

June 4, 1968

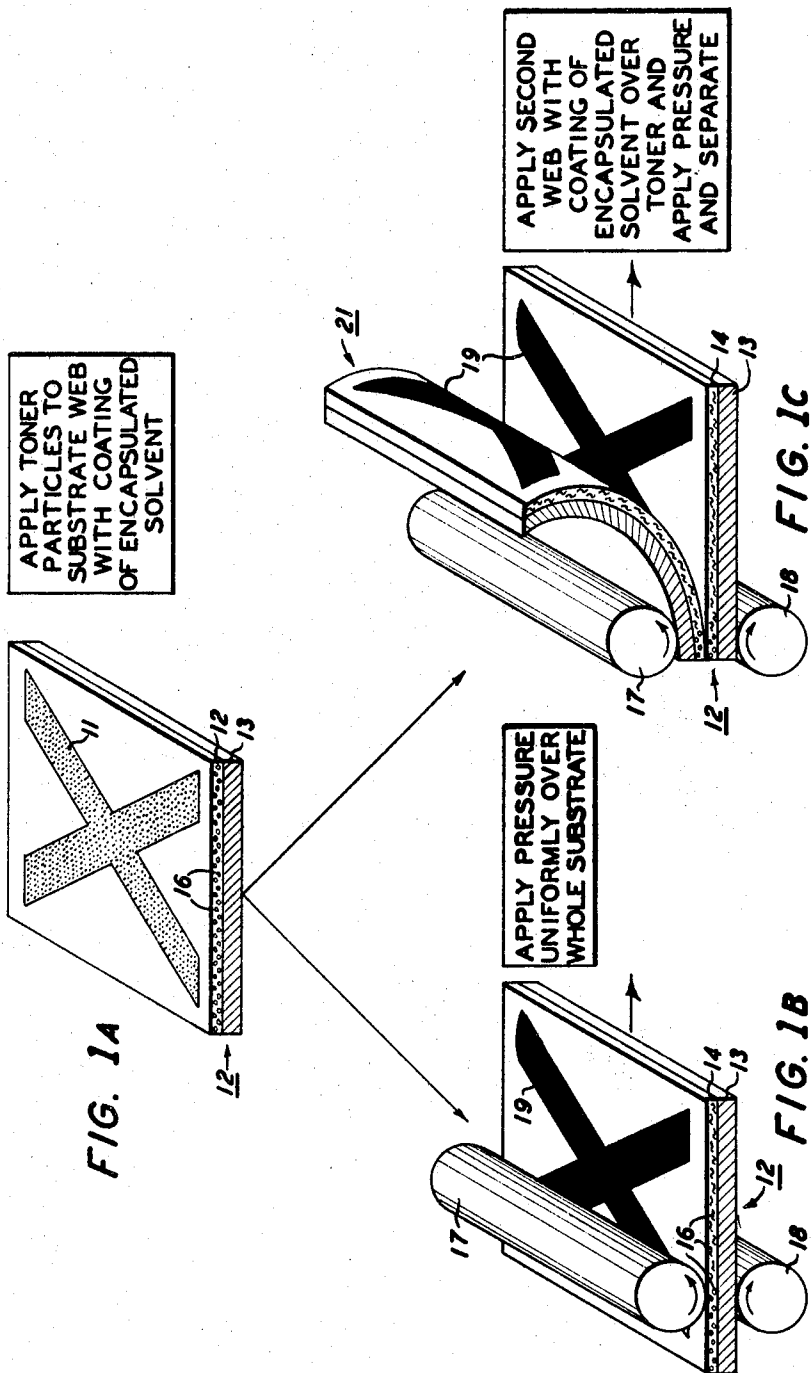
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3,386,822

SOLVENT CAPSULE FIXING OF POWDER IMAGES

Filed Feb. 28, 1964

2 Sheets-Sheet 1



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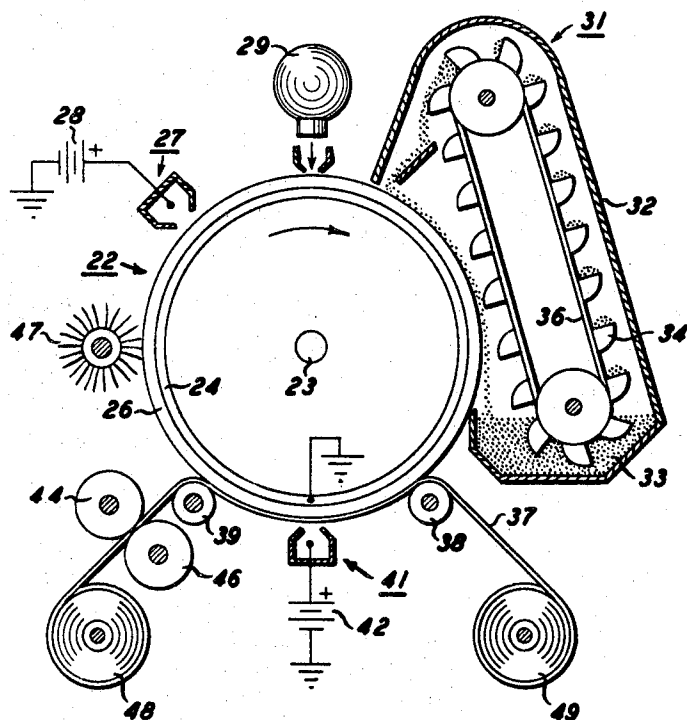


FIG. 2

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3,386,822

SOLVENT CAPSULE FIXING OF
POWDER IMAGES

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ABSTRACT OF THE DISCLOSURE

Permanent images are formed by electrostatically depositing a pattern of electroscopic developing particles on a substrate bearing a uniform coating of capsules containing a liquid which will dissolve, adhere to or react with the electroscopic developing particles and then releasing the liquid in the capsules by applying sufficient pressure over the entire surface of the substrate to rupture the capsules. Optionally, a second substrate bearing a uniform coating of capsules containing a solvent, adhesive or co-reactant may be applied over the deposited toner pattern prior to the capsule rupturing step thereby forming a positive image on one sheet and a negative image on the other sheet.

This invention relates in general to electrostatography and in particular to the formation of fixed images made from powdered developers in electrostatographic imaging systems.

Electrostatography has been defined as encompassing the entire field of forming and utilizing latent electrostatic charge patterns to record or reproduce patterns or images in visible form. This field was pioneered by Chester F. Carlson when he disclosed in U.S. Patent 2,297,691, the basic technique of one major sector of the field known as xerography. In the most commonly practiced form of xerography, a photoconductive insulating layer is first given a uniform electrostatic charge over its entire surface and is then exposed to an image of activating electromagnetic radiation such as light, X-ray or the like which selectively dissipates the charge in illuminated areas of the photoconductive insulator while charge in the non-illuminated areas is retained so as to form a latent electrostatic image. This latent electrostatic image may then be developed or made visible by the deposition thereon of finely divided electroscopic marking material on the surface of the photoconductive insulating layer, as a result of which the marking material conforms to the pattern of the latent electrostatic image. Where the photoconductive insulating material is reusable, this visible image of finely divided or powdered marking material is then transferred to a second surface such as a sheet of paper and fixed in place thereon to form a permanent visible reproduction of the original. Hundreds of additional patents have issued in the field of xerography since the time of the original Carlson patent including many improvements to the basic process and as a result of this development, xerography is today by great margin the largest commercial sector of electrostatography.

The other broad general branch of electrostatography is frequently referred to as electrography and it is considered distinct from the xerographic branch in that it does not employ a photoresponsive medium and an electromagnetic radiation image to form its latent electrostatic image. Electrography encompasses a number of techniques such as xeroprinting and TESI recording. Xeroprinting may be said to be the electrostatic analog of ordinary printing. This process, which is more fully described in U.S. Patent 2,567,047 to Schaffert, employs a xeroprinting plate made up of a pattern of insulating material which is generally on a conductive backing so

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that when the xeroprinting plate is charged as with a corona discharge electrode, an electrostatic charge pattern is retained only on the patterned insulating sections of the plate. This electrostatic image may then be developed with the same developing materials and techniques employed in developing ordinary xerographic images. In TESI recording (an acronym stemming from the phrase "Transfer of ElectroStatic Images") the electrostatic charge patterns conforming to the desired reproductions are formed on a uniform insulating layer by means to an electrical discharge between two or more electrodes on opposite sides of the insulating medium. By controlling the shapes, combinations and numbers of electrodes employed, charge patterns of almost any shape may be formed on the insulating medium. Again, image development is by the same techniques as in xerography. In another system of xeroprinting which is described, for example in U.S. Patent 3,081,698 to Childress, a conductive screen with a plurality of apertures which define the image area to be reproduced is spaced opposite a conductive backing electrode and a potential is applied between this backing electrode and the screen such that when finely divided electrostatographic developing particles, smaller in diameter than the apertures in the screen are applied to the surface of the screen opposite the backing electrode, the electrostatic field set up by the potential source causes the particles to move through the apertures in the screen to form an image of the developing particles on the backing electrode in the configuration of the apertures on the screen. Various surfaces may be interposed between the screen and the backing electrode so that the particle image may be intercepted and formed on these interposed surfaces. Regardless of the surface upon which the toner image is deposited, it may be fixed in place upon that surface or transferred to another surface and fixed thereon.

The common feature of all of these electrostatographic systems is that they employ the lines of force from an electric field to control the deposition of finely divided marking particles, which are known in the art as toner particles, on a surface, thus forming a visible image with the particles.

Although other developing materials and techniques such as the use of liquid developers have been employed in electrostatographic systems, one of the great advantages of these systems is that the latent images may be developed with particulate or powdered developing materials thus eliminating the necessity for handling messy and malodorous liquid developers as is the case with many photographic systems. On the other hand, the advantages of being able to use particulate developing materials have, in the past, been offset to some extent by the requirement that these particulate developing materials be fixed in some manner at the end of the process so as to yield a permanent visible image rather than one in which the powder may be merely brushed away. For the most part, commercial toners are made up of a thermoplastic electroscopic resin blended with a pigment or dye to impart intense coloration to the particles. Images made up of these particles are fixed to the paper or other substrate either by subjecting them to heat or solvent vapors which renders the resin in the toner particles sufficiently soft and viscous so that it wets the substrate and becomes firmly attached thereto even after it is removed from the heat or solvent vapor atmosphere. Heat fixing produces good results and is the most widely used fixing technique because, although, solvent vapor fixing acts most effectively to fix the images it has certain undesirable side effects such as allowing solvent vapor fumes, which may be toxic if solvent concentration in the air is high enough, to escape into the atmosphere in offices or other business establishments where the electrostatographic appa-

ratus is located when it is used according to known techniques. On the other hand, heat fixing, although effective and non-toxic, tends to unduly complicate the electrostatographic reproduction apparatus, especially where fixing and image formation are included in one apparatus such as that disclosed in U.S. Patent 2,945,434 to Eichler because the heat generated by the fixing unit must be removed from the machine so that it does not damage heat sensitive elements in the apparatus such as the amorphous selenium photoconductive plates used in many xerographic devices and the like. Heat fixing also imposes certain limitations on the toner resins employed in developing the electrostatographic images in that the resins employed in manufacturing the toner must have melting points which are low enough to allow easy heat fixing of the images. On the other hand, this requirement conflicts with certain desirable properties of the toner including the one that the toner particles will not agglomerate upon subjection to mild heating encountered with hot summer temperatures and that the resin be tough and able to withstand mechanical handling in the apparatus without breaking up into ultrafine dust particles during handling of the toners within the apparatus.

Accordingly, it is an object of this invention to improve electrostatographic powder imaging.

Another object of this invention is to define a novel method for forming fixed visible images from powdered electrostatographic images.

It is a further object of this invention to define a novel method of electrostatographic powder image fixing in which a controlled amount of solvent for fixing the image is held in small capsules which are coated on a sheet of paper or other substrate to which the powder image is transferred.

An additional object of this invention is to describe a process in which the toner image is sandwiched between two sheets of substrate material bearing encapsulated solvent to simultaneously form a positive image and a mirror image of the original.

A still further object of this invention is to define an electrostatographic technique in which the toner particles include a material which will induce a color change if brought into contact with a liquid encapsulated on the surface of a transfer substrate.

The above and still further objects, features, advantages of the present invention will become apparent upon consideration of the following detailed disclosure of exemplary embodiments of the invention especially when taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a flow chart of the process with pictorial representation of the process steps beside each of the boxes in the flow chart and with the FIGURES 1a and 1b and 1c being used to represent the steps in the process.

FIG. 2 is a side-sectional view of a detailed exemplary apparatus which may be used in carrying out the process of the invention in a xerographic reproduction system.

Referring now to FIGURE 1 it is seen that the first step of the process consists of depositing toner particles 11 on an imaging web 12 in the form of the image to be reproduced. In this case, the image takes the form of the letter X. This deposition of the toner particles 11 on imaging web 12 may be accomplished by employing any one of the electrostatographic imaging techniques described above. Accordingly, the toner image may be formed on a separate surface and transferred to imaging web 12 as described below in connection with the xerographic example of FIGURE 2. In the alternative, the toner image may be formed on the imaging web 12 in the first instance, for example, employing the technique described above in connection with Childress patent or by TESI printing directly on the imaging web 12. This TESI printing technique requires that the imaging web 12 be sufficiently electrically insulating to hold a charge pattern because the technique consists of forming a latent electrostatic charge pattern on the

imaging web by electrical discharge from shaped electrodes and then developing this latent charge pattern with the electroscopic toner particles 11 which are attracted to the charge bearing areas of the web. Imaging web 12 is made up of a supporting substrate layer 13 which may consist of a web or sheet of plastic, paper or the like covered with an overlayer 14 including a great number of minute liquid containing capsules 16. Generally, the choice of materials for the substrate layer 13 is not critical and ordinary office bond paper or other inexpensive materials may be employed. However, where a latent electrostatic image is formed directly on the imaging web 12 and then developed with the toner particles 11, the requirement that the imaging web be capable of holding the charge pattern through the development step may dictate the choice of a highly insulating material such as an alkyd resin, polyethylene terephthalate, polystyrene or some other electrically insulating material or a paper sheet coated with such a material as the substrate. Layer 14 may include a binder to hold capsules 16 together and to hold them in intimate contact with substrate 13; however, in many cases, the material from which the capsule shells are formulated will bind the capsules together and hold them on the substrate 13. In one embodiment of the invention, the capsules 16 include a liquid solvent which is capable of at least partially dissolving and rendering a component of the toner particles tacky. In the alternative the capsules may contain an adhesive liquid which has no actual solvent action on the toner but instead merely causes it to adhere to the underlying substrate. Once the toner image has been deposited upon the imaging web 12 either one of two optional steps depicted in FIGURES 1a and 1b is carried out. Referring now to FIGURE 1b it is seen that this step consists of applying pressure uniformly over the whole substrate with the toner particles 11 thereon and in the exemplary drawing it is seen that this pressure is applied by passing the imaging web 12 between two pressure rollers 17 and 18 so that sufficient pressure is applied to the imaging web to rupture the capsules uniformly throughout layer 14 and release the solvent contained therein over the whole web surface. Capsules 16 are shown as ruptured in FIGURE 1b after having passed between roller 17 and 18. The amount of solvent contained in the capsules is not sufficient to make imaging web 12 feel extremely wet but it is sufficient to dissolve and render viscous the resin of the toner particles causing them to come together in a cohesive mass which wets and adheres to the underlying imaging web 12 as shown at 19 in FIGURE 1b. This fixing technique is unusually effective even with relatively small controlled amounts of solvent in the capsules because the solvent is released at the interface between the imaging web and the toner particles. Therefore, the solvent first softens that side of the toner particles adjacent the imaging web causing it to wet this web almost immediately upon solvent release and does not require diffusion of the solvent through the top side of the toner particles before the particle can wet the underlying imaging web as is the case with all other known solvent fixing techniques. In fact, it has been found with the system of this invention, the amount of solvent required in the capsules is so small that the fixing process may be carried out in an open room and without the benefit of a vapor tight container while still not releasing sufficient solvent to the atmosphere to be even noticeable let alone offensive or toxic to human operators.

FIGURE 1c shows an optional process step which is an alternative to that of FIGURE 1b. This step is essentially the same as the FIGURE 1b step except for the fact that prior to the application of pressure to imaging web 12 by roller 17 and 18 a second imaging web 21 which may be identical in all particulars with imaging web 12 is laid down over the toner particle image with its solvent capsule-coated surface facing imaging web 12. This forms a sandwich made up of the toner particle image between the two imaging webs each with their solvent capsule coated

surface facing the toner particle image. Thus, when this alternative process step is employed in the process, the capsules in both imaging webs 12 and 21 are ruptured when the sandwich is fed between pressure rolls 17 and 18 so that solvent from the ruptured capsules in one of the webs is applied to each side of the toner particles, making the toner particles tacky so that they will tend to adhere to both imaging webs 12 and 21. Following capsule rupture and solvent release imaging webs 12 and 21 are separated and since the solvent softened toner particles tend to adhere to both of these webs, the effect of this separation is to "tear the toner particles in half" so that mirror images are formed on both of the imaging webs 12 and 21. It should be clear at this point that the alternative process step of FIGURE 1c will only be resorted to in special instances where two mirror images of the same subject are required.

With regard to materials employed in the process, the toner particles 11 generally, but not always, include a colorant such as a dye or an organic or inorganic pigment which will be included in amounts of from about 5 to about 20% by weight of the toner depending upon the intensity of its coloration, the coloration of other toner components, etc. In certain other specialized instances, such as for example, where other toner components are intensely colored in their own right or where uncolored toner images are to be employed as the resist in etching processes to form printed circuits or the like the toner may include no color component whatsoever. In those instances according to this invention, where a solvent is included in the capsules the toner will include as one of its components an electroscopic material which is soluble or at least partially soluble in the solvent in the capsules which are contained on coating 14 of the imaging web and which will wet and adhere to the imaging web when subjected to such solvent action. This soluble component of the toner is its major component and will, in most instances, constitute from about 80 to about 95% by weight of the toner, in cases where the toner includes a colorant and approximately 100 percent by weight of the toner where no additional colorant is employed. By way of example, the electroscopic, soluble component of the toner may consist of gum copal, sealing wax, coumarone-idenes, polystyrene, rosin modified phenol-formaldehyde, or plasticized copolymers of methacrylic esters and styrene as described, for example, in U.S. Patents Re. 25,136; 2,297,691; 2,659,670; and 3,079,342 as well as a great number of other natural, modified natural, and synthetic materials. Most of these materials may be classified as resins as that term is understood in its broadest sense. The toner particles will generally range from sub-micron size up to about 50 microns in diameter, for best results, with the particular size selected depending for the most part upon the electrostatographic system in which it is employed. Reference is made to the list of patents immediately above not only for an exemplary list of materials which may be employed in the toners but also for dyes, pigments and other colorants which may be employed in the toners and detailed descriptions of exemplary methods of toner manufacture. Where an adhesive is used in the capsules the toner need not necessarily include a soluble resin component but may instead be made from insoluble thermoset resins, metal powders or the like. There are no critical requirements for the capsule material or the binder employed to hold it to substrate 13 (if one is required) except that the capsule shell be capable of holding the selected solvent or adhesive that the binder be capable of holding the capsules to the substrate 13 and that the material be so selected that the solvent wetted toner will adhere to its surface. It is also preferable for the solvent to be somewhat volatile or if an adhesive is used that it be air hardenable so that the toner image bearing surface will be non-tacky and capable of being handled after fixing. The method of manufacture of this coating of encapsulated solvent is immaterial

to the operation of the invention so long, of course, as it will produce this desired coating. The capsules may be formed, for example, by extruding the solvent core and the shell material through coaxial tubes rotating in the head of a spray drying unit. Additional techniques for forming encapsulated solvents and coating them on paper substrates are disclosed in U.S. patents 2,800,457 and 2,800,458 to Green and 2,969,330 and 2,969,331 to Brynko. The Green patents describe encapsulation of the solvents in a hydrophillic colloid material and generally may be employed to encapsulate any water-non-miscible solvent (which is less than about 1% soluble in water) including, for example, kerosene, xylene, chlorinated diphenyls such as trichlorodiphenyl and the like. The Brynko patent describes encapsulation of these solvents in a cross-linked synthetic polymer such as cross-linked polystyrene and because of this fact, it can retain some solvents which might tend to attack the hydrophillic colloid capsule shell described in the Green patents. Techniques for encapsulating solvent with condensation polymers such as urea formaldehyde resins are also known in the art and may be employed in connection with this invention. Water immiscible adhesives may also be encapsulated by these techniques by merely substituting them for the solvent.

In another embodiment of this invention, the capsules coated on the imaging web contain a colorless liquid which includes a component that is selected so that it will react with a component in the toner particles to form a colored compound. In this instance, then, the capsules need not necessarily contain a solvent or adhesive but may instead, for example, also contain any one of the oily materials listed in U.S. Patent 2,969,330 to Brynko including, for example, olive oil, sperm oil, coconut oil, cottonseed oil or the like. It is also to be noted that in this embodiment of the invention the toner particles employed to form the image need not necessarily contain a soluble resin binder as would be the case with the toners described above. Instead, they need only include a material which will react with a component of the encapsulated liquid on the imaging sheet. There are, however, no differences in the processing steps to be carried out with this embodiment of the invention with the only differences residing in the materials to be employed. Accordingly, then if the process steps of FIGURES 1a and 1b are carried out with the materials of this embodiment, the toner material is laid down by the same imaging techniques described above in connection with FIGURE 1a and the toner bearing imaging web 12 is then subjected to uniform application of pressure as with the pressure roller 17 and 18 described in connection with FIGURE 1b serving to rupture the liquid containing capsules in the imaging web so that the liquid within the capsules comes into contact with the toner particles wherever they reside on the surface of the imaging web. In this way, the liquid from the capsules is allowed to react with the material contained in the toner particles so as to change from the colorless to the colored form thereby forming a colored image on the surface of the imaging web when this colored liquid material dries or is absorbed into the imaging web surface. The choice of color reaction partners for inclusion in the liquid of the capsules and in the toner material is almost unlimited. One proved system comprises including the leuco form of a dye in solution in the oil of the capsule and an acidic solid such as silica gel, alumina, infusorial earth or acid clays in the toner material. Another pair of exemplary color reaction partners which may be employed in this technique include rubeanic acid and an organometallic compound such as nickel acetylacetonate with the rubeanic acid used as the toner material itself or included as a component of the toner material and the nickel compound dissolved in the liquid included in the capsule. When this combination of materials is employed, the rubeanic acid in the toner material complexes with the nickel in the nickel compound to

form an intensely colored image in toner covered areas when the capsules in the imaging sheet are ruptured. This color reaction technique may be employed not only with process step 1b of the invention but also with the alternative step described in FIGURE 1c because obviously, the rubeanic acid in the toner image will complex with the dissolved nickel salt from the capsules in imaging web 21 as well as with those of imaging web 12 when the capsules in both of these webs are broken by the application of pressure.

In FIGURE 2 there is illustrated an exemplary electrostatographic apparatus of the xerographic type employing the concept of this invention. This apparatus consists of a cylindrical xerographic drum 22 mounted for rotation about a horizontal axis 23. The xerographic drum 22 consists of a supporting substrate 24 and a photoconductive insulating layer 26. By way of example, the substrate layer of the xerographic plate may consist of a grounded layer of a conductive metal such as aluminum with a thin surface coating of aluminum oxide. Any one of a number of other conductive materials such as brass, steel, tin oxide or the like may also be used and photoconductive insulating layer 26 may consist of amorphous selenium, alloys of selenium with arsenic or tellurium, sintered or evaporated layers of other photoconductors such as cadmium sulfide, cadmium selenide, etc., or a photoconductive insulating material in particulate form suspended in an insulating film forming binder material such as zinc oxide or cadmium sulfide powder suspended in a silicon resin or the like. Since the particular type of xerographic plate selected for use in the system may require variations in subsequent steps of the electrostatic imaging process, this example will be explained in terms of the use of an amorphous selenium xerographic plate on aluminum oxide coated, aluminum substrate. It is to be noted that although the plate 22 is illustrated in the form of a rigid cylinder, it may take many other shapes including that of a flat plate, a polygon or an ellipse or the like may be flexible as well as rigid. Thus, for example, it may take the form of an endless belt. As the plate 22 rotates in the direction indicated by the arrow, it is first charged so as to sensitize it to light exposure. This is accomplished with a charging unit 27 connected to a source of high positive potential 28. The charging unit 27 contains one or more wire filaments which are connected to the potential source and operate on the corona discharge technique as described, for example, in U.S. Patent 2,588,699 to Carlson and 2,777,957 to Walkup. Essentially, this technique consists of spacing a filament slightly from the surface of a xerographic plate having its conductive base grounded and applying a high potential to the filaments so that a corona discharge occurs between the filament and the plate thereby serving to deposit charged, ionized, air molecules on the plate surface and raising its level of potential with respect to ground. The photoconductive insulating surface of the plate will hold this charge when not exposed to light because in this condition, it has a very high resistivity. Other charging techniques known in the xerographic art such as induction charging as described, for example, in U.S. Patent 2,833,930 to Walkup may also be employed for the purpose of sensitizing the plate. As the cylindrical xerographic plate continues to rotate at a uniform velocity, it passes the charging unit 27 so that uniformly charged portions of the xerographic drum then come beneath a projector 29 or other means for exposing the charged plate to the image to be reproduced with light or other electromagnetic radiation such as X-ray. This exposure step serves to dissipate charge from areas of the xerographic plate which are exposed to light from the image exposure resulting in a residual charge pattern on the plate corresponding to the original image to be reproduced. Subsequent to the formation of this residual charge pattern or latent electrostatic image by the charging and exposure stations of the apparatus, the drum surface moves past a developing unit generally desig-

nated 31. The illustrated developing unit is of the cascade type which includes an outer container or cover 32 with a trough at its bottom containing a supply of developing material 33. The developing material is picked up from the bottom of the container and dumped or cascaded over the drum surface by a number of buckets 34 on an endless driven conveyor belt 36. This development technique which is more fully described in U.S. Patents 2,618,552 to Wise and 2,618,551 to Walkup utilizes a two element developing mixture including toner particles and grossly larger carrier beads. The carrier beads serve both to deagglomerate the toner particles and to charge them by virtue of the rubbing together of the carrier and toner in the apparatus and the relative position of the toner carrier materials in the triboelectric series. In other words, the toner is both carried and triboelectrically charged by the carrier beads. These carrier beads also serve to impart better flow characteristics to the finely divided toner particles owing to the size and weight of the carrier beads. When the carrier beads with toner particles clinging to them are cascaded over the drum surface, the electrostatic field from the residual charge pattern on the drum pulls toner particles off the carrier beads serving to develop this pattern. The carrier beads, along with any toner particles not used to develop the image then fall back into the bottom of container 32. As a general rule, the toner and carrier materials are selected so that the charge triboelectrically imparted to the toner is opposite in polarity to the residual charge pattern on the xerographic plate so that the particles are deposited upon charged areas of the plate, however, in specialized instances, the toner particles are charged to the same polarity as these residual charge pattern on the plate and background areas of the plate bearing no charge pattern are developed. Other developing systems than the cascade system described, may also be employed including, for example, magnetic brush development as described in U.S. Patent 3,015,305 to Hall, skid development as described in U.S. Patent 2,895,847 to Mayo or powder cloud development as described in U.S. Patent 2,918,910 to Carlson may be substituted along with any one of a number of other development techniques known in the art. Once the residual charge pattern on the xerographic plate has been developed with toner particles by the development unit 31, the plate bearing this developed power image moves around until it comes into contact with a copy web 37 which is pressed up against the drum surface by two idle rollers 38 and 39 so that the web moves at the same speed as the periphery of the drum. A transfer unit 41 is placed behind the web and spaced slightly from it between the rollers 38 and 39. This unit is similar in nature to the plate charging mechanism 27, 28 and also operates on the corona discharge principle. The transfer unit is connected to a source of high potential 42 of the same polarity as that employed in the charging unit 27 so that it deposits charge on the back of web 37 which is of the same polarity as the charge on the xerographic plate and is opposite in polarity to the toner particles utilized in developing the plate. As more fully described in U.S. Patent 2,576,047 to Schaffert, the application of this corona discharge to the back of the web serves to transfer the developed toner particle image from the surface of the drum to the web. Other transfer techniques known in the xerographic art may also be employed. Once the toner image has been transferred to web 37 the web is separated from contact with xerographic drum 22 and the drum continues in its rotation passing under a cleaning brush 47 which prepares it for another cycle of operation while the web passes between two pressure rollers 44 and 46 which serve to rupture the capsules coated upon the surface of the web as described above in connection with FIGURE 1, serving to fix the image to the web. With this apparatus then, the toner may include either a soluble component which is at least partially soluble in a solvent included in the capsules coated on web 37 or it may include a compo-

nent which undergoes a color reaction with a colorless liquid included in the capsules coated on web 37. Following fixing of the image by rolls 44 and 46, imaging web 37 may be collected on a take-up roll 48 similar to supply roll 49 from which it originally comes. If a toner is employed which undergoes a color reaction with the liquid included in the solvent capsule coating and the toner particles are not caused to adhere to the surface of web 37, a brush or other mechanism may be supplied to brush toner particles off the surface of the web 37 prior to its being wound on take-up roll 48 but after the web has passed beneath the pressure fixing rolls 44 and 46 so that no residual free powder is left on the web.

The present invention has been described with reference to certain specific embodiments which have been presented in illustration of the invention. It is to be understood, however, that numerous variations of the invention may be made and that it is intended to encompass such variations within the scope and spirit of the invention as described by the following claims.

What is claimed is:

1. The method of forming a fixed image comprising depositing a pattern of electroscopic developing particles corresponding to an image to be reproduced on a surface of a substrate bearing a uniform coating of minute capsules containing a liquid which will adhere said particles to said substrate and then applying pressure over the whole surface of said substrate, said pressure being of sufficient intensity to rupture said capsules so as to release their content to adhere said particles to said substrate.

2. A method according to claim 1 wherein said liquid is at least a partial solvent for at least one component of said developing particle.

3. A method according to claim 1 in which said liquid is an air hardenable adhesive.

4. A method of forming an electrostatic graphic image comprising setting up an electrostatic field pattern, forming a developing particle image by depositing electroscopic developing particles corresponding to said electrostatic field pattern on the surface of a substrate bearing a uniform coating of minute capsules containing a liquid which will adhere said particles to said substrate and then applying pressure over the whole surface of said substrate, said pressure being of sufficient intensity to rupture said capsules so as to release their liquid content to adhere said particles to said substrate.

5. A method according to claim 4 in which said liquid is an air hardenable adhesive.

6. The method according to claim 4 in which said electrostatic field pattern is xerographically formed.

7. A method according to claim 4 in which said liquid is at least a partial solvent for at least one component of said developing particles.

8. A method according to claim 7 including the further step of placing a second substrate bearing a uniform coating of minute capsules containing a liquid which is at least a partial solvent for a major component of said developing particles down on said developing particle image with its capsule coating surface facing said image after transfer of said particle image and then applying uniform pressure over the whole surface of the sandwich formed by said substrates with their capsule coated surfaces facing said particle image, said pressure being of sufficient intensity to rupture said capsules on both of said substrates and then separating said two substrates whereby a portion of said image is caused to adhere to each of said substrates.

9. The method of forming a fixed image comprising depositing a pattern of electroscopic developing particles corresponding to an image to be reproduced on the surface of a substrate bearing a uniform coating of minute capsules containing a liquid which is at least a partial solvent for at least one component of said developing particles and then applying uniform pressure over said substrate, said pressure being of sufficient intensity to rupture said

capsules whereby their liquid contents are released causing softening and permanent adherence of said particles to said substrate.

10. The method of forming an electrostatographic image comprising setting up an electrostatic field pattern, depositing electroscopic developing particles corresponding to said electrostatic field pattern on the surface of a substrate bearing a uniform coating of minute capsules containing a liquid which is at least a partial solvent for at least one component of said developing particles and then applying uniform pressure over said substrate, said pressure being of sufficient intensity to rupture said capsules whereby their liquid contents are released causing softening and permanent adherence of said particles to said substrate.

11. The method of forming an image comprising forming a latent electrostatic image on an insulating surface bearing a uniform coating of minute capsules containing a liquid solvent, depositing finely divided, electroscopic developing particles over said substrate so that they adhere in latent image configuration, said developing particles including as a major component a material which is at least partially soluble in the solvent included in said capsules and which will wet and adhere to said insulating surface when exposed to said solvent and subjecting said insulating surface bearing said capsules to the application of uniform overall pressure of sufficient intensity to rupture said capsules whereby their liquid contents are released so as to fix said particles to said substrate.

12. The method of forming a fixed image comprising forming a latent electrostatic image on a first surface, depositing finely divided, electroscopic developing particles over said first surface so as to form a particle image conforming with said electrostatic image, transferring said particle image to a second surface bearing a uniform coating of a minute capsules containing a liquid solvent which will at least partially dissolve a major component of a material included in said particles and render it tacky, and subjecting said second surface with said particle image thereon to the application of uniform overall pressure of sufficient intensity to rupture said capsules whereby their liquid contents are released on said second surface to fix said particles to said substrate.

13. The method of forming a fixed xerographic image comprising uniformly charging a xerographic plate, exposing said charged xerographic plate to a pattern of actinic, electromagnetic radiation so as to dissipate charge in exposed areas and form a latent electrostatic image, developing said latent electrostatic image with finely divided, electroscopic, developing particles including a resinous component which is rendered tacky upon exposure to a liquid which is at least a partial solvent for it, transferring said particles in image configuration to a substrate bearing a uniform coating of minute capsules containing a liquid which is at least a partial solvent for said major component of said developing particles and then applying uniform pressure over said substrate, said pressure being of sufficient intensity to rupture said capsules whereby their liquid contents are released causing softening and permanent adherence of said particles to said substrate.

14. The method of forming an image comprising forming a latent electrostatic image on an insulating surface bearing a uniform coating of minute capsules containing a liquid which includes a first color reaction partner, depositing finely divided, electroscopic, developing particles over said substrate so that they adhere to said substrate in electrostatic image configuration, said developing particles including at least as a major component a second color reaction partner capable of converting said first color reaction partner to an intensely colored substance when said two color reaction partners are brought into contact with each other and subjecting said insulating surface bearing said capsules with said developing particles thereon to the application of uniform overall pressure of sufficient intensity to rupture said capsules whereby their

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liquid contents are released and are converted to an intensely colored substance in those areas of said substrate upon which said particles reside.

15. The method according to claim 14 further including the step of placing a second insulating surface bearing a uniform coating of minute capsules containing a liquid which includes a color reaction partner for said second color reaction partner in said developing particles on the deposited developing particles prior to application of pressure so that the two insulating surfaces form a sandwich with their capsule coated surfaces facing the intervening deposited developing particles in image configuration.

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