Dec. 24, 1957 H. BOGDONOFF 2,817,277

ELECTROPHOTOGRAPHIC CAMERA

Filed Jan. 7, 1955

FIG.1

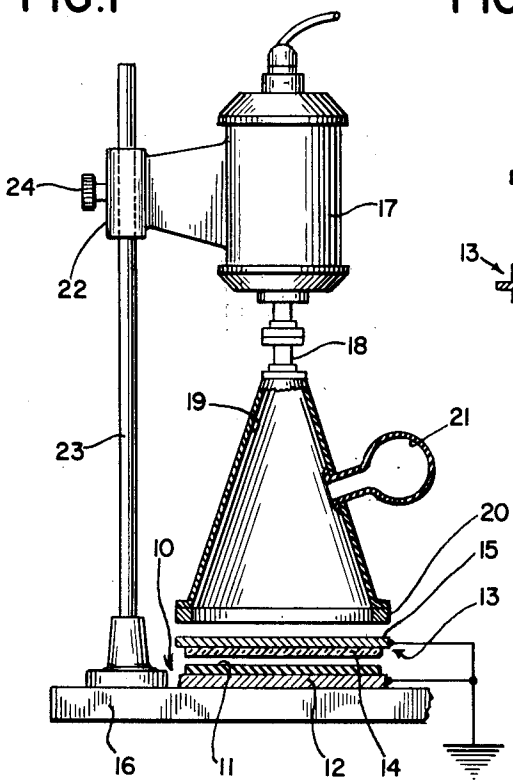


FIG.3

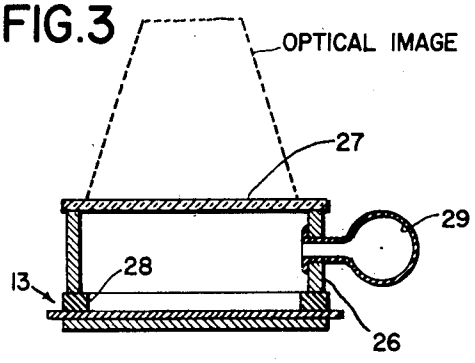


FIG.4

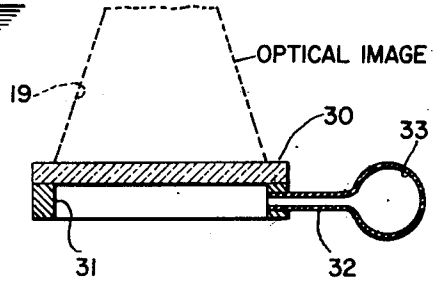
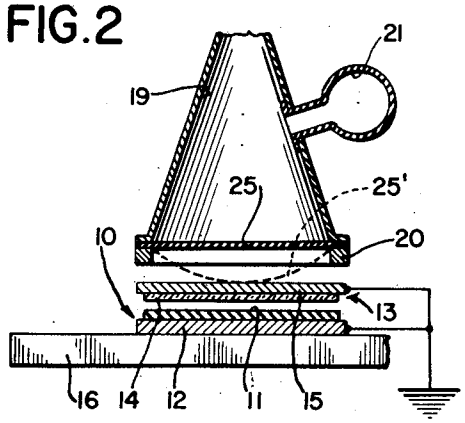


FIG.2



INVENTOR
HAROLD BOGDONOFF

BY Frank A. Steinhilper

ATTORNEYS

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ELECTROPHOTOGRAPHIC CAMERA

Harold Bogdonoff, Rochester, N. Y., assignor to The Haloid Company, Rochester, N. Y., a corporation of New York

Application January 7, 1955, Serial No. 480,521

1 Claim. (Cl. 95—1.7)

The present invention relates generally to electrophotographic techniques, and more particularly to methods and apparatus for obtaining effective contiguity between a photo-conductive layer and an insulating film while exposing the layer to a pattern of light and shade to be recorded.

In the electrophotographic or xerographic technique as described, for example, in U. S. Patent No. 2,297,691, issued to Chester F. Carlson, an electrostatic charge is impressed on the surface of a photo-conductive layer and the charge is dissipated by exposure to a pattern of light and shadow to be recorded in proportion with the amount of light reaching each part of the layer, thereby forming an electrostatic latent image corresponding to the light image. The image is then developed and rendered visible by depositing a finely divided powder on the layer, the powder being attracted to the charged areas and assuming a configuration corresponding to the electrostatic image. Thereafter the powder image is transferred to a sheet of paper or other material to which it is subsequently affixed.

In the improved electrophotographic technique disclosed in the co-pending patent application Serial No. 434,491, filed June 4, 1954, in the name of Lewis E. Walkup, to form the electrostatic charge pattern an electric field is imposed through a photo-conductive layer and to a contiguous insulating layer, while the photo-conductive layer is subject to the action of a pattern of light and shadow or visible light or other active radiation. The insulating layer is mounted on a transparent conductive backing to constitute an induction electrode. The insulating layer is positioned in very close proximity to the surface of the photo-conductive layer, whereby the electric charge under the influence of the applied field through the photo-conductive layer and through the insulating layer migrates through the photo-conductive layer, preferentially at those areas exposed to activating radiation, and migrates to the insulating layer across the minute air gap which may exist between this insulating layer and the photo-conductive surface, again under the influence of the applied field.

In an apparatus of this improved type, at least during the exposure operation, the transparent conductive backing and the photo-conductive layer are generally in normal surface contact with opposed surfaces of the insulating layer. To obtain good results it is important that the physical contact between the insulating layer and the photo-conductive layer be intimate and free of air pockets. Heretofore this contact was established by means of a glass plate in conjunction with a plaster cushion so as to press the insulating layer against the photo-conductive layer. Experience has shown that a contact assembly of this type is troublesome and often gives rise to uneven contact and air bubbles which impair the quality of the reproduction.

Accordingly, it is the principal object of the present invention to overcome the above-noted drawbacks and

to provide an improved method and means for obtaining intimate contact between the insulating layer and the photo-conductive layer.

More particularly, it is an object of the invention to provide a hood structure for subjecting the insulating layer to air pressure urging it into intimate contact with the photo-conductive layer.

Still another object of the invention is to provide a hood or shield structure coupled to the optical system of the electrophotographic camera, said structure including a gasket surrounding the mouth of the hood and adapted to engage the induction electrode to define a pressure chamber, said hood being further provided with air pressure means for increasing air pressure inside the chamber, thereby to flatten the film against the photo-conductive layer.

Yet another object of the invention is to provide a hood adapted to engage the induction electrode to define a pressure chamber independently of the optical system of the camera.

A further object of the invention is to provide a hood structure including a membrane adapted to subject the insulating layer to a pressure urging it against the photo-conductive layer, which pressure originates at the center of the membrane and thereafter spreads outwardly so as to flatten out the insulating layer in a manner obviating the creation of air pockets.

It is also an object of the invention to provide relatively simple and inexpensive means for subjecting the film to a pressure flattening it out against the photo-conductive layer.

For a better understanding of the invention as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawing, wherein like elements are identified by like reference numerals.

In the drawing:

Fig. 1 is an elevational view, partly in section, of a camera including a hood forming a pressure chamber in accordance with the invention.

Fig. 2 is a preferred modification of the structure shown in Fig. 1.

Fig. 3 is a longitudinal cross-sectional view of another embodiment of a hood structure in accordance with the invention.

Fig. 4 is a longitudinal cross-sectional view of still another embodiment of a hood structure in accordance with the invention.

Referring now to the drawings, and more particularly to Fig. 1, there is shown a photo-sensitive or xerographic member or plate, designated by numeral **10** and constituted by a photo-conductive layer **11**, overlying and in intimate contact with a conductive backing **12**. The photo-conductive layer **11** is preferably formed of a vitreous or amorphous selenium deposit on the surface of the conductive backing **12**. Alternatively, photo-conductive substances such as anthracene or sulphur may be employed as the photo-conductive material in conjunction with a suitable backing member. Photo-conductive binder layers such as photo-conductive phosphor crystals dispersed in suitable organic binders may also be employed for this purpose.

Superposed on the surface of the xerographic member **10** is an induction electrode, generally designated by numeral **13**, comprising a thin insulating layer **14**, in combination with a transparent conductive backing **15**. The xerographic member **10** is supported on a rigid base **16**, while induction electrode **13** may rest on the xerographic member. Certain elements in the drawing, such as photo-conductive layer **11**, are too thin to be realisti-

cally illustrated and therefore are shown out of proportion and diagrammatically.

An optical system 17 is provided to impress on the photo-conductive layer 11 a pattern composed of areas of light and shadow, such as an optical image to be recorded. As illustrated in Fig. 1, the optical system includes a conventional lens barrel 18 adapted to project onto the photo-conductive layer an image of an original document or other pattern of light and shadow to be recorded. Since induction electrode 13 is transparent it will be readily appreciated that a suitable image may be projected therethrough onto the surface of photo-conductive layer 11. Both the backing 12 of the electrophotographic member and the conductive backing of the induction electrode are grounded.

The insulating layer 14 of the induction electrode preferably is constituted by a thin "Mylar" film having a thickness in the order of 1 mil. "Mylar" is a highly transparent polyester film made from polyethylene terephthalate—the polymer formed by the condensation reaction between ethylene glycol and terephthalic acid. Such films possess excellent mechanical and dielectric characteristics. The transparent conductive backing for the "Mylar" insulating layer preferably is in the form of a transparent film coated or impregnated with conductive materials, such as metals or ionic salts or the like, where sufficient moisture is present to render the materials conductive. Both insulating layer 14 and the conductive backing therefor are formed of flexible material, hence the induction electrode combination is flexible in nature.

Means to flatten the insulating layer 14 against the photo-conductive layer 11 is provided comprising a shield or hood 19 having a conical shape, the throat of the hood being rigidly secured to the barrel 18 of the optical system. Surrounding the mouth of hood 19 and affixed to the lip thereof is a gasket 20, preferably fabricated of medium hard rubber. Attached to the wall of hood 19 and communicating with the interior thereof is a flexible bulb 21 made of rubber or any other suitable material.

The coupling of hood 19 to the lens barrel 18 is made such as to form a hermetic seal therebetween, thereby to close off the throat of the hood in an air-tight manner. When the gasket 20 of the hood is brought to bear on the backing surface of induction electrode 13, the mouth end of the hood is also closed off in an air-tight manner, thereby defining an enclosed chamber. The air pressure within the chamber may be increased by squeezing bulb 21. Inasmuch as the only flexible wall of the chamber is that formed by the induction electrode, the increase in internal pressure tends to flex this electrode outwardly.

The optical system 17, and the hood 19 attached thereto, is displaceable relative to induction electrode 13. For this purpose the optical system 17 is attached to a collar 22 which is slideably received an a vertical post 23 rigidly mounted on base 16. Collar 22 is provided with a set screw 24, whereby the optical system 17 may be held at an adjusted position thereof. Obviously many other types of conventional mechanisms may be employed for the purpose of elevating and lowering the optical system and the attached hood structure.

The electrophotographic process is carried out in the following manner: the first step entails the electrostatic charging of the dielectric surface of induction electrode 13. This may be accomplished by means of a corona discharge from wires or needles (not shown) in the way described, for example, in the patent to Ebert, 2,647,464. Induction electrode 13 is then placed over the xerographic plate with the "Mylar" film 14 in juxtaposed relation with respect to the photo-conductive layer 11. At this point the optical system 17 with the hood attached thereto is lowered until gasket 20 firmly engages the transparent backing 15 of the induction electrode. Thus, the insulating "Mylar" film 14 is sandwiched between the backing electrode 15 and the photo-conductive layer 11.

Now in order to ensure effective contiguity between the film and the photo-conductive layer, bulb 21 is squeezed to raise the pressure within the hood chamber. Inasmuch as the insulating film 14 and the backing 15 therefor are flexible, the increased pressure causes the film to flatten out against the photo-conductive layer 11 to establish an intimate contact therebetween throughout the entire area of contact. Thereupon the photo-conductive layer is exposed to the pattern of light and shadow projected from the optical system 17. Subsequent to this exposure, bulb 21 is released to reduce the pressure within the hood chamber, and the optical system is withdrawn. Finally, the "Mylar" insulating film is removed and developed in the manner described in the above-identified co-pending application. The powder cloud technique may be used for this purpose.

Alternatively, in lieu of lowering the position of the optical system and hood to effect engagement of the gasket and the induction electrode, the hood may be held stationary while the photo-conductive plate and the induction electrode are raised to meet the gasket on the hood.

In the modification illustrated in Fig. 2 the xerographic member 10, the induction electrode 13 and the hood structure are identical with that shown in Fig. 1, save that the hood structure is further provided with a membrane 25 which encloses the mouth of hood 19 in an air-tight manner and preferably is spaced about ¼ to ½ an inch from the outside face of gasket 20. Membrane 25 is fabricated of a thin, transparent and flexible material, such that when the air pressure within the hood chamber is increased by squeezing bulb 21, membrane 25 is distended and swells outwardly, as indicated by dashed line 25'. Thus, the air chamber in this instance is not completed by the induction electrode, as in Fig. 1, but by the stretchable membrane 25. Gasket 20 does not serve in this embodiment to provide an air seal, but rather acts as a spacer between the membrane 25 and the induction electrode 13 when the hood is brought down to engage the induction electrode or when the xerographic member 10 is raised for the same purpose.

In operation, after contact is effected between the induction electrode 13 and the face of gasket 20, bulb 21 is squeezed to cause the membrane 25 to belly outwardly such that as the pressure increases the central portion of the membrane will first engage the corresponding area of the induction electrode to press it against the photo-conductive layer and thereafter concentric areas of the membrane going from the center thereof to the periphery will successively engage the corresponding areas of the induction electrode. Thus, the "Mylar" film will be pressed against the photo-conductive layer initially at the center and then moving out toward the edges, this action serving to smooth out the "Mylar" and to remove any air bubbles which may otherwise form in pockets or creases. After intimate contact has been established the remaining steps of exposure and development are carried out along the lines indicated in connection with Fig. 1.

In the modification shown in Fig. 3, the hood structure is rendered independent of the optical system, this being accomplished by means of a structure comprising a cylindrical casing 26 enclosed at one end by a glass plate 27 and having a gasket 28 secured to the other end thereof. A flexible bulb 29 is attached to the wall of the casing and communicates with the interior thereof. In operation the hood structure is placed against the induction electrode and held thereagainst, while bulb 29 is squeezed to flatten out the insulating layer against the photo-conductive layer. The exposure of the photo-conductive layer is effected by passing the light through glass plate 27. The hood structure shown in Fig. 3 may be made to constitute a self-sufficient pressure chamber by the use

of a flexible membrane, such as membrane **25** in Fig. 2.

A somewhat simplified air pressure device for the purpose of establishing intimate contact between the insulating and photo-conductive layers is illustrated in Fig. 4, wherein a glass pane **30** is attached directly to one face of a gasket **31**. Extending laterally into the gasket is a tube **32** which connects with a flexible bulb **33**. The device shown in Fig. 4 may be placed against an induction electrode of the type shown in the previous figures, whereby a pressure chamber is defined in the space between glass pane **30** and the induction electrode. The pressure in this chamber may be increased by squeezing bulb **33**, thereby urging the insulating layer of the induction electrode into intimate contact with the photo-conductive layer. It is to be understood that while the means for increasing the air pressure has been shown in the form of a flexible bulb, other means for this purpose may be used, such as a pressurized gas source in conjunction with a suitable valve having an exhaust outlet and adapted at one operating position to increase the pressure within the chamber and at another operating position to release said pressure. This valve operating may be coordinated with the mechanism for shifting the hood structure position to provide automatic operation.

While there has been shown what are at present considered to be preferred embodiments of the invention, it is to be understood that many changes and modifications may be made therein without departing from the essential spirit of the invention. It is intended, therefore, in the appended claim to cover all such modifications that fall within the true scope of the invention.

What is claimed is:

An electrophctographic induced image camera comprising a xerographic member including a photoconductive layer, a flexible transparent induction electrode including a charged insulating layer, said electrode being superposed on said member with said insulating layer in surface contact with the photoconductive layer, an optical system to project a light pattern onto said xerographic member through said induction electrode, a conical hood attached at its throat end to said optical system, a gasket mounted at the mouth end of said hood, a flexible bulb connected to said hood and communicating with the interior thereof, and means to effect physical engagement between said induction electrode and said gasket so that said hood is enclosed at the throat end by said optical system and is enclosed at the mouth end by said electrode to define an air chamber, whereby said insulating layer may be forced into intimate surface contact with said photoconductive layer by squeezing said bulb to increase the pressure in said chamber.

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