June 10, 1952 C. F. CARLSON 2,599,542

ELECTROPHOTOGRAPHIC PLATE

Filed March 23, 1948

Fig. 1

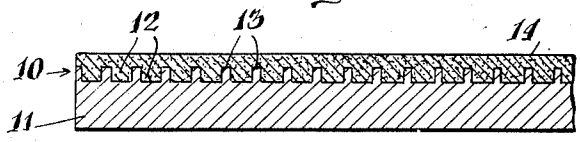


Fig. 2

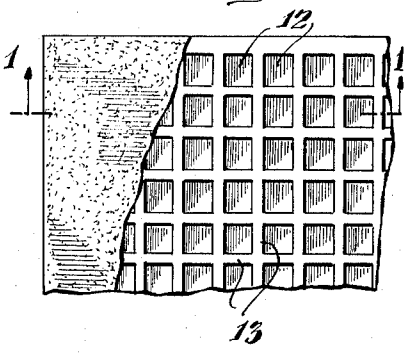


Fig. 3

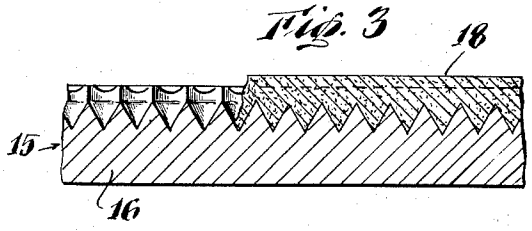


Fig. 4

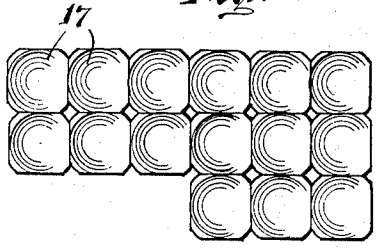


Fig. 5

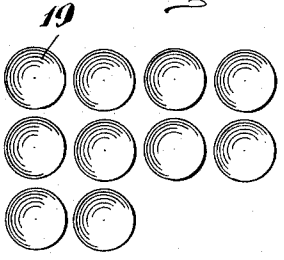


Fig. 8

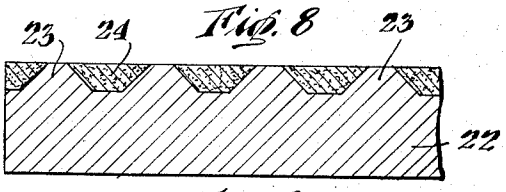


Fig. 6

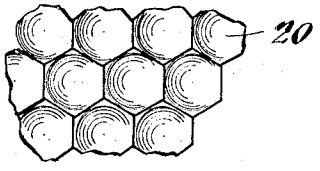


Fig. 9

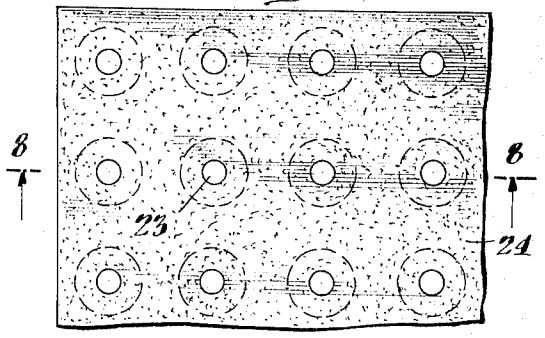
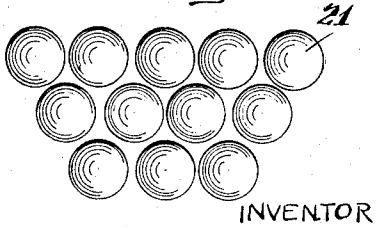


Fig. 7



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ELECTROPHOTOGRAPHIC PLATE

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Application March 23, 1948, Serial No. 16,545

5 Claims. (Cl. 95—1.9)

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This application relates to electrophotography and particularly to electrophotographic plates.

An object of the invention is to improve electrophotographic plates.

Another object is to improve the rendering of electrophotographic images particularly copies of continuous tone originals and electrophotographs made by photographic exposure of three dimensional subject matter.

A further object is to provide for the direct production of half-tones, electrophotographic prints, printing plates, masters and electrophotographic copies of various kinds.

Other objects of the invention will be apparent from the following description and accompanying drawings taken in connection with the appended claims.

The invention accordingly consists in the features of construction, combination of elements, and arrangement of parts as will be exemplified in the structures to be hereinafter described and the scope of the application of which will be indicated in the following claims.

In the accompanying drawings in which are shown by way of illustration several possible embodiments of my invention:

Figure 1 is a cross section of an electrophotographic plate embodying features of the present invention;

Figure 2 is a fragmentary face view of the electrophotographic plate of Figure 1 with a portion of the coating removed to expose the metal backing plate;

Figure 3 is a cross section of a modified electrophotographic plate;

Figure 4 is a fragmentary face view of the backing plate used in preparing the electrophotographic plate of Figure 3;

Figures 5, 6 and 7 are fragmentary face views of modified backing plates;

Figure 8 is a cross section taken on the line 8—8 of Figure 9; and

Figure 9 is a face view of a further modified electrophotographic plate.

The present invention contemplates an electrophotographic plate comprising a conductive backing plate having a pattern of projections and recesses or hills and valleys thereon, and photoconductive insulating material filling the recesses and in some cases also covering the projections. It is preferred that the projections or recesses be spaced in either a regular or a random manner with a spacing similar to that commonly used in half-tone work such as between 40 and 400 to the linear inch, which is equal to

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between 1,600 and 160,000 to the square inch. The surface may resemble a waffle-grid, or may be regularly pitted with tapered depressions or a random distribution of closely-spaced pits, or of projections rising above a relatively smooth surface.

The plates described herein are intended primarily for use in the process of electrophotography such as that described in Carlson Patent 2,297,691 issued October 6, 1942.

By using the plates of the present invention in the process described in the Carlson patent an electrophotographic image may be produced having the characteristics of a half-tone without the necessity of using a half-tone screen such as is normally used in producing half-tone photographs. Such half-tone images may be fixed on paper or other surfaces to provide a finished print or they may be used in the preparation of printing plates, photo-engravings, photo-offset plates, masters for spirit or gelatin duplicators and for other purposes.

The use of a backing plate having alternate small hills and valleys also improves the mechanical properties of the plate such as the adherence of the photoconductive coating and the resistance to chipping or cracking of brittle photoconductive coatings as a result of abrasion or bending.

While a preferred embodiment of the invention is described herein, it is contemplated that considerable variation may be made in the method or procedure and the construction of parts without departing from the spirit of the invention. In the following description and in the claims, parts will be identified by specific names for convenience, but they are intended to be as generic in their application to similar parts as the art will permit.

Referring to the drawings, Figures 1 and 2 illustrate an electrophotographic plate 10 comprising a metal backing plate 11 having a regular pattern of substantially rectangular depressions 12 therein surrounded by raised ridges 13, the top surface of the ridges all lying in a plane so as to present a substantially plane or smooth upper surface to the backing plate 11, except for the recesses or depressions 12. A layer 14 of photoconductive insulating material overlies and is bonded to plate 11, the layer 14 filling recesses 12 and covering ridges 13. The layer 14 has a smooth upper surface. The thickness of layer 14 above ridges 13 may be varied but in most cases will not exceed a few hundredths of an inch. The preferred thickness is in the order

of 1 to 5 mils. The spacing of recesses 12 correspond to the spacing desired in the half-tone dots to be produced. Thus if a copy is desired comparable to newspaper work, there will be generally between 60 and 100 depressions per linear inch (3,600 to 10,000 per square inch) spaced by ridges 13 which are, generally, considerably narrower than the depressions.

Depressions 12 may be formed in the plate during casting as by die casting, or they may be formed mechanically by pressure against a suitable die or use of a suitable toothed instrument.

Almost any conductive material of suitable mechanical properties can be used for plate 11, metal being preferred because of its strength and convenience of manufacture. Thus, the backing may be formed of zinc, aluminum, cadmium, various die casting alloys, copper, lead, steel or other metals.

Coating 14 is formed of a photoconductive insulating material such as anthracene, sulphur and other photoconductive insulating materials and mixtures. It may be applied to backing 11 by any one of several methods. One method comprises evaporating the material on to the plate. Another method comprises ball milling together a suspension of the photoconductive material and 5% to 20% of a binder such as ethyl cellulose in a volatile solvent such as ethyl acetate to form a thick creamy suspension which may be then applied to the surface of the plate as a coating and allowed to dry. Another method comprises filling the recesses only with such a suspension or filling them with the pure powdered material and consolidating the layer under pressure after which a further layer overlying the ridges is applied by evaporating the same material or a photoconductive insulating material of different properties or composition. The surface of layer 14 may be polished smooth.

Figures 3 and 4 illustrate a modified electrophotographic plate 15 having a metal backing 16 provided with a series of overlapping conical depressions 17 which are coated with a photoconductive insulating layer 18.

Figures 5, 6 and 7 show other patterns in which the conical depressions may be arranged. Thus, depressions 19 in Figure 5 are spaced apart sufficiently to avoid overlapping. Depressions 20 in Figure 6 are overlapped and adjacent rows of depressions are off-set so as to provide a three-way intersection between depressions. In Figure 7 the depressions are not overlapped but adjacent rows are off-set to permit a maximum number of depressions to be spaced in a given area.

The electrophotographic plate shown in Figures 8 and 9 comprises a backing plate 22 having a series of truncated conical projections or pyramids 23 on its upper surface, the space surrounding the projections being filled with a photoconductive insulating coating 24, the upper surface of coating 24 and the flattened tops of projections 23 all lying in a single plane so as to provide small spaced bare areas of the metal as seen most clearly in Figure 9.

It is also contemplated that projections 23 may assume other shapes and forms and may, in fact, be extended into ridges, in which case the completed plate will be similar to the plate shown in Figures 1 and 2 in the limiting case where layer 14 does not extend above the top edge of ridges 13.

A backing plate can also be made by applying a fine mesh wire screen over a backing plate, as by soldering or use of an organic adhesive, the spaces provided by the reticulated network of the screen being filled with photo-conductive insulating material. The top surface of the screen may be covered with the material or may lie in the same plane as the surface of the photoconductive material.

The electrophotographic plates of the present invention may be used in the process of electrophotography described and claimed in the aforementioned Carlson patent to produce copies in which the powder image is or resembles a half-tone.

It is, of course, contemplated that variations can be made in the carrying out of the processes as by varying the method of charging and of applying the powder or other finely-divided material as well as in the method of handling the powder image after it has been obtained.

In performing the elecctrophotographic process, with most methods of development of the electrostatic image, the developing material, such as powder, tends to deposit most heavily along the edges of the charged areas. It is sometimes said that potential gradients are developed, rather than absolute potentials. With line copy, such as drawings, typewriting and the like, this property of the process is an advantage in producing intense development of narrow lines with good definition. However, with continuous-tone images where various shades of gray are present and large uniform dark areas must be developed, it has been difficult to obtain as dense a deposit of developer in the centers of the large dark areas as at the edges. The present invention overcomes this problem by breaking up the image into tiny areas having steep potential gradients and hence the overall result is an average appearance more directly proportional to the average densities in the various areas of the original.

The powder image obtained with the plates of the present invention will vary in detailed structure depending upon the pattern of the depressions and projections provided on the backing plate but in overall appearance they all resemble half-tones in nature.

The powder images may be affixed to paper or other surfaces to provide photographic copies or they may be transferred to metal surfaces to which they are subsequently fused for use in preparing photo-engravings, photo-offset plates and the like, as described in the aforementioned Carlson patent. If the powder is of a composition containing a dye of a high color value the image may be transferred and fixed on a master sheet or a gelatin base for use in producing copies by spirit or hectographic duplication.

Other variations and applications will readily occur to those skilled in the art.

While the present invention, as to its objects and advantages, has been described herein as carried out in specific embodiments thereof, it is not desired to be limited thereby but it is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. An electrophotographic plate comprising a conductive backing plate having a surface characterized by a pattern of alternate projections and depressions, said surface having between 1,600 and 160,000 depressions to the square inch, and a coating of photoconductive insulating material filling said depressions and having a smooth outer face at a height not exceeding 5 mils above said projections.

2. An electrophotographic plate as claimed in claim 1, in which said outer face of said photoconductive insulating material is at a height between 1 and 5 mils above said projections.

3. An electrophotographic plate as claimed in claim 1, in which said projections and depressions form a regular pattern.

4. An electrophotographic plate comprising a conductive backing plate having a surface characterized by a pattern of alternate projections and depressions, said surface having between 3,600 and 10,000 depressions to the square inch, and a coating of photoconductive insulating material filling said depressions and having a smooth outer face at a height not exceeding 5 mils above said projections.

5. An electrophotographic plate comprising a conductive backing plate having a surface characterized by a pattern of alternate projections and depressions, said surface having between 1,600 and 160,000 depressions to the square inch, and a coating of photoconductive insulating material filling said depressions and having a smooth outer face at the height of said projections.

CHESTER F. CARLSON.

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The following references are of record in the file of this patent:

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