

Jan. 15, 1957

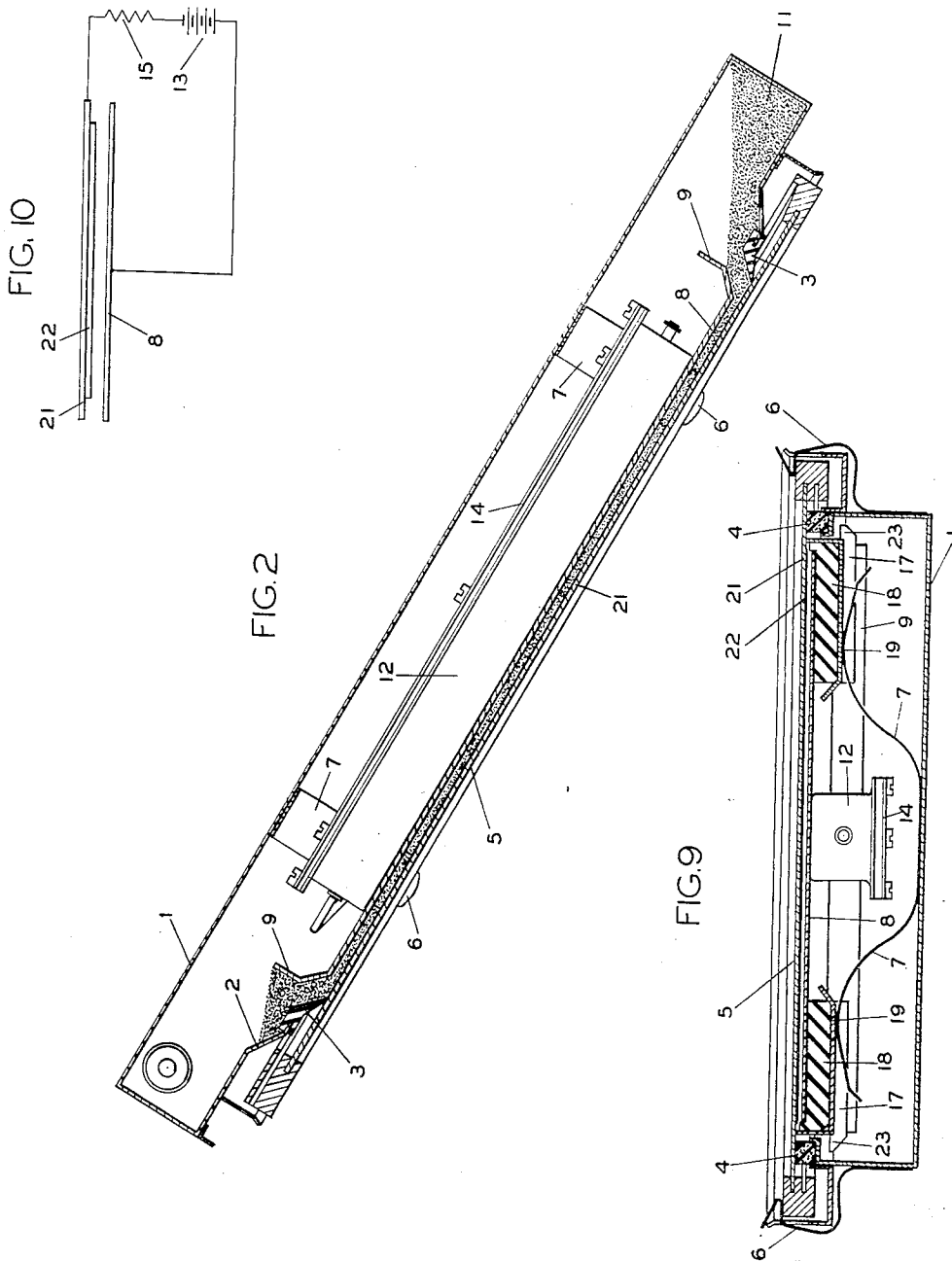
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2,777,418

APPARATUS FOR DEVELOPING A POWDER IMAGE ON A XEROGRAPHIC PLATE

Filed Feb. 8, 1954

4 Sheets-Sheet 2



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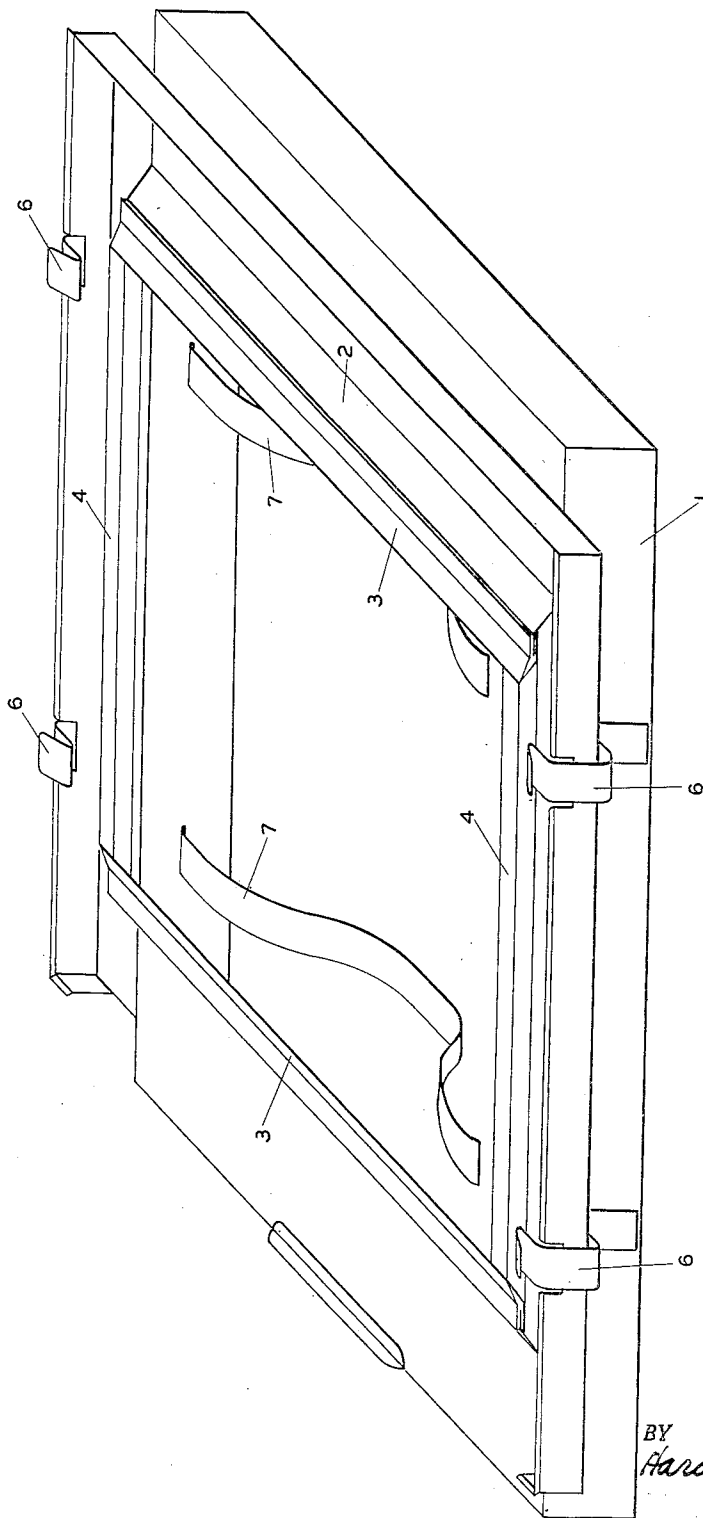


FIG. 3

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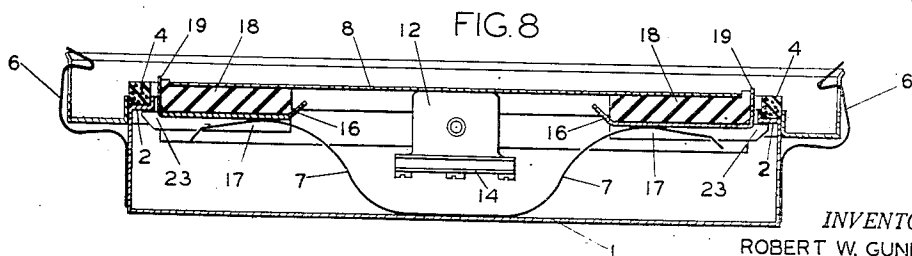
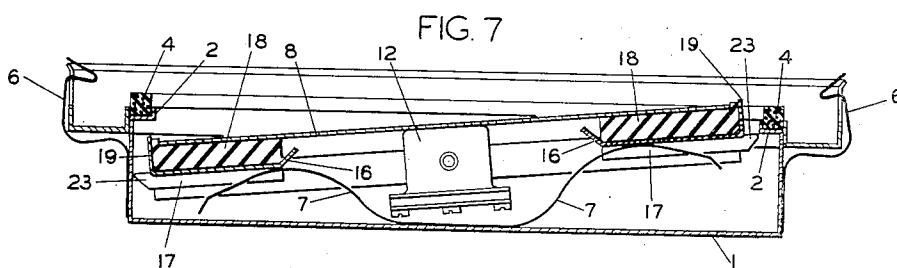
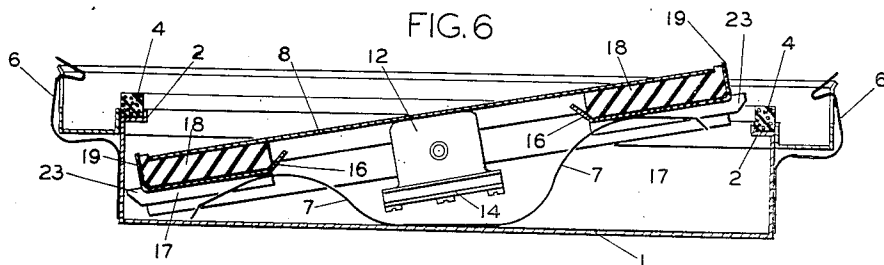
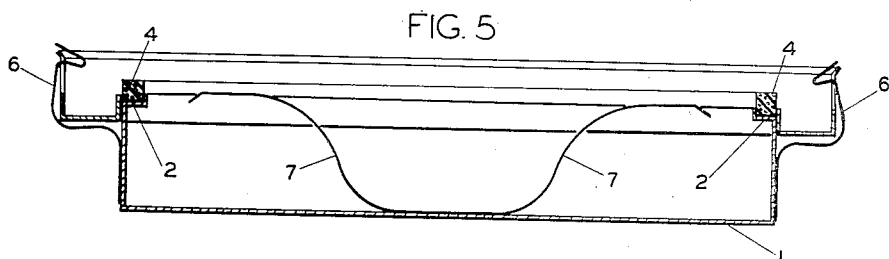
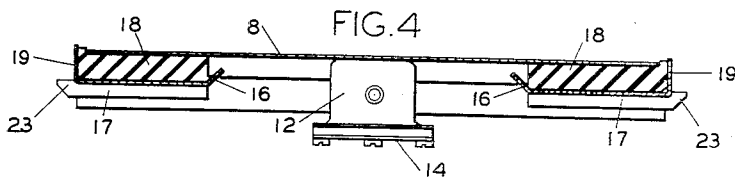
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4 Sheets-Sheet 4



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APPARATUS FOR DEVELOPING A POWDER IMAGE ON A XEROGRAPHIC PLATE

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Application February 8, 1954, Serial No. 408,713

2 Claims. (Cl. 118—51)

This invention relates to a method and apparatus for developing a powder image on a xerographic plate and has for its primary purpose to improve the character of xerographic copies by producing more uniformity and greater blackness or darkness in the image areas and by preventing to a greater extent than heretofore the adherence of developer powder to the non-image or discharged areas.

In the production of xerographic copies, the usual procedure is first to charge electrostatically the photoconductive insulating image layer of a xerographic plate, then expose the charged surface of the image layer under light to the subject to be copied producing an electrostatic image, after which the image layer with the electrostatic image thereon is subjected to the cascading operation of electroscopic or developer powder thereover to produce a powder image which is thereafter transferred and affixed to paper or other transfer medium, and the procedures as heretofore practiced have resulted in the image areas of the copy being black or dark adjacent to their edges and light or white at the central areas owing to the improper and non-uniform adherence of developer powder to the image areas, and it is a purpose of the invention to overcome this difficulty by bringing about uniform adherence of the developer powder over the entire image areas, thereby producing uniformly black or dark image areas in the finished copy.

In the development of powder images on flat xerographic plates, a further difficulty has been experienced in effectively removing all of the developer power from the discharged or background areas where the electrostatic charge has been conducted off upon exposure of the xerographic plate, and a further purpose is to enable an effective and more complete removal of developer powder from the discharged or background areas, in addition to more uniform adherence of the developer powder over the image areas when developing flat xerographic plates.

The invention further resides in the provision of a practical and efficient apparatus for carrying out the above stated purposes by the application to a powder cascading receptacle of a development electrode suitably retained in the receptacle and including a conducting plate positioned in close proximity to the image layer and provided with electrical charging means operative to impose a potential on the conducting plate and produce a field between the xerographic plate and the development electrode, the conducting plate being positioned and arranged to establish contact through a battery circuit with the metallic backing of a xerographic plate located in the powder receptacle, thus establishing connection from the metallic backing of the xerographic plate to the current source that imposes the charge on the development electrode.

To these and other ends, the invention consists in the construction and arrangement of parts that will appear clearly from the following description when read in conjunction with the accompanying drawings, the novel fea-

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tures being pointed out in the claims following the specification.

In the drawings:

Fig. 1 is a perspective view looking toward the inner surface of the development electrode, the latter being removed from the powder receptacle;

Fig. 2 is a longitudinal sectional view taken centrally through the powder receptacle, showing the development electrode partially in elevation and a xerographic plate both positioned in the powder receptacle, and the latter arranged to cascade developer powder over the charged image layer of the xerographic plate;

Fig. 3 is a perspective view of the powder receptacle with the development electrode removed;

Fig. 4 is a transverse sectional view of the development electrode;

Fig. 5 is a transverse sectional view of the powder receptacle;

Fig. 6 is a view similar to Fig. 5, showing the initial position of the development electrode while being inserted into the powder receptacle;

Fig. 7 is a view similar to Fig. 6, illustrating an intermediate position of the development electrode while being inserted into the powder receptacle;

Fig. 8 is a view similar to Fig. 7, illustrating the final position of the development electrode when yieldably supported in the powder receptacle;

Fig. 9 is a sectional view taken transversely of Fig. 2, illustrating the relationship between the contact shoes of the development electrode and the metal backing or support of the xerographic plate, when positioned in the powder receptacle, and

Fig. 10 is a diagrammatic view of the circuit connecting the battery means of the development electrode with the metal backing of the xerographic plate.

Referring more particularly to the drawings in which like reference numerals refer to the same parts throughout the several views and which are intended to serve only as an example of one practical embodiment of the invention, there is illustrated a powder receptacle, see Figs. 2, 3, and 5 to 8 inclusive, of the general character illustrated in Patent No. 2,600,580, dated June 17, 1952, and including a bottom wall 1 and a top wall having an opening therein defined by lateral flanges 2 extending around the opening and supporting compressible or rubber strips 3 and 4 against which the xerographic plate 5 is held by spring catches 6 when positioned in the powder receptacle, see Fig. 2.

The powder receptacle with the xerographic plate held therein is oscillated to cascade the electroscopic or developer powder alternately in opposite directions over the xerographic plate in a manner similar to that disclosed in the aforementioned Patent No. 2,600,580, and the structure thus far described is substantially in accordance with such prior patent while the present invention has to do more particularly with a development electrode that is arranged within the powder receptacle and includes a conducting plate located parallel and in slightly spaced relation to the image surface of the xerographic plate while cascading the developer powder over the image surface of the xerographic plate, the powder moving between the image surface and the development electrode plate which is arranged in close proximity to the xerographic plate during the powder developing operation.

To accomplish this, the powder receptacle is provided with metal springs 7 suitably attached to the bottom wall 1 of the powder receptacle and having upwardly extending free ends upon which the development electrode is yieldably supported when located in operative position in the powder receptacle. The development electrode, which is illustrated in detail in Fig. 1, includes a conducting or

metal plate 3 that terminates at its ends in flanges 9 extending inwardly, see Figs. 1 and 2, which function to deflect the developer powder indicated at 11, Fig. 2, to between the conducting plate 8 and the xerographic plate 5 and to prevent the main body of developer powder from passing to the central area of the powder receptacle above the development electrode during the powder cascading operation.

The development electrode also includes a battery case 12 attached to the plate 8 and housing preferably three 30-volt batteries 13 connected in series and all protected by a cover plate 14. The battery at one end is connected to the conductor plate 8 while the battery at the opposite end of the battery case is connected through a suitable resistor 15 to conducting strips 16 mounted on the metal shoes 17 which are insulated from the conducting plate 8 by blocks of insulating material 18, while 19 indicates supporting lugs at the ends of the shoes 17 arranged to engage the portion of the grounded metallic or aluminum conducting backing 21 of the xerographic plate surrounding the selenium or photo-conductive image layer 22 when in position to receive the developer powder. The lugs 19 of the shoes act to hold the conducting plate 8 and xerographic plate 5 spaced from each other preferably a distance of approximately $\frac{3}{32}$ ", and the conducting strips 16 afford a connection from the metal backing of the xerographic plate to the battery and conducting plate 8, producing an electrostatic field between the conducting plate 8 and the image layer of the xerographic plate when the parts are in position for developing.

The development electrode is removably held within the powder receptacle by legs or extensions 23 on the shoes 17, the legs 23 engaging under the flanges 2 of the powder receptacle when operatively positioned therein. The development electrode is positionable within the powder receptacle by inserting it from one side, see Fig. 6, depressing the adjacent ends of springs 7 thereunder until legs 23 at the opposite side of the development electrode can be brought under the flange 2 as illustrated in Figs. 7 and 8, and when the development electrode is finally positioned, the springs 7 serve to hold it yieldably through the action of the springs 7, see Fig. 8, while the legs 23 limit the outward movement of the development electrode and retain it against outward movement beyond the flange 2. When the xerographic plate is secured in position as in Fig. 2, the lugs 19 engage the metal area around the image layer of the xerographic plate and are held thereagainst by the yielding action of springs 7, the xerographic plate being held against the development electrode by the spring catches 6 previously mentioned, and under which the xerographic plate is inserted when positioned in the powder receptacle.

The structure is such that when the xerographic plate is operatively positioned for developing, its image surface is approximately $\frac{3}{32}$ " from the surface of the conducting plate 8, which has a uniformly flat and unbroken surface throughout its area with an error of uniformity of not more than $\pm\frac{1}{64}$ ". The spacing between the conducting plate 8 and the image layer of the xerographic plate is preferably not more than sufficient to permit movement of the developer powder over the image layer and enable the developer powder to adhere to the charged image areas.

The xerographic plate when charged usually has a potential of approximately 600 volts while after exposure, a charge of approximately 10 to 30 volt potential remains on the background or discharged areas with the full charge remaining on the undischarged or image areas, and the conducting plate 8 of the development electrode causes the lines of force from the undischarged or image areas to be directed in generally parallel relationship toward the conducting plate 8 in perpendicular relationship to the image surface and to the conducting plate 8. This results in uniform adherence of the developer powder over the image area and produces a uniformly dark or con-

centrated image with lines that are not diffused, as contrasted with powder developing procedures in which there is no conducting plate in parallel relation and close proximity to the xerographic plate and in which the lines of force from the edges or outer portions of an image area are consequently directed in curved paths to the adjacent discharged or background areas, resulting in the lines of force being dissipated from the image area and producing black or dark effects around the edges and light or white effects at the central portions.

The potential imposed on conducting plate 8 of the development electrode is preferably from 60 volts to 90 volts, with a polarity the same as the polarity of the charged image areas and the same as the polarity of the charge on the background areas of the xerographic plate but with a greater voltage than that of the charge on the background areas, resulting in an electrical field which neutralizes the field caused by the residual charge on the discharged or background areas. In this manner, the conducting plate 8 prevents developer powder from adhering to the discharged or background areas, and produces a copy having uniformity in both the image and background areas, with more perfect contrast between the image and background areas, and greatly improved quality of the copy.

For the purpose of uniform development of the image areas, the conducting plate 8 of the development electrode may be maintained at ground or substantially zero potential, and the potential which is imposed on the conducting plate 8 for preventing adherence of powder to the discharged or background areas is comparable to the residual voltage on the discharged areas, while the maximum potential on the conducting plate 8 is sufficiently low so as not to affect the powder on the image areas.

While the invention has been disclosed with reference to the particular structure herein shown, it is not confined to the details and arrangement set forth, and this application is intended to cover such modifications or departures as may come within the purposes of the improvement or the scope of the following claims.

I claim:

1. A portable apparatus for developing a powder image by gravitating developer powder over the insulating image surface of a flat xerographic plate having a conductive metal backing, which consists of a powder receptacle adapted to be manually oscillated to gravitate the developer powder over the surface of said plate, means for supporting the xerographic plate in the powder receptacle, a development electrode consisting of a uniformly flat conducting plate that is uniformly spaced from said image surface a distance of approximately $\frac{3}{32}$ ", means for removably supporting the development electrode above the plate in the powder receptacle, and electric charging means connected to said conductive backing and to said development electrode and operating to impose on said development electrode a charge having a potential of from 60 volts to 90 volts, said potential being greater than the potential of the background areas of the image on the plate and less than the potential of the image areas and acting to prevent adherence of developer powder to the background areas and to effect uniform adherence of the developer powder to the image areas and thereby producing uniformly black image areas.

2. A portable apparatus for developing a powder image by gravitating developer powder over the insulating image surface of a flat xerographic plate having a conductive metal backing, which consists of a powder receptacle adapted to be manually oscillated to gravitate the developer powder over the surface of said plate, means for supporting the xerographic plate in the powder receptacle, yieldable supporting means in said powder receptacle, a development electrode removably mounted on said yieldable supporting means above the plate, flanges in the powder receptacle against which said development electrode is yieldably held, the development electrode being

spaced uniformly from the insulating image surface a distance of approximately $\frac{3}{32}$ ", said development electrode consisting of a uniformly flat conducting plate, a battery attached to and insulated from the under surface of said conducting plate, said battery connected at one end to said conducting plate, conducting shoes carried by and insulated from said conducting plate and connected to the other end of said battery, lugs carried by said conducting shoes extending inwardly therefrom and engaging the metal backing of the xerographic plate, and extensions on said shoes engaging the aforesaid flanges and holding the electrode above the plate in the powder receptacle, said conducting shoes and lugs acting as conductors between the battery and the metal backing of the xerographic plate and the battery having a capacity and acting to impose on said conducting plate a charge having a potential of from 60 volts to 90 volts, said potential being greater than the potential of the background areas of the image on the plate and less than the potential of the image areas and acting to prevent adherence of developer powder

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to the background areas and to effect uniform adherence of developer powder to the image areas and thereby produce uniformly black image areas.

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