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METHOD OF MAKING HALF TONES

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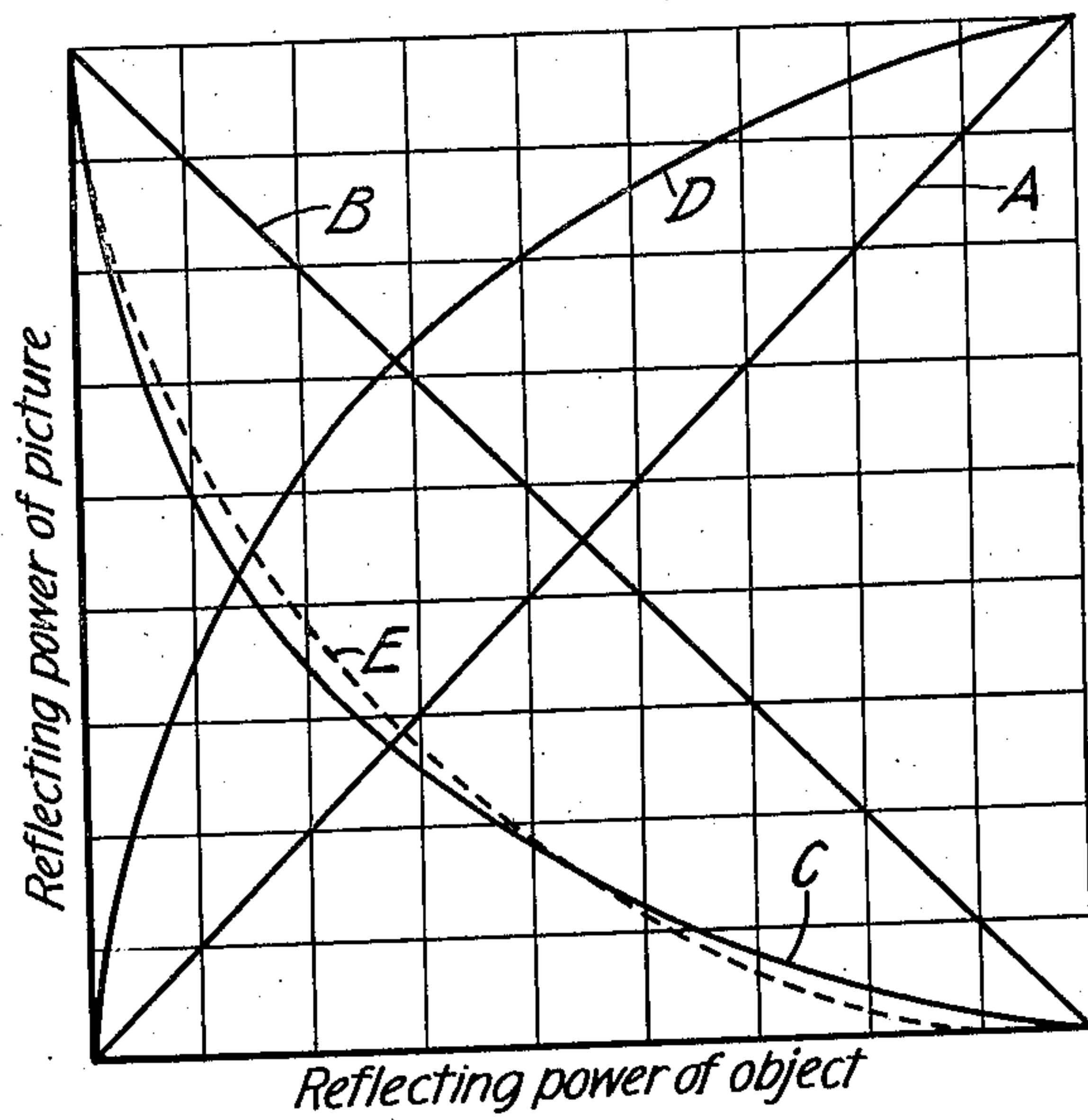


Fig. 1

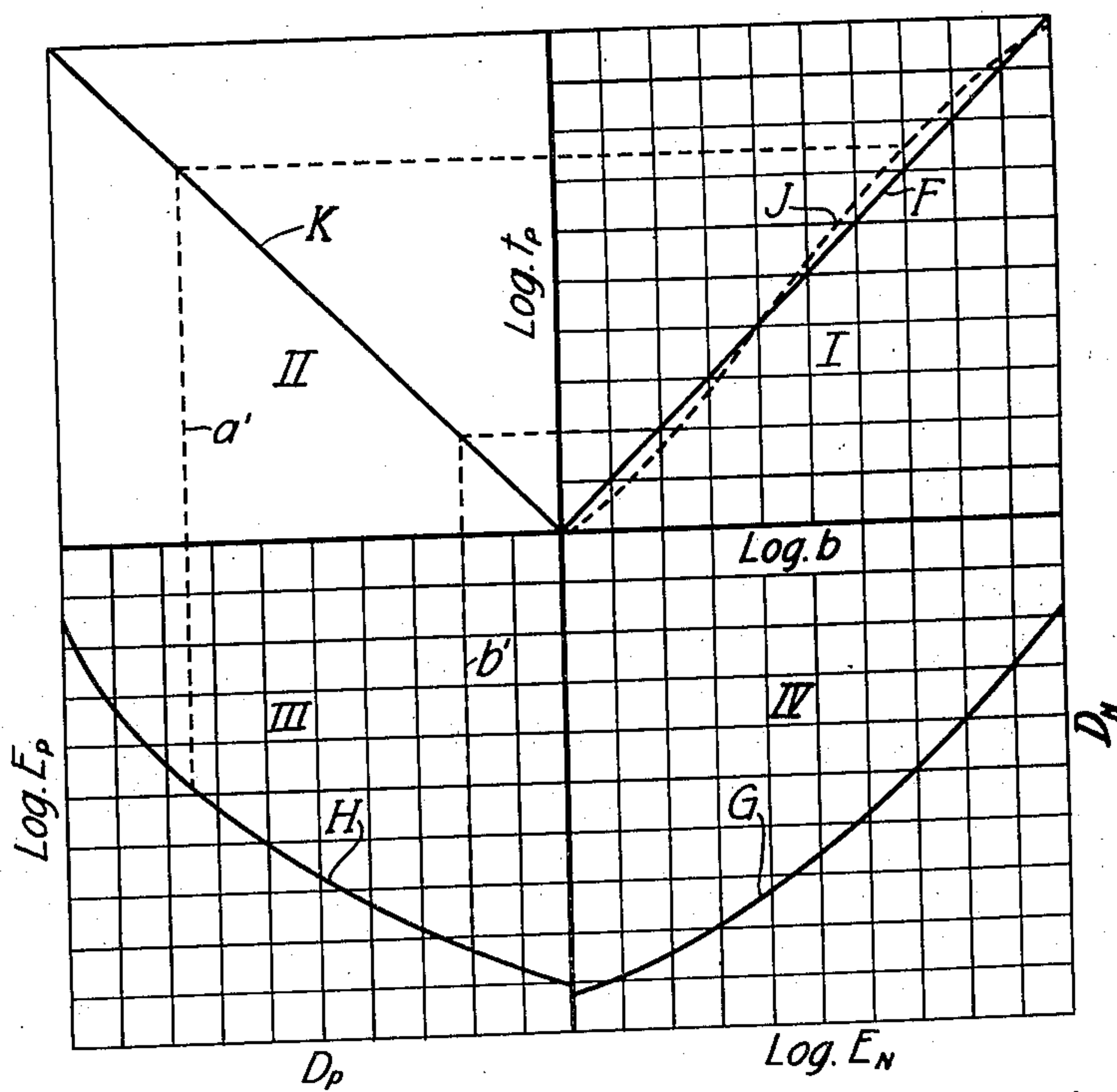


Fig. 2

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METHOD OF MAKING HALF TONES.

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This invention relates to half-tone photo-engraving and has for an object the production of accurate tone rendition in half-tone engraving processes by a simple and straightforward photographic procedure.

In the attainment of this object the preferred procedure to be followed consists in first making an ordinary variable density negative of the object to be reproduced, making from this negative through a line or cross-line screen a structured positive, and making a structured negative by contact printing or other process which gives a complementary image. This structured negative may then be used for printing on metal to make a half-tone printing plate.

The two figures of the drawing are diagrams illustrative of the improved results obtained by this invention.

In the half-tone photo-engraving process the various values of light and shade are reproduced by a structure e. g., lines or dots of varying size. This structure, when produced by appropriate printing and etching operations on a metal plate, is used in a typographic printing press. The printing ink adheres to the raised portions of the plate until this is pressed upon the paper, when it is transferred, giving the characteristic half-tone picture of black lines or dots on a white background.

The negative to be used for printing the typographic printing plate must be exactly complementary to the final picture desired, that is, the black spaces in the final picture must be clear in the negative and the white spaces of the final picture opaque portions in the negative. If the various reflecting powers of the original object are represented as the abscissæ of a rectangular coordinate diagram and the reflecting powers of the final picture by the ordinates, the relationship for correct tone rendering is a straight line as represented by the diagonal line A in Figure 1. Because of the complementary character of the negative above discussed, the characteristic of the structured negative should be exactly complementary to the line A, that is, it should be a straight line B.

The present invention is based on experiments by the inventor from which it was discovered that half-tone negatives, as made by the ordinary procedure of exposing the plate

or film to light from the object through a cross-line screen separated by a small distance from the sensitive surface, do not possess the characteristics given by the line B, but possess a strongly curved characteristic of the general shape shown in curve C, Fig. 1, where the ordinates now represent transmitting power of the negative. Since the print obtained on the metal, and consequently the final picture, is exactly complementary to this, the final characteristic for the half-tone process as carried out in a straightforward manner is that shown in curve D of Fig. 1.

The fact that a simple exposure through a half-tone screen produces a final half-tone reproduction of incorrect tone values has long been recognized and has led to the use of empirical correction processes, such as multiple exposure through several different diaphragms, and also to processes of local retching and other treatment. These processes are necessarily only approximate, depending upon the skill of individual operators and are time-consuming. In certain applications of the half-tone process where accurate tone rendering is essential, for instance, in three-color half-tone reproduction, these empirical correction processes can never hope to be entirely satisfactory and the inherent imperfection of tone rendering in the half-tone process as above illustrated is a cause of great additional labor and expense in producing satisfactory results.

The procedure which is herein proposed to replace the present inexact methods, is further based upon the observation that the characteristic of an ordinary variable density negative as made in an ordinary camera without the interposition of a cross-line screen, is represented in the coordinates used in Fig. 1 by a pronounced curve, rather similar in shape to curve C which has been represented in Fig. 1 by the dashed curve E. The proposed procedure is then similar to that used in ordinary photography, in which it is always necessary, because of the curved characteristics of a single photographic operation, to make two operations, namely, negative and positive. By virtue of these two operations the curved characteristic illustrated in Fig. 1, curve E, is compensated for by the matching of the positive and negative characteristics, giving a resultant straight line characteristic of the kind desired.

The procedure for attaining correct tone rendering in half-tone reproduction according to the present invention consists in first making an ordinary variable density negative of the object to be reproduced; then making from this a structured positive by the ordinary procedure used in half-tone negative making, that is, making the positive through a line or cross-line screen, separated from the sensitive plate by a small distance and depending upon the penumbra effect, due to the finite size of the perforations in the screen, to produce lines or dots of varying size on the sensitive plate. It will be apparent from a consideration of the several curves of Fig. 1 that by this procedure there is produced a positive structured image in which, if the opposition of the curvatures of the ordinary negative characteristic and the half-tone screen process characteristic have been exact, the reproduction of tone values is correct. The next step then consists in making by contact printing, or its equivalent, a structured negative which is exactly complementary to the positive which has just been produced. This negative then has the characteristic shown in curve B of Fig. 1 and is suitable for printing upon metal to make a half-tone printing plate of correct tone rendering characteristics.

In practice the present inventor has found that the exact opposition of the ordinary variable density negative characteristic and the half-tone photographic procedure negative calls for the kind of variable density negative characteristic which is found in the relatively underexposed regions and particularly if certain developers are used. A desirable developer which may be used for this purpose is known as "metol" and is a commercial product comprising a composition of mono-methyl-paramino-phenol sulphate. When the entire process is carried out in this way, very accurate tone reproduction is attained in the final structural negative. The degree of accuracy obtained is illustrated by the diagrams of Fig. 2. In this diagram, in which, according to common practice in photographic sensitometry, the coordinates are the logarithms of exposure, and density, the several steps are represented in the first, fourth and third quadrants. In quadrant I is shown the original object characteristic F, being a diagonal straight line at 45° . In quadrant IV is shown the characteristic G of a variable density negative made in accordance with the above description. It is shown as a line of slight curvature, which is the characteristic of a somewhat underexposed negative developed in "metol". A fully exposed negative would be represented by a straight line on this type of chart. In quadrant III is shown the characteristic H of a structured negative, now a positive, as made through a cross-line screen. It is also a line of slight

curvature on this kind of chart. In quadrant I is shown in dotted line the characteristic J, obtained by matching these two photographic operations together. This dotted line is obtained by projecting the curve H by the lines α' and b' from quadrant III to quadrant I by means of the guide line K in quadrant II. The characteristic curve J is a straight line at 45° and simulates the full line characteristic F which represents ideal tone rendering. For details of this method of representing photographic characteristics due to several successive processes, reference may be made to a paper by L. A. Jones, Journal of the Optical Society of America, May 1921, page 232.

What is claimed is:

1. The method of producing a halftone negative, suitable for printing upon metal to produce a typographic printing plate possessing correct tone rendering characteristics, which consists in first making a variable density photographic negative from the object, then making a structured positive from this by exposure through a screen, and finally producing a negative from this positive by reproducing its structure complementary to the object characteristic.
2. A method of producing halftone pictures, having true tone values, which comprises producing a variable density negative directly from the object, making a structured positive transparency through a screen from said negative, making a structured negative from said positive, and printing a positive having a characteristic simulating the object characteristic.
3. A method of producing halftone pictures having true tone values, which comprises producing a variable density negative from the object having a slightly curved characteristic on a diagram having logarithmic coordinates, making a structured positive transparency therefrom, and making from the positive a structured negative for printing upon metal to produce a typographic printing plate.
4. A method of reproducing correct tone values in a halftone process, which comprises making from the original image a structureless negative having throughout the range of exposure and transmission density a slightly curved characteristic on a diagram having logarithmic coordinates, making therefrom through a screen a structured positive transparency, and producing therefrom a structured negative having a characteristic complementary to the object characteristic for printing upon metal.
5. The method of producing a halftone negative, suitable for printing upon metal to produce a typographic printing plate possessing correct tone rendering characteristics, which consists in first making a variable density photographic negative from the object, then making a structured positive from

this by exposure through a screen standing at a small distance from the sensitive plate in the manner customary in ordinary halftone negative making, and finally producing
5 by contact printing, a negative from this positive reproducing its structure complementary to the object characteristic.

6. A method of producing correct tone values in a halftone process, which comprises
10 making an under-exposed structureless negative directly from the object, developing said negative in a developing medium which produces a slightly curved characteristic on a diagram having logarithmic coordinates,
15 producing a structured positive from said developed negative by copying through a structured screen, and finally producing a

negative from said positive reproducing its structure complementary to the object characteristic. 20

7. A method of producing correct tone values in a halftone process, which comprises making an under-exposed structureless negative directly from the object, developing said negative in a "metol" solution, producing a
25 structured positive from said developed negative by copying through a structured screen, and finally producing a negative from said structured positive reproducing its structure complementary to the object characteristic. 30

In witness, I hereunto subscribe my name this 18th day of October, A. D., 1926.

HERBERT E. IVES.