half-tones and high lights in the printing process. Thus these ducts take the place of the printing dot in half-tone printing, and in a similar way perform the office of the cells of varying depth as found in photogravure printing. However, the graduated tone effect depends not only upon the actual size of the dot, but in the difference in the rate of ink flow as affected by the frictional area of the sides of the dot.

Plates of this type can be produced with precision and ease by my method, which is partly photographic and partly photo-mechanical.

In the accompanying drawing.

Fig. 1 shows a view of a portion of a plate, illustrating how the dots may be arranged therein to produce the desired lights and shades.

Fig. 2 shows a magnified view of a portion of a screen positive used in the production of the plate.

Fig. 3 shows a similar view of a portion of a screen negative employed in the method.

Fig. 4 shows a longitudinal sectional view through a cylinder over which is arranged a printing plate embodying my invention.

Fig. 5 is a transverse sectional view through the parts appearing in Fig. 4.

Having selected a photograph, I place this on the copy board of a copying camera, and by means of the usual photographic operations produce a negative thereof, either on paper or on glass. Thus I obtain a photograph in negative form, the high lights of the original being represented by dark areas, the middle tones by less pronounced shades, and the shadows by white areas. It is from this negative that I carry out the next operation, which will give a screen positive in which the high lights will be represented by small opaque dots, the middle tones by larger dots, and the shadows by very large opaque dots, which, however, do not overlap or touch in any part.

This screen positive, in which the dots are approximately diamond-shaped, appears as shown in Fig. 2. Referring to the diagram, dot **2** represents a large shadow dot, formed by the light action from the white areas of the negative, and progressively, proceeding toward the right, may be seen the middle tone dots **3**, and high light dots **4**, the latter merely points, as compared with the shadow dot **2**.

This screen positive is produced as follows:

The negative copy of the original is placed before a camera in which a half-tone screen has been established at a suitable distance in front of a sensitive photographic plate. In the lens chamber reserved for stops as employed in the half-tone process I place a diamond-shaped stop with the sides parallel to the lines of the half-tone screen. With this stop in place, and by altering the distance of the screen from the sensitive plate, I readily determine a screen distance that, upon making the exposure, gives a dot formation corresponding precisely to the tone gradations of the original copy. That is to say, small dots will appear as high-light dots, larger dots representative of the middle tones, and very large dots representative of the shadows. Further, if the exposure has been timed correctly, these large shadow dots will not be joined or connected in any part, but will be more or less diamond-shaped, and with parallel sides.

Study of the shadow areas of Fig. 2 will show that I have produced a grid of transparent area, isolating the large dots, and that proceeding toward the middle tones this grid becomes wider between dots, and the dots smaller. In the extreme high lights the grid has become very heavy and the lines correspondingly wide, with the intervening dots relatively small.

As a further provision for the control of tone gradation, I am able by screen adjustment, and in development of the sensitive plate, to make the

large dots very opaque, while rendering the small high light dots more or less translucent, or, in the highest lights, absent entirely. This procedure, as will be explained later, is most important in making my process highly flexible and useful for the purposes set forth.

Having produced my screen positive, as illustrated by Fig. 2, I now proceed along one of two courses, according to the effect that I desire to secure. If I am seeking a precise and exact reproduction of the photographic copy, and do not intend to alter largely the tone values thereof, I proceed as follows:

I place the screen positive, shown in Fig. 2, in a photographic printing frame, or in the so-called "step and repeat" machine, and print it down photographically on a sensitive plate, thereby transforming it into a negative. In this negative the diamond-shaped dots will appear as transparent areas and the surrounding grid as an opaque network. This formation is shown in Fig. 3.

I now proceed to sensitize a smooth metal plate, with a light sensitive solution, of which bichromated glue, as commonly used in photo-engraving, is an excellent example. However, there are numerous compounds of the kind, that can be used with equal success. Upon this sensitized plate I impose my screen negative, as indicated in Fig. 3, and submit the whole to the action of light. After a suitable exposure the sensitized plate is developed in water. If bichromated glue has been used, the glue that has not been acted upon by the light will wash away, leaving a dot formation corresponding to the transparent dot areas of the negative.

The plate is then heated until the glue dots are "burned in" or carbonized, rendering them similar to the enamel dots of a half-tone plate that has been prepared for etching, but with one important exception. Whereas, in the true half-tone formation, the shadows will consist of large areas produced by overlapping dots, giving so-called "solids", in my plate the shadow dots will be found isolated by narrow lines of exposed metal, forming a distinct grid or mesh effect. The plate thus produced I style a "master plate". From it, as will be explained, I can produce an infinite number of printing plates of exactly the same size and printing value.

It will be appreciated that I have created a screen effect similar to that seen in screen intaglio, but with tone values determined largely by the size of the dot between the walls of the screen, rather than by the depth of the cell itself. The advantage of this formation will be pointed out hereinafter.

Referring again to the master plate, I proceed as follows:

The plate is rubbed over with a compound that will prevent adherence of any metal that may be deposited thereon. Wax may be used for this purpose, although there are various methods for accomplishing this purpose. Having so prepared the plate, I insert it in an electroplating bath, suitably prepared for the metal that is to be deposited, and proceed to form a relatively thin coating of metal over the master plate. No metal will form over the enamel dots, which are non-conducting, but it will form rapidly over those parts corresponding to the grid of varying width of line.

When a deposit of the required thickness is formed I remove the master plate from the bath and strip away the deposited plate. The latter will be found to be a perfect representation of my photographic negative as disclosed by Fig. 3. The dots will be holes or ducts through the plate, and corresponding to the transparent dots of the negative.

The master plate may be returned immediately to the plating bath and another plate prepared for stripping away. This operation may be continued indefinitely, making as many duplicated plates as required.

The stripped plate is now ready for printing. It is placed around a hollow metal cylinder **5**, the surface of which is perforated by many small holes **6**, which are covered in turn by a porous blanket **7** of suitable material. It is over this blanket that the printing plate is secured, encircling the cylinder and closely fastened thereto by suitable gripping and locking devices **8**.

Ink is introduced into the hollow cylinder. It quickly percolates through the porous blanket, and reaches the inner surface of the printing plate, filling the minute ducts. As the cylinder is set revolving, with paper passing between it and an impression roller, capillary attraction draws the ink through the ducts, and results in printing upon the paper. However, it may be desirable to exercise control over the rate of ink flow with relation to press speed and impression pressure. This I may accomplish by making the ink-containing cylinder air-tight, and by connecting it with an air pump **9** by means of a passage **10** through the axle **11** of the cylinder. I can thus control the pressure of the air inside of the cylinder, either introducing air to raise the pressure above that of the atmosphere, or actually reducing it in order to create a partial vacuum. It will be readily apparent that by this means I have very complete and delicate control over the ink flow.

Having described my method of producing a printing plate where a precise duplication of the original is required, I shall now describe an alternative method followed where a change in tone value or contrast is demanded.

Returning to my screen positive as shown in Fig. 2, instead of transforming this into a negative, I proceed as follows. A piece of carbon tissue as commonly employed in the photogravure process is sensitized with potassium bichromate and dried in the usual manner. It is then placed in a printing frame beneath the screen positive, and a print of the latter made upon the tissue. This action of the light is continued until the gelatine has been rendered insoluble for a considerable depth around the large shadow dots, but without actually penetrating these dots, or creeping to any appreciable extent beneath them. At the same time, incursion of light will occur around the much smaller high light dots, and the gelatine beneath these dots will be rendered more or less insoluble.

I now transfer my carbon tissue in the usual manner to a metal plate, develop in warm water, and dry. Inspection will show the areas corresponding to the large shadow dots almost, if not entirely, devoid of gelatine covering, while in the high light areas considerable gelatine will be found at the bottom of the dots.

I now proceed to etch with a heavy solution of perchloride or iron, of 41 or 49 Baumé. This solution will readily penetrate the shadow dot areas, and etch corresponding depressions in the metal, but as the high light dots are approached the etching will cease, for the heavy perchloride will not penetrate the gelatine skin at the bottom

of the high light depressions. Consequently, by resorting to a perchloride of slightly less density, say 36 Baumé, I may etch the high light areas as I see fit, stopping the action when I consider the area and depth of the dots sufficient. Thus I may control the relative contrast of my picture, regardless of the original.

With this etching completed, I wash away the gelatine, and dry what is now a master plate, save for one remaining operation. This consists in filling in the etched depressions or cells of varying area with a non-conducting and acid resisting compound, of which many combinations are possible. Wax works very well, and if rubbed over the plate soon fills the depressions. The surplus may be readily polished from the surrounding surfaces. I now proceed as in the first operation, treating the plate in order that a deposited metal may not adhere thereto, and plating thereon and stripping away the relatively thin coatings as heretofore described.

Type matter in my new process is handled with the utmost ease, and in practically the same manner as pictures, although even more easily. A negative of the type matter is made, and between it and the sensitized metal plate a transparent medium carrying a screen of narrow opaque lines is interposed. This gives a grid effect throughout the type matter, as printed down upon the master plate, and the result is identical with the pictorial process save that all ducts for the type matter are of the same size, thus giving a uniform printing throughout.

With my method of supplying ink to the printing surface by small holes or ducts, graded as to size and arrangement to print the desired impression, and controlling the supply of ink through the openings by air pressure or the like, any desired amount of ink may be supplied to the printing surface, whereby to give either a thin or a heavy coat to the printed matter. With other methods of printing, the amount of ink which the printing surface will take is restricted, and only one shade of printing can be produced with a given plate, except that the printed matter be run through the press a second or third time.

Various changes in the construction and arrangement and details of the method herein disclosed may be employed without departing from the spirit of my invention, as expressed in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A method of preparing a printing plate consisting in making a screen positive in which tones and shadows are represented by distinct dots in photographic gradation, producing a negative of the screen positive on a sensitive plate, sensitizing a smooth metal plate superposing said negative on said sensitized plate and subjecting said plate to light transmitted through said dot formation on said sensitized plate, developing said plate and fixing its coating so that it becomes non-conducting, and then electroplating on said fixed coating to produce a printing plate having distinct openings of graduated sizes and stripping the plate from said coating.

2. A method of preparing a stencil plate including making a screen positive in which tones and shadows are represented by distinct and separate dots in photographic gradation by photographing a negative of the original through a half-tone screen and a stop disposed with the sides of its opening parallel to the lines of the half tone screen and adjusted to produce a dot formation in which every dot is fully separated from adjacent dots and surrounded by areas interpretive of tone value, transforming said screen positive photographically into a screen negative, reproducing said dot formation on a sensitized metal plate, and forming a stencil plate having openings corresponding to said dot formation from said sensitized metal plate.

3. A method of preparing a printing plate including the steps of making a screen-positive in which tones and shadows are represented by distinct and separate dots in photographic gradation by placing a negative of the original in a camera having a half-tone screen and a stop disposed with the sides of its opening parallel to the lines of the half-tone screen, adjusting the half-tone screen to produce a dot formation on the sensitive plate corresponding substantially to the tone gradation of said original, and consisting of a dot formation in which every dot is fully separated from adjacent dots and surrounded by areas interpretive of tone value, making the exposure to produce said screen positive, forming a screen negative from the screen positive, coating a plate with a known light sensitive substance, passing light through said screen negative to reproduce the separated dot formation in said substance, and forming the printing plate from said coated plate.

4. A method of preparing a printing or stencil plate which includes the steps of producing a film by photographing a negative of the picture or the like that is to be reproduced by said plate through a half-tone screen and a stop adjusted so as to produce on the sensitive plate of the camera a dot formation corresponding substantially to the tone gradation of said picture or the like in which every dot is fully separated from adjacent dots and surrounded by areas interpretive of tone value, coating a plate with a known light-sensitive substance, reproducing said dot formation on said substance, and forming from said coated plate a printing or stencil plate having openings corresponding to said dot formation.

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