United States Patent

Tanno

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[54] **XEROGRAPHIC APPARATUS**

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[51] **Int. Cl.**.....**G03g 15/00**

[58] **Field of Search** 355/16, 11, 3; 118/637, 37

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Assistant Examiner—Richard L. Moses
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[57] **ABSTRACT**

In a xerographic apparatus by taking advantage of the adhesive property of an oxide film produced by anodic oxidation of a metal, particularly aluminum, strong adhesion is obtainable in the formation of the xerographic medium between the metal substrate and a photoconductive insulator when the latter is evaporated on the surface of the metal substrate. Moreover, both the metal substrate and the photoconductive insulator may be made flexible if the thickness of the metal substrate and the photoconductive insulator evaporated thereon is made sufficiently thin.

5 Claims, 4 Drawing Figures

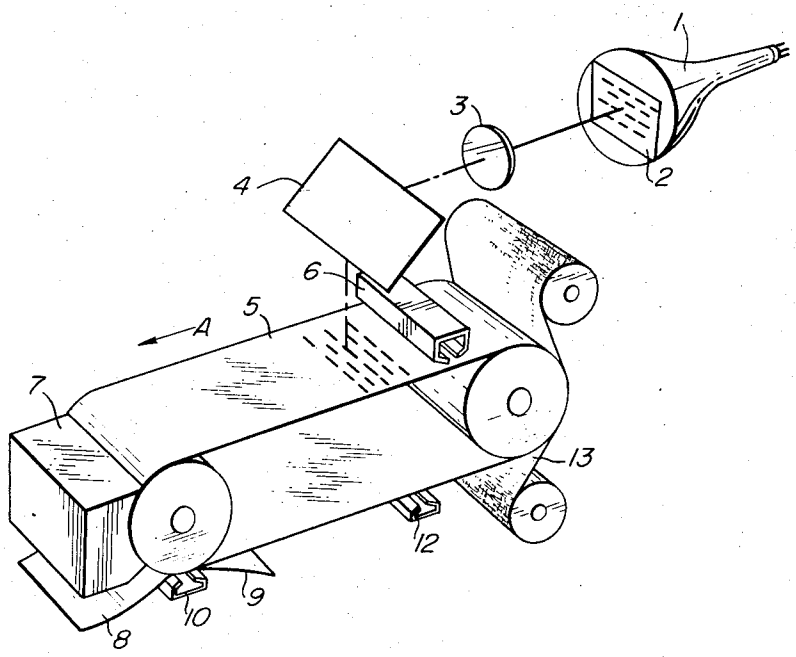


FIG. 1

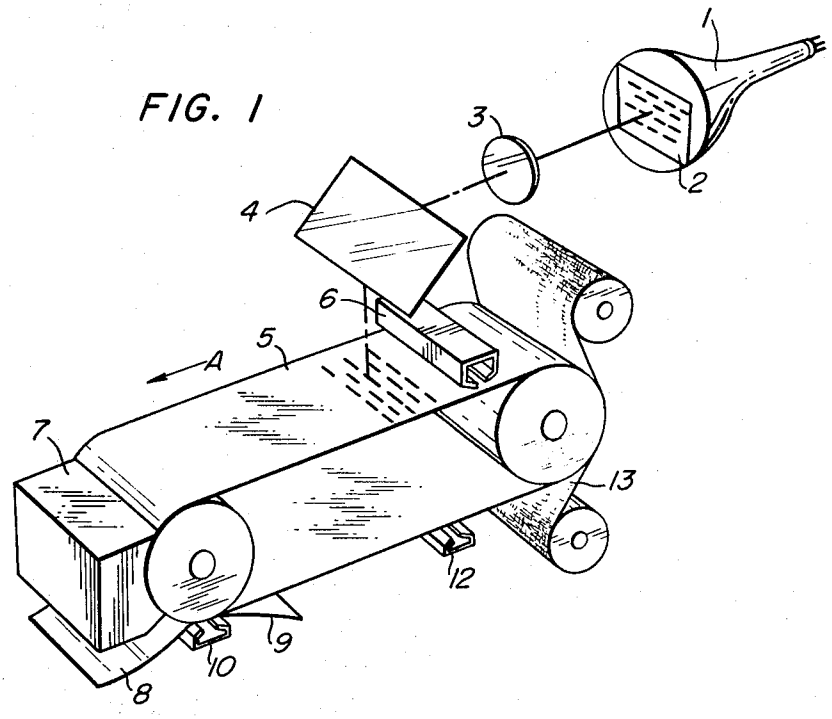


FIG. 2

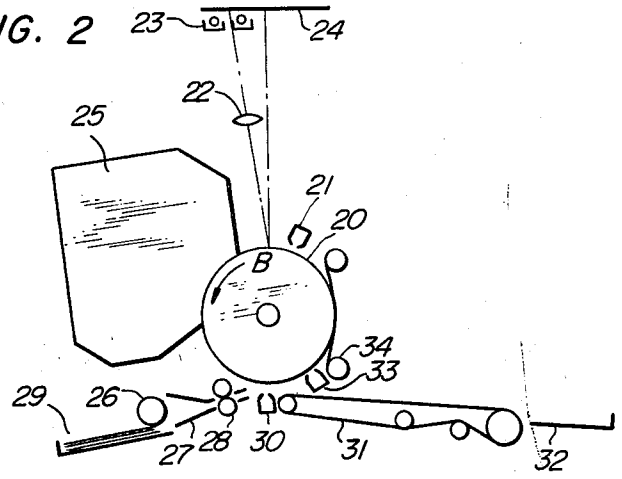


FIG. 3

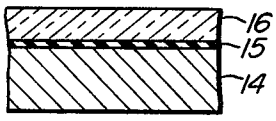
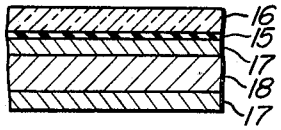


FIG. 4



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XEROGRAPHIC APPARATUS

BACKGROUND OF THE INVENTION

Xerographic media for xerographic apparatus are formed by depositing any photoconductive insulating materials of the glass group such as selenium on metallic substrates through an evaporation process. However, due to inferior adhesion or bond strength between the metallic substrates and the photoconductive insulating materials as well as low degree of their flexibility, it has been necessary for ordinary xerographic media to be formed on inflexible, rigid cylindrical metallic substrates. Because the construction of xerographic apparatus depends on the configuration of the xerographic medium used, conventional recording systems must necessarily be formed as a rotating drum system as determined by the shape of the xerographic medium and thus the configuration of xerographic medium limits the uses and scope of application of xerographic apparatus. This in turn means that the objective of increasing the uses and range of application of xerographic apparatus may be attained by the development of a flexible xerographic element having improved adhesion or bond strength between a metallic substrate and a photoconductive insulator.

The inventor has conducted various experiments in an attempt to find a xerographic element which is flexible and yet exhibits strong adhesion between its metallic substrate and a photoconductive insulator. The results obtained from these experiments have shown that regarding flexibility, if a metallic substrate which constitutes a xerographic element is made sufficiently thin and the thickness of a photographic insulator to be evaporated on the metallic substrate is also reduced sufficiently, a xerographic element thus formed by them will be provided with a sufficient flexibility. In fact, such a xerographic element in the form of an endless belt was incorporated into a xerographic apparatus which, in actual operation, showed no peeling of the photoconductive insulator off the substrate, nor was there any unfavorable change with respect to flexibility. Moreover, no untoward change in the essential characteristics of the xerographic medium for the xerographic apparatus was revealed.

Regarding the adhesion between a metallic substrate and a photoconductive insulator, it has also been discovered from the aforesaid experiments that an oxide film formed by anodic oxidation of the metallic substrate possesses a strong adhesiveness. And this good adhesion has been found to exhibit an especially strong adhesion with respect to photoconductive insulators of the calcogenide glass group as the photoconductive insulators. It has been further discovered that an oxide film of aluminum or alluminum alloys, when they are used as a substrate, exhibits much more improved adhesion. The same properties have been found to be obtainable with other metals on which aluminum plating is effected and in this case a xerographic medium is attained which combines the properties of the base metal and those of an aluminum oxide film.

Where an electrolyte containing a phosphoric acid was used in the anodic oxidation of the above metallic substrate, remarkably improved adhesion was obtained between the substrate and the photoconductive insulator. With other electrolytes, however, it has also been found that oxide films obtained by an anodizing process

could greatly contribute toward the improved adhesion of evaporated films.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a technique which ensures remarkably improved adhesion of photoconductive insulating materials to metallic substrates.

Another object of the present invention is to provide a flexible xerographic medium and a novel xerographic apparatus incorporated with said xerographic medium.

Further object of the present invention is to provide a highly durable xerographic medium which is superior both in flexibility and adhesion.

Still further objects as well as the features an advantages of the present invention will be apparent from the following description made in conjunction with the accompanying drawings.

The present invention provides a xerographic apparatus which has various uses and wide application and its merit resides in the fact that a recorded image of a remarkably higher degree of resolution is attained, particularly in the case of recording by a plane exposure method with cathode-ray tube display recording or other systems and there is thus realized a xerographic apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing schematically a construction of a xerographic apparatus according to the present invention.

FIG. 2 is a view showing diagramatically the construction of a conventional xerographical apparatus.

FIG. 3 and FIG. 4 are longitudinal sectional elevations of xerographic media according to the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a schematic diagram showing an embodiment of xerographic apparatus according to the invention, in which a photoconductive film of a flexible xerographic medium is adhered on a thin oxide film formed on a substrate.

In the embodiment of FIG. 1 which comprises a xerographic medium according to the present invention, as a system for exposing information a recording system of a cathode-ray tube display is illustrated for the sake of better understanding of the invention.

In the figure, numeral 1 designates a cathode-ray tube which, though a high resolution displaying cathode-ray tube is most suited to the purpose, may be of any kind provided that information 2, such as characters, lines and pictures can be displayed on the surface of the tube. The information 2 displayed on the cathode-ray tube 1 is projected through a lens system 3 onto a reflecting mirror 4 from which the information 2 is reflected onto a xerographic medium 5. The cathode-ray tube 1, the lens system 3 and the reflecting mirror 4 form one means for projecting the information 2 onto the xerographic medium 5 and various other means may be used in place thereof. The xerographic medium 5 constitutes an important feature of the present invention and it is prepared in accordance with a procedure which will be explained hereinafter. In this embodi-

ment, the xerographic medium **5** is shown taking the form of an endless belt which is rotated in the direction indicated by an arrow A. Numeral **6** designates an electrifier which is utilized in the same manner as used with the ordinary xerographic apparatus to uniformly charge the xerographic medium **5** electrically. The electrifier **6** is therefore located in a previous position of the surface of the xerographic medium **5** onto which the information **2** is to be exposed, but such exposure is not made as yet. Since this electrification of the medium **5** is effected in the dark excepting the radiation from the cathode-ray tube **1**, uniform electrification is attained by the electrifier **6** and this charge may be retained satisfactorily without any loss in the course of the subsequent steps of exposure, development, powder transfer, etc. The exposure of the information **2** to the charged xerographic medium **5** takes place with the medium **5** being brought to a stop tentatively. Because the exposure of the information **2** is effected by means of a perfect plane exposure which is a stationary exposure as well, there will be no deterioration of resolution and it is thus possible to attain a sufficiently high degree of resolution which is only limited by the resolving power of the cathode-ray tube **1**. After the information **2** has been exposed on the surface of the xerographic medium **5** and there has been formed an electrostatic latent image corresponding to the information **2**, this electrostatic latent image is developed in the same manner as is done with the conventional xerographic apparatus. In this embodiment, this is done by a developing device **7** disposed on the side of one extreme rotating end of the xerographic medium **5** taking the form of an endless belt. The developing system employed in this embodiment is a so-called cascade developing system within which is disposed a bucket conveyor for causing tonor powder to fall in a cascade; the bucket conveyor being adapted to take up tonor powder consisting of the tonor and carrier material which are sprinkled over the electrostatic latent image formed as a result of the exposure to make it into a visible image. Disposed at the back of the developing device **7** is a transfer means which transfers this visible image onto a recording paper (not shown). This transfer means feeds the recording paper so that its surface tends to contact the visible image, the paper being moved through paper feed guides **8** and **9** in the same direction and at the same speed as the xerographic medium **5**. Advancing along with the xerographic medium **5** the recording paper is caused, when it charge the visible image on the surface of the medium **5**, to draw and transfer thereonto the visible image on the surface of the medium **5** by virtue of the electric charge of a transfer electrifier **10** which electrically charges the recording paper from its back. Here the transfer electrifier **10** is of the same construction as the previously explained electrifier **6** that functions prior to the exposure. The charge given by the transfer electrifier **10** (i.e. so-called corona discharger) should be preferably adjusted suitably as occasion demands so it not only permits the transfer of the visible image onto the recording paper, but also it provides no excess charge which will tend to produce a stripping discharge when the recording paper is stripped from the surface of the xerographic medium **5** on which the visible image is formed. After the visible image has been transferred onto the recording paper in the manner just described, occasionally a very small portion of the developing powder forming the visible image may remain on the surface of the xerographic medium **5** after the transfer, along with the residual charge. The remaining charge and the developing powder are removed firstly by means of a charge removing electrifier **12** which is disposed at the rear of the transfer means to provide electric charge of opposite polarity to that of the residual charge so as to neutralize and remove the residual charge. The remaining developing powder is then removed by means of a cleaning web **13** disposed behind the electrifier **12**. The cleaning web **13** is made of soft cloth or wool so as not to damage the xerographic medium **5** and it is moved in a direction opposite to the direction of movement of the xerographic medium **5** with the web being urged lightly against the latter. Since the cleaning web **13** is operated after removal of the residual charge, the remained developing powder is readily brushed off and the xerographic medium **5** is cleaned. In this embodiment, the cleaning web **13** is disposed on the rotating side of the medium **5** opposite to the other rotating side on which the developing device is located and the web is moved in contact with the corresponding rotating side.

Although the recording is effected according to the procedure described above, it should be noted here that satisfactory recording may be ensured with those apparatus which are not provided with the electrifier **12** and cleaning web **13** for removing the residual charge and the remained developing powder, respectively.

As described above, by employing a flexible xerographic medium which constitutes one of the features of the present invention, there is provided a xerographic apparatus wherein a plane exposure as previously explained is realizable. Moreover, the range of application of the apparatus may be increased considerably since the xerographic medium which is the most important constituent component of the xerographic apparatus is flexible, which means that its surface area which are to be exposed may be changed freely and easily in accordance with the methods or directions in which information will be supplied.

The procedures for providing a xerographic medium with required flexibility which has been described as another feature of the present invention will be explained on the basis of the following experiments:

EXPERIMENT 1

Employing a cold rolled stainless steel sheet of 80 μ thickness as a metallic substrate, its surface was cleaned with trichloroethylene, formed into an endless belt shape and then, rotating it in a vacuum, selenium was evaporated on the metal surface to be 12 μ in thickness. The xerographic medium was subjected to a mandrel test wherein there was no peeling between the metallic substrate and the evaporated layer of selenium under a bending test with a mandrel as large as 16 ϕ in diameter. There was also no damage to the properties of the xerographic medium and a good xerographic element was thus obtained which could be used as a highly flexible xerographic medium.

EXPERIMENT 2

The same results as in the case of experiment 1 were obtained with a xerographic medium which was prepared by utilizing as a metallic substrate a cold rolled stainless steel sheet of 50 μ thickness whose surface was cleansed with hot trichloroethylene, anodized in a solution containing phosphoric and sulfuric acids to produce a dull satin finish on the surface, and a layer of selenium having a thickness of 12 μ was then evaporated. Thus, an excellent xerographic element which could be used as a highly flexible xerographic medium was also obtained in this experiment.

EXPERIMENT 3

The same results as in the case of the experiments 1 and 2 were obtained in this experiment which was conducted on a xerographic medium that was prepared by evaporating a layer of selenium, 12 μ in thickness, on a sheet of a beryllium copper alloy as thick as 80 μ used as a metallic substrate, thereby producing a satisfactory xerographic element which could be used as a highly flexible xerographic medium.

However, it has been found out that it is not preferable to evaporate photoconductive material containing arsenic and sulfur onto a beryllium copper sheet, while an evaporated layer of arsenic triselenide completely detatched in a few days. The cause in this case was believed to be due to the existence of reactivity between the metallic sheet and the photoconductive material. Under these circumstances, efforts must be made to ascertain the properties of a photoconductive material that will be determined or depend on additives to selenium or the like and to select, as a metallic substrate, a metal having properties that fit those of the photoconductive material.

Summarizing the results of these experiments, it has been shown that a xerographic element possesing the characteristic properties of a xerographic medium required for xerographic apparatus was obtained where a flexible metal was selected as a metal substrate and the thickness of the metallic substrate and of a photoconductive material evaporated on the substrate were made less than 100 μ and 20 μ, respectively. The product retained its required flexibility and there was no stripping or detaching of the photoconductive material from the metallic substrate under the bending test using a mandrel of 16 millimeters in diameter. If especially the thickness of photoconductive material were limited to less than 10 μ, a metallic substrate having a thickness of as thick as several hundred microns would still be usable as a xerographic medium. However, under the conditions where, as in this embodiment, a xerographic medium could be used in the form of a running belt while ensuring the good properties of a xerographic apparatus, it has been discovered that the best xerographic medium for the purpose can be attained if the thickness of a metallic substrate is less than 100 μ, a glassy selenium or similar material is used as a photoconductive material and this photoconductive material is evaporated on the surface of the metallic substrate ranging in thickness from 10 to 15 μ.

Considering the thickness and the properties of a metallic substrate and a photoconductive material, a highly flexible xerographic medium may be obtained without any deterioration of the properties required for a xerographic apparatus.

Though this research and continued experiments on a xerographic element to be used as a flexible xerographic medium, the inventor has discovered that if the metallic substrate is subjected to a preliminary anodizing process in the course of evaporation of the photoconductive material onto the substrate, an oxide film of high adhesive strength is produced. Thus, if the photoconductive material is evaporated on this oxide film taking advantage of its adhesive strength, it ensures good adhesion and consequently there is no occurrence of peeling between the metallic substrate and the photoconductive material in said flexible xerographic element, thereby providing a xerographic medium which is more durable. The inventor has also discovered that a flexible xerographic element which exhibits improved and more stable adhesion may be provided if a proper oxidizing solution is selected for such anodizing treatment.

It is to be noted here that improvement of adhesion between a metallic substrate and a photoconductive material which will be explained hereinafter is applicable not only to the previously described flexible xerographic medium, but also to those rotating drum type xerographic media which have been conventionally in use, with the rotating drum type.

Before proceeding with the description of the feature of the present invention, that is, the improved adhesion between a metallic substrate and a photoconductive material, those methods of bonding a metallic substrate and a photoconductive material together which are currently practiced will be briefly explained.

Presently aluminum or aluminum alloys are most widely used as a metallic substrate. The surface of such metallic substrate is subjected to a mirror finish prior to the evaporation of selenium thereon. However, this mirror finish tends to reduce adhesion of an evaporated film and this tendency conflicts with a property which will ensure good adhesion between a metallic substrate and a photoconductive material. Therefore, the usual practice has been to cut the mirror finished surface with a diamond cutter to offer a very minute irregulalities on the surface to improve adhesion between the surface and the photoconductive material. This method has involved disadvantages wherein adhesion between the metallic substrate and the photoconductive material is unsatisfactory, despite the attempt to improve the adhession by means of cutting, the cutting on the surface of the metallic substrate further causing the detachment of the photoconductive material so that the xerographic medium must be handled with the utmost care, otherwise the surface will be easily damaged and such detaching may easily occur by vibration or shock, or even by slight mistakes at the time of mounting the xerographic medium or at the time of paper feeding during the toner transfer operation. These drawbacks are due to the inconsistency between the mirror finish and the decreased adhesion of the surface of the metallic substrate as previously described and to the fact that the surface must be cut by means of a diamond cutter to make best use of these incompatible conditions.

The improved adhesion between a metallic substrate and a photoconductive material which is one of the fea-

tures of the present invention requires no mirror finish or cutting by a diamond cutter of the surface as would be the case with the conventional metallic substrates; contrary it is capable of providing a xerograph element having an unprecedentedly good adhesion which is attained by evaporating a photoconductive material on an oxide film of good adhesion that is produced upon the anodic oxidation of a metallic substrate.

The experiments which led to the discovery of a xerographic element exhibiting such good adhesion will be explained hereinafter with reference to FIGS. 3 and 4.

EXPERIMENT 4

An aluminum sheet with a superfinished surface was immersed in a 10 percent solution of phosphoric acid and anodic oxidation was carried out by making the aluminum sheet serve as the anode and a stainless steel sheet serve as the cathode and by applying a voltage of 15 volts for about 10 minutes. As the anodic oxidation proceeded, a marked wetting appeared on the surface of the aluminum sheet as compared to the surface before the anodic oxidation commenced. This wetting is caused by formation a film of oxide. Although the oxide film is light colored in the order of an interference color, it appears so markedly on the surface that the state of wedness may indicate that the surface of the aluminum has been activated and consequently it will provide a means of judging whether the anodic oxidation has been effected. Another means to determine whether anodic oxidation has taken place is to measure the current value in the anodic treatment, which has the same effect. That is, by the time the anodic oxidation is completed, the current will decrease less than one tenth of its initial value. When the completion of anodic oxidation is confirmed by such means, the aluminum sheet is rinsed with water without delay. Such immediate rinsing is desirable because the anodized surface of the aluminum sheet is active and it is thus likely to be easily contaminated. After subsequent drying operation it is preferable to immediately evaporate the photoconductive material such as selenium on the anodized surface. In this test, after rinsing the water drops were removed and the aluminum sheet which was still partially moistened was placed in a vacuum evaporating unit where evaporation was carried out. In this vacuum evaporating chamber 99.99 percent selenium was evaporated on the surface of the aluminum sheet at 2×10^{-5} Torr atmosphere. Observation of the evaporation process revealed that the coloring grew gradually distinct as compared to the initial light coloring and this change in coloring took place quite uniformly all over the surface of the aluminum sheet. There was an extremely marked difference as compared to those which were not subjected to anodic oxidation or surface treatment. This represented that the surface treatment resulted in the uniform adhesion of selenium and in an increased amount of adhesion as well. The evaporated film thus produced exhibited a very high adhesive strength and there was no peeling of the evaporated selenium in a peeling test conducted wherein a test piece was notched by a diamond cutter to produce slots at a space of 2 mm each and tested by an adhesive tape. The adhesive strength exhibited was extremely high as compared to those of the usual aluminum plates not subjected to such surface treatment.

In the test explained above, the rinsing, drying and evaporation were effected continuously in this order. However, this is not an absolutely essential requirement, although such continuous processing is preferable because the activation offered on the surface of the aluminum plate has been found out to last for a considerable period despite the fact that it tends to be easily contaminated.

EXPERIMENT 5

The aluminum plate was subjected to surface treatment in the same manner as in the preceeding experiment. The simple substance or solid solution of arsenic triselenide (As_2Se_3) or arsenic trisulfide (As_2S_3) was evaporated on the metal surface to form a film of less than 20 μ thickness as in the case of experiment 4 and the product thus obtained was subjected to a spalling test wherein there was no detaching of the photoconductive material from the metallic substrate. The photoconductive material easily detached from the metallic substrate which was not subjected to surface treatment, however.

The results of the experiments 4 and 5 have shown that anodic oxidation of an aluminum plate will provide the plate with very good adhesion.

Although the metallic substrate onto which selenium is to be evaporated in the aforesaid experiments and the embodiment, has been explained as confined to aluminum sheet, the same effect may be obtained with aluminum alloys and is thus not limited to aluminum sheet only. However, those aluminum alloys such as high tensile aluminum alloy containing relatively large amount of copper do not show good adhesion and therefore they are not preferable as metallic substrate for evaporating glassy photoconductive materials which are composed of selenium or contain selenium as the main constituent component.

FIG. 3 is a longitudinal sectional elevation showing a xerographic element prepared according to the previously described procedure. In this figure, numeral **14** designates a metallic substrate composed of aluminum or any of the aforesaid aluminum alloys; **15** an oxide film of good adhesion which is produced on the surface of the metallic substrate **14** through anodic oxidation thereof; **16** a photoconductive material evaporated on the surface of the oxide film **15**. This photoconductive material **16** consists of glassy material and may include among others simple substances of Se, As_2Se_3 and As_2S_3; solid solution of Se and As_2S_3, and solid solution of Se and As_2S_3; solid solution of As_2Se_3 and As_2S_3, or solid solution formed by adding solid solution of As_2Se_3 and As_2S_3 to Se. Also included are all those materials which are formed by adding to these glassy simple substances or solid solutions sulfide tellurium or oxide of metals and sulfides.

It is now evident that the oxide film produced by anodic oxidation of aluminum exhibits desirable properties as a base for photoconductive materials. However, since the mechanical strength of aluminum itself is not so high, it is possible to plate aluminum on the surface of any other metal of greater strength and to use it as a substrate where such greater strength may be required for a substrate. FIG. 4 shows by way of an example a metallic substrate composed by plating aluminum or aluminum alloy **17** on the surface of a metal **18** of higher strength such as steel. This composite

metallic substrate is then subjected to anodic oxidation to form an oxide film **15** on the metal surface and then a photoconductive material **16** is evaporated on the surface of the oxide film **15**. In fact, the same effect as in the case of FIG. **3** was attained when an aluminum-plated other metal was utilized.

In summary, the results of the experiments **4** and **5** have shown that anodic oxidation of aluminum produces, according to oxidizing solutions used, various porous oxide films of good adhesion which are called as alumite formed by means of the electrolyte containing sulfaric acid, phosphoric acid or the like. One of the features of the present invention, that is, a xerographic element having good adhesion between its photoconductive material and metallic substrate is attained by evaporation of the photoconductive material such as selenium on the porous active oxide film of good adhesion. The xerographic element thus obtained exhibits a marvellous adhesive strength as previously described. This is attained without any sacrifice of other properties required of a xerographic medium and moreover it has an incidental effect, that is, decreased charge attenuation in the dark decay. In connection with experiments 4 and 5 emphasis has been placed on the improvement of adhesion between a metallic substrate and a photoconductive material which is determined by the nature of an oxide film produced on the metallic substrate. It has also been explained that such oxide film exhibits especially excellent effect when aluminum is used as a metallic substrate employing an electrolyte of the phosphoric acid for anodic oridation. However, this merely means that electrolyte of the phosphoric acid can produced a superior oxide film having good adhesive power and therefore the use of other electrolyte or anodic oxidation will also ensure satisfactory attainment of the objects of the present invention. Although the metallic substrated used in the embodiment has been explained as aluminum, it will also be apparent from the aforementioned experiments that there are several metals other than aluminum that may be used as a metallic substrate. In this case, due consideration must be made to select an electrolyte that fits a metal used. Care must be taken in anodic oxidation of a metallic substrate not to permit excessive anodic oxidation because it debars so-called light attenuation wherein the potential of a xerographic medium, when the medium is subjected to rays of light, does not drop to zero.

As described above, a xerographic element of good adhesion is provided by anodizing an aluminum sheet and then evaporating a photoconductive material on an oxide film thus produced. This xerographic element of good adhesion, when coupled with a flexible xerographic element according to the experiments **1** to **3**, provides a highly flexible xerographic element which exhibits good adhesion.

It should be noted, however, that the contribution of this improved adhesion is not limited to such flexible xerographic element, but it is well suited for use with a rotating drum type xerographic medium such as in current use with the rotating drum type. A rotating drum type xerographic apparatus incorporating a rotating drum type xerographic medium will be explained hereinafter in conjunction with FIG. **2**.

In FIG. **2**, numeral **20** designates a rotating drum type xerographic medium composed of a xerographic element prepared according to the procedures of the experiments **4** and **5** as shown in FIG. **3** and FIG. **4**. The xerographic medium **20** rotates in the direction of the arrow. The medium is electrically charged uniformly over the surface thereof by an electrifier **21** and then information **24** illuminated by an illuminator **23** is exposed on the charged surface of the xerographic medium **20** through a lens system **22** to offer on the charged surface a latent image corresponding to the information. Numeral **25** designates a developing device of the same construction as the device of FIG. **1** so that the latent image is developed into a visible image according to the same cascade developing method as in the case of FIG. **1**. This visible image comes into contact with a paper adapted to contact the surface of the xerographic medium **20** when the paper is advanced by means of a paper feed roll **26**, a paper feed guide **27** and another paper feed roll **28** which are disposed at the back of the developing device **25**. Numeral **30** designates a transfer electrifier adapted to charge when the paper **29** contacts the visible image to transfer it to the paper **29**. After the transfer of the visible image to the paper **29** by the transfer electrifier **30**, the paper **29** is stripped from the xerographic medium **20** to be received by a paper container **32** through a paper feed belt **31**. Numeral **33** designates an electrifier which provides charge required to remove the residual charge on the surface of the xerographic medium **20** as explained in connection with FIG. **1**, and numeral **34** designates a cleaning web.

The present invention, as described above, provides means for ensuring good adhesion between a base metal and a photoconductive material and means for furnishing thus bonded metallic substrate and photoconductive material with the required flexibility. The present invention further provides a xerographic element that combines simultaneously both means for improving adhesion and for furnishing flexibility to thereby provide a novel and highly flexible xerographic medium. The provision of this highly flexible xerographic medium makes it possible to further provide a xerographic apparatus of wide application wherein a plane exposure and others may be effected.

The features of a xerographic apparatus according to the present invention will be summarized as follows:

1. A highly flexible xerographic element may be provided, if the thickness of a metallic substrate and a photoconductive material which constitute a xerographic medium is duly considered together with their respective properties.
2. In particular, a xerographic element will attain a good effect wherein a metallic substrate has a thickness of less than 100 μ, a glassy photoconductive material is used for evaporation onto the surface of the metallic substrate, and the thickness of the photoconductive material ranges from 10 to 15 μ.
3. A xerographic element having good adhesion between a metallic substrate and a photoconductive material may be provided, if, prior to the evaporation of the photoconductive material on the metallic substrate, the base metal is subjected to anodic oxidation to produce a porous film of oxide on the metal surface and the photoconductive material is evaporated on the

surface of this oxide film by virtue of the film's adhesive property.

4. When aluminum or a low-copper-content aluminum alloy is used as a metallic substrate, its oxide film may provide a xerographic element having a more improved adhesion.

5. A similar xerographic element may be provided with any other metal, provided that said metal is plated with aluminum used as the metallic substrate or the aforesaid aluminum alloy.

6. When aluminum or said aluminum alloy is employed as a metallic substrate, the use of an oxidizing solution of the phosphoric acid group may provide a xerographic element exhibiting further improved adhesion.

7. When any metal other than aluminum or aluminum alloys is used as a metallic substrate, the selection of an oxidizing solution suitable for this particular metal may produce an oxide film of good adhesion, thereby permitting the provision of a xerographic element exhibiting good adhesion.

8. By combining both said means for furnishing flexibility and good adhesive power, a xerographic element may be provided which combines all the features of both said means.

9. A xerographic element possessing especially good adhesion may be provided, if aluminum, an aluminum alloy, or any other metal on which is applied said aluminum or an aluminum alloy is used as a metallic substrate and subjected to anodic oxidation employing an oxidizing solution of the phosphoric acid group, and on the surface of an oxide film thus produced is evaporated any simple substance of Se, As_2Se_3 or As_2S_3, a solid solution of Se and As_2Se_3 or of Se and As_2S_3, a solid solution formed by adding Se to the solid solution of As_2Se_3 and As_2S_3, a solid solution of Se and Te or any of said solid solution in which part of S or As component is substituted by Te.

10. The improved adhesion between a metallic substrate and a photoconductive material attained by means of anodic oxidation may be applied to any rotating drum type xerographic medium and may also contribute to improved adhesion in other types of xerographic media.

11. The development of xerographic element possessing high flexibility and adhesion makes it possible to suitably arrange and construct th configuration of a xerographic medium and thus a xerographic apparatus of wide application may be provided.

12. In the said xerographic apparatus, a highly durable xerographic medium may be readily provided wherein it takes the form of an endless belt and a plane exposure with the highest resolution is realizable.

13. A recorded image with remarkably good resolution may be provided, particularly in the recording system employing a cathode-ray tube display.

It should be noted that the above description is concerned with only a portion of the embodiment of the present invention and therefore it is not intended in any way to limit the scope of the invention. It is also self-evident that many modifications and adaptations may be made within the scope of the objects of the invention and the claims.

I claim:

1. A xerographic apparatus comprising a xerographic medium including a metallic substrate and a layer of photoconductive material deposited on the metallic substrate, said layer being adapted to be charged uniformly with electrostatic charges, electrifying means for charging the surface of said photoconductive layer uniformly with electrostatic charges, means for applying optical information to said photoconductive layer to form a latent image corresponding to said information, developing means to develop said latent image, and means for transferring the information thus developed to a recording medium, characterized in that said metallic substrate is made of a material selected from the group consisting of aluminum and alloys of aluminum, and a means for preventing obstruction of the electrical conductivity of said photoconductive layer when said photoconductive layer absorbs light radiation comprising a very thin anodized oxide porous film formed on the surface of said metallic substrate between said metallic substrate and said photoconductive layer to thereby improve the adhesiveness therebetween.

2. A xerographic apparatus according to claim 1, wherein said metallic substrate of the xerographic medium is constructed in the shape of a rotating drum.

3. A xerographic apparatus according to claim 1, wherein said metallic substrate of the xerographic medium is constructed in the shape of an endless belt.

4. A xerographic apparatus according to claim 1, wherein said photoconductive material comprising a material selected from the group consisting of a unit substance Se, As_2Se_3, and As_2S_3, and a compound of at least two of Se, As_2Se_3 and As_2S_3.

5. A xerographic apparatus according to claim 3 wherein said metallic substrate has a thickness ranging from 50 to 100 μ and said photoconductive material has a thickness ranging from 5 to 20 μ.

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