

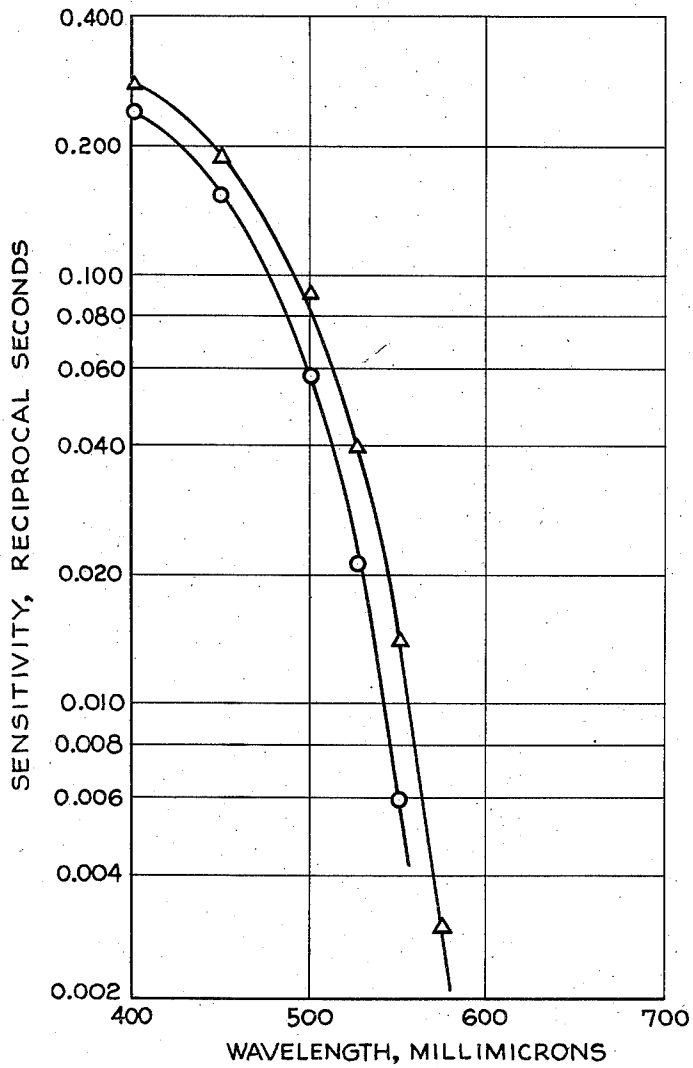
Aug. 20, 1957

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2,803,542

XEROGRAPHIC PLATE

Filed July 26, 1955



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Δ Se-As PLATE

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2,803,542

XEROGRAPHIC PLATE

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Application July 26, 1955, Serial No. 524,478

4 Claims. (Cl. 96—1)

This invention relates in general to the art of electrophotography, now known as "xerography," and, in particular, to a sensitive plate therefor. More specifically, the invention relates to a new xerographic or electrophotographic member comprising a conductive backing having on at least one surface thereof a mixture of a photoconductive insulating coating consisting of a mixture of selenium and arsenic which member is known as a "xerographic plate."

In the art of xerography it is usual to form an electrostatic latent image on a member or plate which comprises a conductive backing member such as, for example, a metallic surface having a photoconductive insulating surface thereon. It has previously been found that a suitable plate for this purpose is a metallic member having a layer of vitreous selenium. Such a plate is characterized by being capable of receiving a satisfactory electrostatic charge and selectively dissipating such a charge when exposed to a light pattern and, in general, is largely sensitive to light in the blue-green spectral range.

Now in accordance with the present invention it has been found that an improved xerographic plate can be prepared by incorporation in the photoconductive insulating coating of a minor amount of arsenic. The plates as thus modified are characterized by a broader range of spectral sensitivity, particularly toward the red end of the spectrum, and by an increased overall photographic speed. In addition, other advantages exist. Thus, the presence of arsenic in a selenium coating markedly inhibits crystallization of the selenium layer. Thus, in the field of xeroradiography, extra thick layers of selenium, namely, about 80–300 microns are needed. The presence of such thick layers results in the trapping of charges in the layer during exposure. As a result, residual charge builds up rapidly in the plate due to the presence of such trapped charges. These charges are removed by heating the plate. Unfortunately, heating promotes the growth of crystals in the selenium layer which, in turn, destroys the photoconductive insulating properties of the selenium. This places a strict limit on the number of times it is possible to "regenerate," i. e. relieve fatigue from, a plate. The inclusion of a minor amount of arsenic in the selenium layer inhibits this crystallization thereby increasing the amount of use obtainable from a xeroradiographic plate. Furthermore, this same mechanism also makes possible the manufacture of xerographic plates by spreading molten selenium-arsenic on the conductive backing.

In general, the permissible range of concentration or proportion of arsenic in the selenium layer is relatively broad and may extend from about 0.5 percent to about 20 percent and preferably lies in the range of about 1 percent to about 10 percent by weight.

The new and improved plates of the present invention can be prepared by a variety of methods. For example, arsenic and selenium in the desired proportions may be mixed and, in molten form, sprayed on the desired surface, or they may be evaporated onto the plate under high vacuum as from a mixture in a single evaporation source

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or optionally from two separate sources operating to volatilize their contents at the desired speed ratio. Likewise, the mixed ingredients may be placed in a suitable film-forming binder and applied to the surface in the form of a selenium-arsenic lacquer. Application of molten selenium-arsenic to the conductive backing may also be used. If desired, a transparent insulating coating, as of vinyl resin, a cellulose ether or ester, a silicone resin, etc. may be coated on top of the xerographic plate to protect the surface thereof from abrasion and mechanical damage.

The figure is a graph showing the spectral response curves of a selenium xerographic plate contrasted with an arsenic-selenium xerographic plate.

The general scope and nature of the invention having been set forth, the following example is given as a typical illustration of a method by which the desired plates may be prepared. A brass plate was polished with Glass Wax (a trade name of the Gold Seal Company, Bismarck, North Dakota, for a composition comprising about 75 percent water, 15 percent naphtha, 7.5 percent abrasive, and the balance ammonia, emulsifier, and coloring agent), rinsed in isopropyl alcohol and then degreased in hot isopropyl alcohol vapor. The brass plate so treated was approximately 2 inches wide, 4 inches long, and $\frac{1}{16}$ inch thick. After this cleaning the plate was then attached to a temperature controlled platen about 6 inches above a porcelain crucible.

In preparing the charge for evaporation, a mixture of ARQ grade (ammonia reduced selenium oxide in quartz) selenium and approximately 2 percent by weight of arsenic were heated together for 2 hours in air with frequent stirring with a Pyrex rod. Most of the arsenic dissolved but a small amount did not go into solution. The excess arsenic was decanted leaving a homogeneous molten mixture. This charge was then placed in the porcelain crucible. The platen backing the brass plate was then heated to place the brass plate itself at a temperature of about 70 degrees C. A bell jar was placed over the assembly and the air evacuated from the system to give a pressure of about 0.2 micron. The arsenic-selenium mixture was then heated in the porcelain crucible and thus evaporated onto the brass plate. Deposition took about 30 minutes. The arsenic-selenium layer so obtained was approximately 50 microns thick. A plate containing only selenium on a brass backing member was prepared by the same process and also was approximately 50 microns thick.

The spectral response of the two plates was then tested by keeping the plates in darkness for at least about 8 hours. A charge of about 200 volts was then placed on the plate by means of a corona charging unit such as is disclosed in U. S. patent application Serial No. 154,295, filed April 6, 1950, by Lewis E. Walkup. The spectral sensitivity data for the graph was then obtained by calculating the reciprocal of the time in seconds required for the plate potential to drop from 200 volts to 100 volts under illumination having an intensity of 0.027 microwatt per square centimeter. As can be seen from the figure, the spectral response of the plate having arsenic-selenium as the photoconductive insulator is definitely shifted toward the red end of the spectrum as compared to the plate having only selenium as the photoconductive insulator and the overall sensitivity is greater for all wave lengths measured up to about 580 millimicrons. Thus, at a wave length of about 450 millimicrons the arsenic-selenium plate has approximately 40 percent more sensitivity than the plate having only selenium as the photoconductive insulator and at a wave length of about 525 millimicrons the arsenic-selenium plate is almost 100 percent more sensitive than the plate having only selenium as the photoconductive insulator.

The selenium used in the preparation of xerographic plates should be free of impurities which adversely affect

its ability to hold electrostatic charges, that is by forming conducting paths in the film or promoting the formation of conducting hexagonal selenium so that electrostatic charges leak off rapidly even in the dark and electrostatic deposition of powder or other finely-divided material cannot be obtained. Preferably, there should be used amorphous selenium available in pellet form $\frac{1}{17}$ inch to $\frac{1}{8}$ inch size under the name "A. R. Q." (ammonia reduced in quartz from selenium oxide) as manufactured, for this grade of selenium is essentially pure, containing less than about twenty parts per million of impurities. If purified, other grades of selenium, i. e. "D. D. Q." (double distilled in quartz) and "C. C. R." (commercial grade) as manufactured can likewise be employed in the process disclosed herein. To purify these grades of selenium, they are first freed of copper, lead, iron, and bismuth by distillation. The selenium is next heated to about 250 degrees C., slightly above its melting point, and, while molten, is then dropped through a shot tower (or in the laboratory by means of an eye dropper) into water to form pellets. The pellets are subsequently treated with petroleum ether to remove water and allowed to air dry. If desired, the purified selenium can be remelted and cast in boats to form sticks. It can also be reduced in size by grinding or micropulverizing to facilitate melting and mixing with the arsenic. Where the plates are prepared either by vacuum evaporation of the selenium and arsenic or by spraying in molten form, it is desirable that the base plate be preheated to a temperature of at least about 75 degrees C. although lower temperatures may be used if desired.

A conductive base plate is usually required for xerographic plates and metal forms the most suitable material. However, a high conductivity is not required and almost any structurally satisfactory material which is more conductive than the selenium-arsenic layer can be used. Materials having electrical resistivities about 10^{10} ohm-centimeter are generally satisfactory for the base plates of this invention although it is more desirable to use materials of less than about 10^5 ohm-centimeter. Any gross surface irregularities, i. e. burns, tool marks, are removed from the base plate by grinding or polishing, although it is unnecessary to polish the plate until it has a mirror-like surface. The plate surface is cleaned before coating with the selenium-arsenic in order to remove grease, dirt, and other impurities which might prevent firm adherence of the coating to the base plate. This is readily accomplished by washing the plate with any suitable alkali cleaner or with a hydrocarbon solvent, such as benzene, followed by rinsing and drying. Suitable base plate materials are

aluminum, glass having a conductive coating thereon as of tin oxide or aluminum, stainless steel, nickel, chromium, zinc, and steel.

Also, conductive plastic, conductively coated paper, or other web or film-like member may be used as the conductive supporting surface as desired. It is to be understood that the backing member selected for this plate may be in the form of a flat plate or may equally be in the form of a cylinder, flexible sheet, or other member having a surface suitable for the xerographic process.

I claim:

1. An electrophotographic process comprising placing an electrostatic charge on the surface of an electrophotographic member comprising a photoconductive insulating layer being a substantially vitreous uniform mixture of between about 0.5% and 20% by weight of arsenic and the remainder substantially vitreous selenium overlying and in electrically conductive contact with a conductive backing member, selectively dissipating electric charge from the surface of the charged photoconductive insulating layer by exposing the charged layer to a light image thereby creating an electrostatic latent image on the surface of the photoconductive insulating layer, and developing said electrostatic latent image with electrically charged powder particles.

2. A process according to claim 1 in which the photoconductive insulating layer is about 1% to about 10% by weight arsenic and the remainder substantially vitreous selenium.

3. A process according to claim 1 in which the photoconductive insulating layer is about 1% to about 10% by weight arsenic and the remainder substantially vitreous selenium, the conductive backing member comprising aluminum.

4. A process according to claim 1 in which the photoconductive insulating layer is about 1% to about 10% by weight arsenic and the remainder substantially vitreous selenium, the conductive backing member comprising brass.

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