Oct. 17, 1961 R. W. GUNDLACH 3,004,860

# INDUCTION POWDER TRANSFER

Filed April 24, 1957 2 Sheets-Sheet 1

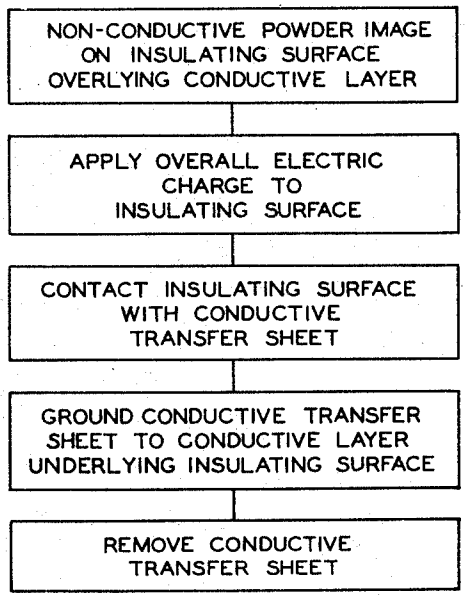



FIG. 1

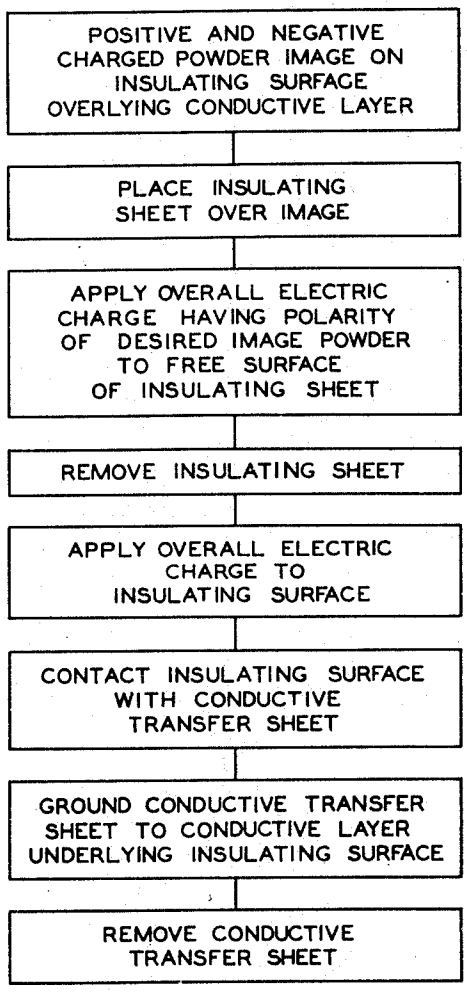



FIG. 2

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INDUCTION POWDER TRANSFER

Filed April 24, 1957 2 Sheets-Sheet 2

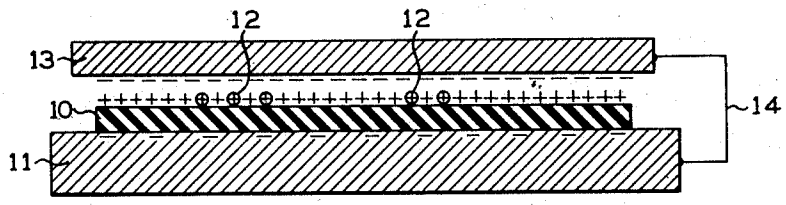



FIG. 3

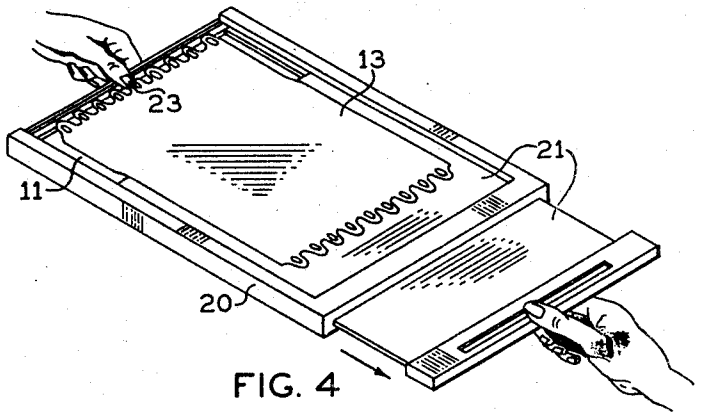



FIG. 4

INVENTOR.
Robert W. Gundlach

BY

United States Patent Office 3,004,860 Patented Oct. 17, 1961



3,004,860

# INDUCTION POWDER TRANSFER

Robert W. Gundlach, Spencerport, N.Y., assignor to Xerox Corporation, a corporation of New York

Filed Apr. 24, 1957, Ser. No. 654,950
6 Claims. (Cl. 117—17.5)

This invention relates to xerography and, more particularly, to the transfer of powder images from insulating to metal surfaces.

In the art of xerography as disclosed for example, in Carlson, U.S. Patent 2,297,691, it is customary to form a powder image on a photoconductive insulating layer backed by a conductive member by electrostatically charging the photoconductive insulating surface, selectively dissipating the charge thereon through exposure to a pattern of light and shadow, and then selectively depositing charged powder particles on the surface in accordance with the amount of charge remaining. This powder pattern may be examined on the photoconductive surface or it may be transferred to an insulating member such as a sheet of paper by the electrostatic transfer method shown in Schaffert 2,576,047 and Mayo et al. 2,626,865 or it may be transferred to an adhesively coated surface. The xerographic process, including the above electrostatic transfer method has achieved widespread commercial success because, among other things, it is an economical and convenient method of copying documents and because powder images may be transferred to specially prepared sheets of paper and serve as lithographic printing plates. Other procedures are also known for producing powder images on insulating surfaces which do not necessarily have photoconductive properties. Methods are known, for example, whereby an undeveloped electrostatic image pattern may be transferred to a nonphotoconductive insulator and be developed thereon. Furthermore, powder images may be formed on a plain insulating surface by selectively charging certain areas by corona discharge from adjacent conductive elements followed by powder development to form an image. As a final example a conductive surface may be coated with a pattern of insulating material as by applying an insulating lacquer. If such a plate is electrostatically charged, only the insulating areas will retain the charge and these may be developed with charged powder particles.

Whatever the method of forming the powder image on an insulating surface, the above electrostatic method is only suitable for transferring the powder image to an insulating surface. In carrying out electrostatic transfer, a piece of insulating material such as a sheet of paper is placed in contact with the powder image and an electrostatic charge of polarity opposite that of the powder is placed on the side of the sheet of paper opposite the powder. Upon removal of the paper the bulk of the powder image is found to be electrostatically affixed to the paper. Attempts to substitute a conductor such as a thin sheet of metal for the sheet of paper have always resulted in a failure to transfer the image. The metal sheet has only to become grounded at a single point in order to lose all of the charge which is required to effect transfer and such grounding is virtually inevitable because the insulating layers used for image formation in xerography and allied processes are in the form of relatively thin coatings on a conductive backing and contain a number of pinholes or other small conductive imperfections. Not only does grounding at a point electrically discharge the metal sheet, but it also causes a destructive arc at the point of grounding which further damages the insulating layer. It is obvious that the metal sheet may be conductively connected to a source of electric potential rather than electrostatically charged, but this merely multiplies the



amount of current which can flow through imperfections in the insulating layer together with the consequent damage at these points without in any way making powder transfer possible. This inability to transfer powder images to metal or other conductive surfaces has been a serious limitation in the use of xerography and allied processes. There has long been a need for a xerographic method of preparing metal rather than paper lithographic printing plates. This requires simply the transfer of a powder image to a metal sheet which has been treated so as to have a water-receptive surface. A method of transferring a powder image to a metal surface has also been needed for printed circuits and related arts which involve the application of a resist material to metal surfaces.

The need for such a transfer process has fathered extensive research aimed at its discovery. An early result of such research was in Copley Patent 2,637,651 which discloses a method of transferring a powder image electrostatically from an insulating surface to a sheet of paper or the like and then as a second operation electrostatically transferring the powder image from the paper to a metal surface. Although this method is capable of producing acceptable results, it has not been commercially accepted because of the additional complications involved in transferring twice instead of once, because two successive registration steps are required, and because the resulting image is mirror-reversed from its usual form. Another approach to the problem is represented by the copending Walkup patent application, Serial No. 411,747, "Transfer and Fixing Apparatus," wherein the image receiving metal sheet is rolled across the image bearing surface in line contact and the powder image is simultaneously treated with a solvent vapor whereby it becomes tacky and adheres to the metal surface. This process requires relatively complex apparatus and critical controls which make it unsuited for general use and, additionally, requires that either the conductive or insulating surfaces be quite flexible to permit the required rolling contact. The copending Matthews et al. patent application, Serial No. 491,344, "Method and Apparatus for Transferring Images to Metallic Plates," likewise involves a rolling line contact between the two surfaces but transfer is effected by an electric field maintained between the conductive surface and the conductive backing of the insulating material. Here a conductive pinhole in the insulating material will ground the conductive sheet only for the short time in which it is in contact with the pinhole. While this is an improvement over the ordinary electrostatic transfer method, more complex apparatus is required and pinholes or other conductive defects in the insulating material are still associated with the failure of an entire line of the image to transfer. The copending Hecksher patent application, Ser. No. 491,343, "Method and Apparatus for Transferring Images From Xerographic to Metallic Plates," is an improvement on the above Matthews et al. application in which the electrostatic transfer forces are supplemented by heating the powder image to make it tacky and more likely to adhere to the metal or conductive surface.

I have now discovered method and apparatus for transferring a powder image from an insulating to a conductive surface which are at once far simpler and more effective than any known heretofore. The invention will be described in more detail with reference to the figures, in which:

FIGURE 1 is a flow sheet illustrating the method of my invention;

FIGURE 2 is a flow sheet showing a modified method according to my invention;

FIGURE 3 is a schematic cross-section of an image bearing surface in virtual contact with an image receiving surface;

FIGURE 4 is a perspective view showing a practical procedure for carrying out part of the invention.

Referring now to FIGURE 1, it is seen that the starting point for the transfer procedure is an insulating powder image on an insulating surface. Methods of obtaining such images lie outside the present inventive concept but will be discussed later on. For the present it will suffice to point out that the insulating surface generally comprises a coating, layer, or web of insulating material which is permanently or temporarily affixed to a conductive support. As is shown, the next step consists in applying an electrostatic charge to the entire area of insulating surface from which it is desired to transfer the powder. The metal or other conductive surface which is to receive the powder image is next placed in virtual contact with the insulating image bearing surface. The conductive image receiving surface is then electrically connected to the conductive support to which the insulating layer is affixed. Since the conductive support is commonly, though not necessarily, at ground potential this operation is referred to as grounding in the figure. Grounding need not be performed as a separate operation, subsequent to contacting the two surfaces, but must take place before separation of the surfaces and must continue during the act of separation to prevent sparking. In many cases grounding will take place simultaneously with the contacting of the two surfaces and in other cases the nature of the apparatus used may be such that the conductive image receiving surface is electrically connected with the conductive support member from some time before contact is made until after the two surfaces are separated. The final step in the method according to FIGURE 1 consists in removing the conductive sheet from the insulating surface whereupon it is found that the bulk of the powder image now resides in the conductive surface.

It was found that the above process sometimes resulted in transferred images with quality noticeably inferior to that obtained by the prior art transfer to paper or the like. The common but not sole method of forming a powder image on an insulating surface involves first forming an electrostatic charge pattern on the insulating surface and then causing electrostatically charged powder particles to adhere to the charge-bearing areas of the surface. It is obviously desirable to employ in this developing process only such powder particles as have the correct polarity of charge to cause them to adhere to the desired parts of the electrostatic image pattern, but in practice a certain number of particles of the wrong charge polarity are also present and deposit in undesired areas, generally immediately adjacent to the desired powder deposits. The prior electrostatic transfer process will transfer only those powder particles having the desired polarity of charge, but it was found that when transferring to conductive surfaces with the method of FIGURE 1 substantially all powder was transferred regardless of charge polarity and with consequent image degradation. The modified method shown in FIGURE 2 permits transfer to conductive surfaces with quality equal to or better than that obtained on insulating surfaces with prior electrostatic transfer methods. Again the starting point is a powder image on an insulating surface, powder particles being charged to both a desired and undesired polarity. Next a sheet of insulating material such as an ordinary sheet of paper is placed over the insulating surface bearing the powder image and an electrostatic charge is applied to the exposed surface of the paper or other insulating sheet. The charge applied should have the same polarity as the powder constituting the desired part of the image. The paper is then removed carrying away the undesirably charged powder pattern only. Generally speaking, this first transferred image, appearing as a weak negative of the desired image, is of no practical value and is discarded. From this point on, the same process steps are used here as were shown in connection with FIGURE 1, thereby transferring the remaining powder on the insulating surface to a desired conductive surface.

FIGURE 3 is a schematic cross section of an insulating image bearing surface and adjacent conductive surface at the point where transfer is about to take place. This figure represents the presently accepted theory underlying the present invention and is for the purpose of illustration rather than limitation, since the present invention is effective irrespective of the validity of the theory. In the figure, **10** represents a layer of insulating material on conductive backing member **11** and bearing on its other surface image powder particles **12**. For the purposes of this figure, layer **10** may be either a true insulator or a photoconductive insulator; **13** is the conductive sheet which is to receive the powder particles **12** and **14** is a wire or other conductive connection between image receiving layer **13** and conductive backing **11**. A uniform positive charge is shown on the surface of layer **10** and powder particles **12** are likewise positively charged as a result of the charging operation shown in the previous figures. The positive charge polarity shown is arbitrary and all the charges shown in the figure could be reversed in polarity without detracting from the effectiveness of the transfer procedure. It is believed that as a result of applying the electrostatic charge to the surface of layer **10**, a substantially uniform charge results as shown regardless of prior electric charges which may have been on the surface of the layer or on the powder particles **12**. The negative charges shown at the interface between layers **10** and **11** and on the surface of layer **13** are induced charges due to the presence of a positive charge on layer **10**. Connection **14** or an equivalent connection between layer **13** and some point at a potential substantially that of conductive backing **11** is required to provide the charges on layer **13**. It can be seen that there is a uniform electric field existing between the facing surfaces of layers **10** and **13** acting in such a direction as to attract the powder particles **12** from layer **10** towards layer **13**. At a sufficiently small spacing between the layers this force overcomes the attractive force between the charged powder particles and the induced charges at the junction of layer **10** with its conductive backing member **11**, and the powder particles jump over to layer **13**. If this layer **10** is a photoconductive insulator rather than a conventional insulator, it must be kept in darkness, or at least away from active radiation, from the time the illustrated charges are placed on its surface until transfer is effected in order to prevent the charges from leaking away due to light induced conductivity of layer **10**.

FIGURE 4 is a perspective view of one way in which the transfer operation may be carried out with commercially available supplies without resorting to a dark room. **20** represent a xerographic plate holder containing a xerographic plate and a dark slide **21** which protects the underlying plate from light. The plate holder structure is shown in greater detail in Mayo Patent 2,619,418. The plate itself, comprises a sheet of aluminum, part of one side of which is coated with a vacuum deposited vitreous selenium photoconductive insulating layer. **11** represents the aluminum plate member which corresponds in function to the conductive support **11** of the preceding figure. The selenium coating is obscured by the overlying metal lithographic master **13**. A powder image may be formed on the selenium coating by conventional xerographic techniques which will be elaborated upon later. A uniform charge is then placed on the selenium. Dark slide **21** is inserted in plate holder **20** and the final transfer operation may be carried out in normal light as shown in this figure. The additional processing steps described in connection with FIGURE 2 may also be performed before arriving at the point shown in the present figure. The lithographic master **13**, which corresponds to the conductive sheet **13** of FIGURE 3, is laid in position on

dark slide **21** as shown and is securely positioned with respect to plate holder **20** through pressure applied by the operator's thumb **23**. Dark slide **21** is then withdrawn by the operator's other hand allowing the lithographic master **13** to progressively fall into contact with the selenium coating without permitting any substantial amount of light to get at the selenium before it is covered by the metal lithographic master **13**. Contact of the master **13** with the exposed areas of the aluminum support plate **11** provides the necessary electrical connection corresponding to connection **14** in FIGURE 3. The lithographic master **13** may then be lifted off whereupon the powder image is found adhering to it rather than to the selenium.

Powder images suitable for the working of this invention may be prepared in a number of ways. Perhaps the most common one is that disclosed in Carlson Patent 2,297,691 wherein a photoconductive insulator on a conductive backing is electrostatically charged. The charge is selectively dissipated through exposure to a pattern of light and shadow or other activating radiation and the remaining charge pattern, known as an electrostatic latent image, attracts suitably charged powder particles to itself. Suitable photoconductive insulators include vitreous selenium, anthracene, sulfur and other vitreous materials on a conductive supporting layer of aluminum, brass, or other metals, on glass bearing a conductive tin oxide coating, metalized paper or other rigid or flexible conductive or conductively coated materials. Another class of photoconductive insulator comprises dispersions of photoconductive pigments such as zinc oxide, lead oxide, mercuric sulfide and others in an insulating binder such as silicone resin or polymethyl methacrylate with a sensitizing dye being added in some cases. Such dispersions may be applied to any of the previously mentioned supports or may also be coated on a paper web which can be made conductive through moistening. The initial electrostatic charging of the photoconductive surface can be accomplished through triboelectrification as shown in the Carlson patent cited above, by maintaining the photoconductive surface in an electric field in the presence of radioactive material as shown in Carlson Patent 2,701,764, by passing a pliable semiconductive electrode at high potential over the photoconductive insulating surface, or by passing a high voltage corona discharge electrode past the photoconductor using methods and apparatus such as those shown in Walkup Patent 2,777,957 and Mayo Patent 2,778,946. Corona charging is a preferred method and the same apparatus and techniques used to charge the photoconductive insulating surface for image formation can also be used to recharge the surface for image transfer. It is generally desired to have a uniform charge distribution for image formation and a reasonably uniform charge distribution for transfer and the devices of Walkup and Mayo above are well suited to this purpose. Exposure of the charged photoconductive insulating surface to a pattern of light and shadow, as in a camera or a photographic enlarger, or exposure to patterns of other activating radiations such as ultraviolet or X-ray causes localized photoconductivity and selective dissipation of the previously uniform charge pattern resulting in an electrostatic latent image capable of being developed with powder particles. Image development can be accomplished by passing over the photoconductive surface a mixture of finely divided particles known as toner together with larger particles called carrier, the two components having a suitable triboelectric relation. Suitable methods, materials and apparatus are disclosed in Sabel et al. 2,600,580, Walkup 2,618,551, Wise 2,618,552, and Gundlach 2,777,418, Walkup 2,638,416, Copley 2,659,670 and Landrigan 2,753,308. By suitable choice of materials, the toner can be made to have either electrical polarity and thereby develop either those areas of the photoconductive insulating surface retaining the greatest charge, known as positive-to-positive development, or those areas retaining the least charge, known as reversal development. Either positive-to-positive or powder images may be successfully transferred to conductive surfaces by the present invention. Development may also be accomplished by immersion in a suspension of powder particles in a highly insulating liquid, or by contact with a gaseous dispersion of the powder particles, or even with a gaseous dispersion of liquid droplets provided that these are capable of drying to powder particles.

Photoconductive insulators used for electrostatic image forming must have sufficient dark resistivity to retain an applied charge long enough to permit exposure and development, which corresponds to a volume resistivity of $10^{13}$ ohm-cm. or better. Generally, this order of resistivity is achieved only with one polarity of charging. Thus, for example, vitreous selenium is generally, though not always, charged positively whereas zinc oxide dispersions, for example, are generally although not exclusively, charged negatively. For image transfer purposes also the photoconductor must retain charge for a reasonable period of time so the same minimum resistivity of about $10^{13}$ ohm-cm. applies and charging for transfer is generally of the same electrical polarity as charging for image formation unless the photoconductor is an adequately good insulator in the dark for either charge polarity. Where the latter condition prevails or a true insulator rather than a photoconductive insulator is employed for image formation, transfer may be effected with equal facility by either polarity of charge.

The toner particles likewise must be capable of retaining a charge for a reasonable length of time when in contact with the photoconductive surface and without losing their charge to the photoconductor. Thus, toners suitable for use in the present invention must also have a resistivity of at least about $10^{13}$ ohm-cm. The toners described in the Copley and Landrigan patents cited above fulfill this requirement as do many other finely divided resinous materials. Generally speaking, toner particles are less than about 10 microns in diameter in order that a developed image may have high resolution and a pleasing appearance and this particle size range is satisfactory for carrying out the present transfer process. The above electrostatic image forming processes may also be mechanized as, for example, disclosed in Crumrine et al. 2,781,705. Methods are also known for the production of powder developable electrostatic charge patterns on conventional insulating material without photoconductive properties. For example, electrostatic charge patterns may be transferred by appropriate techniques from a photoconductive insulating surface to an adjacent insulating surface, upon which they may be developed. Electrostatic charge patterns may also be placed on an insulator by applying appropriately timed and controlled electric pulses to adjacent conductive electrodes of suitable shape. Schaffert 2,576,047 cited above also discloses a method known as xeroprinting in which an insulating pattern is applied to a conductive material, electrostatically charged by corona or other means and developed with powder particles. In all cases the insulating materials employed must be able to retain an electrostatic surface charge for a reasonable length of time so as to permit both image development and image transfer to take place, which implies a necessary resistivity of about $10^{13}$ ohms cm. or greater. While the present transfer method has been described in connection with electrostatically derived powder images, it will be understood that the method is equally suitable for transferring powder patterns prepared by other means as well from insulating to conductive surfaces and may be employed for the transfer of uniform powder layers as well as nonuniform powder patterns in image configuration. It may also be used to transfer materials other than powders, such as insulating foils, provided they are light, insulating, and releasable from the insulating surface.

My invention is particularly adapted to the preparation of metal lithographic masters. Thus, a powder image may be formed on a photoconductive insulating surface such as selenium by conventional techniques and then transferred to a metal lithographic plate by the methods of FIGURE 1 or FIGURE 2 and optionally employing the procedure shown in FIGURE 3 which obviates the need for a darkroom. Metal lithographic plates are standard commercial items comprising a thin flexible metal sheet with a specially prepared water-receptive surface. These include, typically, 6 mil thick chemically grained zinc plates and 3½ to 5 mil thick aluminum plates variously chemically etched, sandblasted, and calender grained to provide water-receptive surfaces as are required in lithographic printing. The aluminum plates as a class are relatively flexible and electrostatic forces are generally sufficient to bring the entire surface of the aluminum into intimate contact with the selenium or other photoconductive or insulating powder image bearing surface. Zinc plates are somewhat stiffer, and air pockets may remain between the zinc and selenium causing incomplete transfer. These may be eliminated by lightly rubbing the back of the zinc plate while it is in contact with the selenium or by drawing a squeegee over it, by passing the zinc and selenium together through a pair of rolls, or by other pressure applying methods. Light pressure may also be used as a precaution with aluminum lithographic plates and is generally useful whenever powder transfer must be effected to relatively stiff conductive surfaces which would not otherwise come into intimate contact with the image bearing surface. Once the powder pattern has been transferred to the lithographic plate it may be permanently bonded thereto by the application of heat as by the apparatus shown in Sabel et al. Patent 2,586,484 or by treatment with a solvent vapor as in Carlson Patent 2,776,907. The powders disclosed in Copley 2,659,670 and Landrigan 2,753,308 cited above are examples of particularly useful types of powders since, being thermoplastic and solvent softenable they are readily bonded to lithographic plates by either heat or solvent vapor and, additionally, have the ink receptivity required for lithographic printing. Heat fusing is preferred over vapor fusing for lithography because of the improved quality of the printed images resulting therefrom. Chemically grained or etched lithographic plates are preferred over other types because they form a more secure bond with the powder particles.

My invention is also particularly suited to the production of printed circuits. For this application a powder pattern in the form of a network of lines is transferred to a copper foil bonded to a laminated plastic insulating board. The powder is subsequently fused to the copper which is then immersed in an etching bath which removes all copper except that protected by the powder, thus leaving a network of copper foil lines on an insulating base. The vapor type of fusing is preferred here because it induces suitable powders to spread slightly over the copper, forming a continuous film impermeable to the etching bath. The powders cited above in connection with lithographic plate making are also suitable here since they are adaptable to vapor fusing and are resistant to a wide variety of chemicals, including those used for etching purposes. They may subsequently be removed by solvents or allowed to remain, since they are also effective soldering fluxes.

My invention, according to FIGURE 1 only, may also be used for transfer under high humidity conditions to such normally insulating materials as paper, which become too conductive to permit electrostatic transfer by the prior art method. The effective conductivity of the paper may be enhanced to facilitate transfer by my method by backing it with a grounded, more conductive material such as a thin metal sheet.

As my invention causes most of the powder to be transferred off the insulating surface, any remaining powder can be cleaned off to permit reuse of the insulating surface. Suitable cleaning methods include washing in an aqueous detergent solution followed by rinsing in water, wiping with a pad of cotton wool and the methods disclosed in Turner et al. 2,751,616 and Insalaco 2,772,991.

The efficiency with which powder is transferred by the present invention from an insulating to a conductive surface varies directly with the electrostatic charge-induced potential which is applied to the insulating surface prior to transfer. Generally speaking, a useful fraction of the powder is not transferred at potentials less than about 200 volts, depending upon the thickness of the insulating layer, and the completeness of transfer improves as the potential is raised above this value, substantially independently of the polarity of charge employed. Where photoconductive insulating materials are employed the maximum potential for transfer is controlled by the maximum potential which the photoconductor can safely withstand without suffering damage. This is in the order of 600 to 800 volts over a wide range of photoconductor thickness and is the same as the potential generally applied to these materials for electrostatic image formation. Consequently, the same charging apparatus and adjustments as are used for forming images on photoconductive insulators may also used for transferring developed powder images from these materials to conductors. Potentials in this range produce a very satisfactory completeness of transfer and may also be used when transferring from insulating surfaces which are capable of withstanding higher potentials without damage.

Transfer should be effected before much of the charge has drained off the powder or the insulating or photoconductive insulating surface. Where these materials have resistivities as low as $10^{13}$ ohm-cms., it may be necessary to transfer within five seconds after charging. With commercially available materials the time may be as long as thirty minutes or even longer.

While the invention has been described in terms of simple manual operations, it will be understood that it is equally adaptable to mechanized automatic processing equipment. Image formation may, for example, be carried out by continuous automatic machines such as that shown in Crumrine et al. 2,781,705, and sheets of conductive material may be applied to the powder image bearing surface by automatic sheet feeding apparatus or the conductive material may be in the form of a flexible continuous metal web, or a flexible web of metal foil-clad insulating materials. Regardless of the nature of the automatic processing equipment it must include means to charge the insulating surface carrying the powder image prior to the point of transfer and must include means for presenting the conductive material to the image bearing surface at the point of transfer and means to establish a conductive path between the conductive material and the conductive support upon which the image bearing insulating material is applied and may also include additional charging means and means to present insulating material to the image bearing surface.

What is claimed is:

1. The method of transfering a releasable insulating powder image on an insulating surface overlying a conductive support to a conductive surface of a transfer member, comprising electrostatically charging the insulating surface together with the image thereon to a potential greater than about 200 volts and less than the breakdown potential of the insulating surface, contacting the insulating surface with the conductive surface, separating the conductive surface from the insulating surface and bringing the conductive surface to substantially the potential of the conductive support for a time extending at least from before until after separation of the surfaces.

2. The method of transferring a releasable insulating powder image on an insulating surface overlying a con-

ductive support to a conductive surface comprising electrostatically charging the insulating surface together with the powder thereon to a potential greater than about 200 volts and less than the breakdown potential of the insulating surface, contacting the insulating surface with the conductive surface of a transfer member, establishing a conductive path between the conductive surface and the conductive support, and removing the transfer member.

3. In a method of transferring one desired polarity of a positively and negatively charged insulating powder image on an insulating surface overlying a conductive support to a conductive surface of a transfer member including contacting the insulating surface with a sheet of insulating material, applying an electrostatic charge of the desired image polarity to the exposed surface of the sheet of insulating material, and removing the insulating sheet with the powder image of undesired polarity thereon, the improvement comprising thereafter electrostatically charging the insulating surface together with the powder image of desired polarity thereon to a potential greater than about 200 volts and less than the breakdown potential of the insulating surface, contacting the insulating surface with the conductive surface, separating the conductive surface from the insulating surface and bringing the conductive surface to substantially the potential of the conductive support for a time extending at least from before until after separation of the surfaces.

4. In a method of transferring one desired polarity of a positively and negatively charged insulating powder image on an insulating surface overlying a conductive support to a conductive surface of a transfer member including contacting the insulating surface with a sheet of insulating material, applying an electrostatic charge of the desired image polarity to the exposed surface of the sheet of insulating material, and removing the insulating sheet with the powder image of undesired polarity thereon, the improvement comprising thereafter electrostatically charging the insulating surface together with the powder of desired polarity thereon to a potential greater than about 200 volts and less than the breakdown potential of the insulating surface, contacting the insulating surface with the conductive surface, establishing a conductive path between the conductive surface and the conductive support, and removing the transfer member with the desired powder image thereon.

5. The method of transferring a releasable insulating powder image on an insulating surface overlying a conductive support to a conductive surface of a transfer member comprising electrostatically charging the insulating surface together with the powder thereon to a potential between about 200 and about 800 volts, contacting the insulating surface with the conductive surface, establishing a conductive path between the conductive surface and the conductive support, and removing the transfer member.

6. In a method of transferring one desired polarity of a positively and negatively charged insulating powder image on an insulating surface overlying a conductive support to a conductive surface of a transfer member including contacting the insulating surface with a sheet of insulating material, applying an electrostatic charge of the desired image polarity to the exposed surface of the sheet of insulating material and removing the insulating sheet with the powder image of undesired polarity thereon, the improvement comprising thereafter electrostatically charging the insulating surface together with the powder of desired polarity thereon to a potential between about 200 and about 800 volts, contacting the insulating surface with the conductive surface, establishing a conductive path between the conductive surface and the conductive support, and removing the transfer member with the desired powder image thereon.

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