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XEROGRAPHIC WET BELT LOADING

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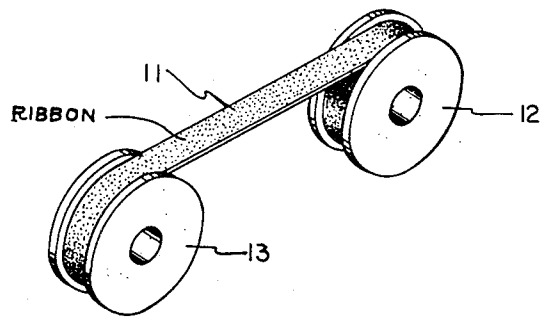


FIG. 1

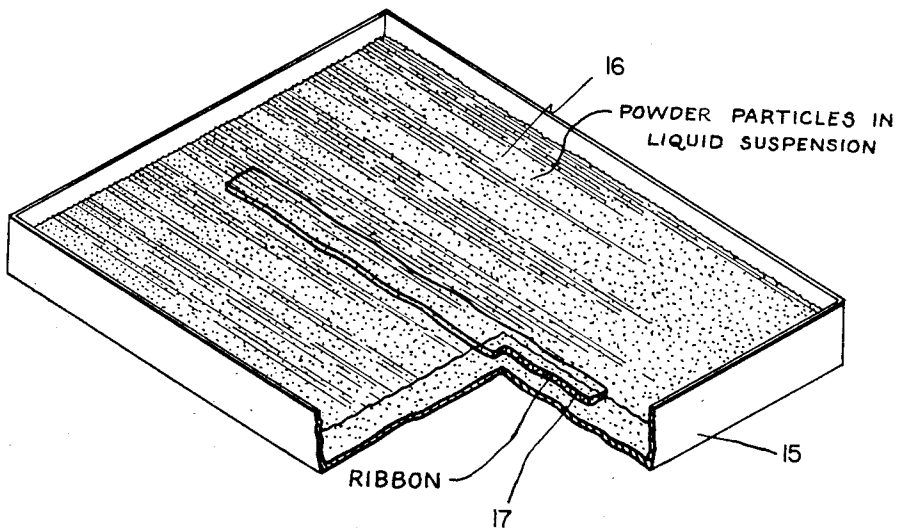


FIG. 2

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XEROGRAPHIC WET BELT LOADING

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This invention relates in general to xerography and in particular to development of electrostatic charge patterns.

Xerography uses the physical phenomena of photoconductivity and electrostatic attraction of electrostatically charged bodies to convert a light image into a physical image consisting of, for instance, black powder on white paper. The xerographic plate may consist of a film of a photoconductive insulating material on a conductive backing member. In use, the plate is generally given an electrostatic surface charge and then exposed to a light image, which results in an electrostatic image on the plate surface. This electrostatic image, which may be allowed to remain on the plate or which may be transferred, is developed by allowing it to attract and collect electrically charged particles of powder. The powder image may then be transferred and fixed to another surface, usually a sheet of paper, and the plate may be cleaned for reuse, or the powder image may be allowed to remain on the plate for photographing, viewing or the like.

Different methods of image development are in use. One form of development is known as powder cloud development and is described, for example, in Carlson U. S. Patent 2,221,776. In this technique for development, a dispersion of powder particles in gas is passed to the surface area bearing the electrical image and properly charged particles are drawn out of the cloud to form a powder deposition in electrical image configuration.

An object in the art of xerography, as in any art concerned with image reproduction, is that of uniformly developing high quality copy. Means of obtaining this objective while using powder cloud development, is through the uniform and constant presentation to the electrostatic charge pattern on a surface of a powder cloud of fine developer powder particles uniformly and densely dispersed throughout.

Powder clouds of dense and uniform dispersion of powder particles may be generated by passing a tape or belt of cloth or the like which has been uniformly loaded with powder articles over an output tube at a uniform rate. Particles are blown from the belt or tape in a controlled gas stream thereby producing a controlled aerosol of uniformly constant and dense dispersion of powder particles. This invention is concerned with the uniform loading of belts, ribbons, tapes and the like with powdered particles.

Thus, it is an object of this invention to devise new means and methods for impregnating or loading tapes, belts, ribbons or the like material with xerographic developer powder particles.

A method which has been used heretofore in the art of xerography to impregnate or load tapes, belts, ribbons or the like with powder particles has involved conveying an aerosol of powder particles to a loading zone through which a tape, ribbon, belt or like material moves at a uniform rate of speed. The aerosol is blown to and through the tape or the like, and particles tend to load in the material, thereby creating impregnated or loaded

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tapes of material. This invention accomplishes loading by immersion of a tape, ribbon, belt or like material into a liquid dispersion of xerographic developer powder particles. The belt is then removed from the dispersion and allowed to dry and is then ready for use in powder cloud belt generators.

The term "dispersion" is used herein in both the specification and claims to include monomolecular dispersions, i. e. solutions, and macromolecular dispersions, i. e. suspensions of developer particles in a suitable liquid.

It is, therefore, an object of this invention to devise new means and methods for impregnating through immersion tapes, ribbons, belts or like material with xerographic developer powder particles.

For a better understanding of this invention, together with other further objects thereof, reference is now had to the following description taken in connection with the accompanying drawings, and the scope of the invention will be pointed out in the appended claims.

Fig. 1 is an isometric view of an embodiment of a belt, ribbon, tape or like material stretched between two spools.

Fig. 2 is a cutaway isometric view of one possible embodiment of this invention showing immersion of a belt, tape, ribbon or like material immersed in a dispersion having xerographic developer powder particles dispersed throughout a liquid.

For a more thorough discussion of this invention, reference is now had to Fig. 1 wherein is shown in detail an embodiment of a belt, ribbon, tape or like material according to this invention. As appears in this figure, a belt 11 of material stretches between spool 12 and spool 13. It is to be realized that the object of this invention is that of loading belts, tapes, ribbons, and the like of material, and there is no intent to limit this invention to belts stretched between spools as shown in this particular figure. When a tape of material or the like has been impregnated or loaded with developer powder particles, it may then be wound on spools to produce a belt similar to the one shown in Fig. 1, or it may be kept in other ways for later use. An impregnated belt on spools as shown in this figure may be used directly in belt powder cloud generator devices simply by inserting the spools in their proper places in the apparatus and operating the equipment. During operation, the belt will move at a uniform rate over an output tube and a constant, steady flow of gas will cause removal of the particles in the belt into a gas stream, thereby creating an aerosol of powder particles. The aerosol may then be conveyed to the development zone for deposition of the powder particles on an electric charge pattern bearing surface. Before deposition, the particles in the aerosol may be charged or deagglomerated, or both, in order to bring about fine grain xerographic development.

Reference is now had to Fig. 2 wherein is shown a tray 15 holding a dispersion of xerographic developer powder particles in a liquid 16. A tape, band, ribbon or belt of material 17 is positioned beneath the surface of the liquid dispersion 16 and therein becomes impregnated, coated or loaded with xerographic developer powder particles.

The liquid dispersion is composed of a liquid in which is dispersed xerographic developer powder particles. The liquid may be any liquid, and is preferably a liquid which will not dissolve and will suspend the xerographic developer powder particles in the dispersion. Although a solvent for the particles will act to bring about a uniform dispersion, the particles when loaded will to some extent be fused to one another and many agglomerates of particles will be present. A non-solvent suspending

agent, on the other hand, will produce a loaded belt composed of individual and deagglomerated particles. Such non-solvent liquids include, but are in no way limited to, fluoro-chloroalkanes available under the general family name of Freon, water, dioxane, trichloroethylene, trichloroethane, dichloroethylene, dichloroethane, and the like. It is to be realized that some of these liquids will act as a solvent for some powders, but not for all, and whether or not the liquid acts as a solvent is, of course, dependent on what the developer is composed of. For example, different types of carbon particles are used in some applications of the art of xerography, and no solvent exists for some of these materials. In such an instance, any liquid which will not affect the belt material detrimentally may be used.

Desirably also, the liquid is a volatile substance. Before being used in powder cloud generators, the impregnated or loaded tape or belt of material must be dried. Drying takes place with greater rapidity when the tape or belt of material has been immersed for loading purposes in a liquid dispersion in which the liquid is volatile. Although it is not intended to limit this invention in any way to the following, they are listed as examples of usable volatile liquids. They are isopropyl alcohol, heptane, sulfur dioxide, acetone, ethanol, methanol, and the like.

Xerographic developer powder particles comprise varying materials, and satisfactory prints or pictures may be produced with belts or tapes loaded or impregnated with the various developer materials. For example, any of a number of various carbon or lamp black materials may be employed, including such materials as furnace blacks, channel blacks, and the like. In addition, there may be used such materials as milled charcoals and similar materials, or, if desired, finely divided materials having added pigment matter. In the latter category are materials such as finely divided resins containing pigments or dyes such as carbonaceous pigments or various coloring pigments, and the like, compositions of this type being preferred where the final print or picture ultimately is to be made permanent by a fusing process including heat or vapor fusing. For highest quality continuous tone xerographic work, the presently preferred material is charcoal. Any and all of these materials which have been found to work well in producing good quality xerographic prints may be used as the xerographic developer powder particles to be held in liquid dispersion to load, through immersion, belts, tapes or like material.

Although in Fig. 2 the tape 17 is shown suspended horizontally in a flat tray within the liquid dispersion held by the tray, it is to be realized that other techniques of immersion and loading may be used and are intended to be encompassed by this invention. The liquid dispersion, for example, may be encased in a container such as a tube or graduate and the tape or belt may be allowed to hang from the top downward into the liquid dispersion, or, using a tray as shown in Fig. 2, the belt or tape of material may be continuously moved through the liquid dispersion, as for example, a roll of photographic film is moved during tray development. It is also possible to impregnate or load tapes or belts of material by simply dipping the belt or tape of material into and out of a proper liquid dispersion.

It has been found through experimentation that leeway exists in this coating operation and that the function of the dipping operation is that of loading or impregnating the tape or belt of material with powder particles. Uniformity in load is desired and uniformity may be obtained by allowing the liquid dispersion to contact all areas of the belt through a uniform time period. The time period may be very brief, as for example, dipping in and out, or the time period may extend over many minutes or a longer period than that. The load to the belt following immersion or dipping will depend on such factors as the density of xerographic developer powder particles in the liquid dispersion, the ability of the tape

or belt of material to load with xerographic developer powder particles through immersion, the time the belt or tape of material is in the liquid dispersion, and the like.

5 An important consideration in forming belts for high quality xerographic reproduction is the belt material itself. The material should be uniform throughout. This will assure presentation to the liquid dispersion of powder particles of a material which is at all points able to hold and accept the same amount of particles and one 10 which will tend to impregnate with an equal amount of particles throughout when immersed in a uniformly dispersed solution or suspension of powder particles in liquid. The belt material should also be a porous material, which will allow the gas of the belt powder cloud generator to pass through it when the aerosol of powder particles is being created. Any material capable of accepting and holding powder particles when immersed in a liquid dispersion of powder particles is intended to be encompassed within the scope of this invention. To 20 date, the best materials have been found generally to be napped cloth materials, as for example, velvet, velveteen, woolens, terry cloth, napped rayon and the like. Napped cotton flannel and equivalent materials are the preferred materials as belt material for loading purposes through immersion. An equivalent material for cotton flannel would be cotton tape or bias material with a napped surface or napped surfaces. The preferred materials have been found generally to accept a more uniform and denser load or impregnation than other materials lacking the napped surfaces. It is to be realized, also, that other materials such as a treated mesh metal screen will also work, and such other materials whether pretreated or not, which will load when immersed, are intended to be encompassed herein.

The loaded or impregnated belt or tape is presently believed to have powder particles extending through all areas of thickness of the belt or tape material. The load accepted by each belt is largely dependent on the density of the cloth and the ability of the cloth to load 40 with powder particles. By ability of the cloth to load, it is intended to include such elements as the effect of the cloth's mesh and the cloth's nap, and the word density is intended to include such elements as the thickness of the cloth. Powder impregnated or loaded to the belt or tape deposits both between the threads and on the threads and between areas of napped material and on the napped material.

Belt materials, it is presently believed, have a saturation point above which they tend not to accept within themselves any more xerographic developer powder particles. Although powder particles may occasionally remain resting on the surface, if they are above the saturation point, they are easily removed by simply shaking the loaded belt. Thus, particles above saturation will shake loose, whereas particles below the saturation point will have become part of the belt material and will remain adhering to the belt material.

Experiments have been carried out loading belts using 60 a one inch wide belt composed of white, heavy cotton flannel, four ounces per yard, and immersing this belt in a liquid dispersion of varying amounts of liquid and varying liquids and varying amounts of xerographic developer powder particles and varying xerographic developer powder particles. Best loading results have been attained as measured by the end prints produced from the loaded belt using charcoal powder particles as the xerographic developer powder particles. Belts have been immersed for varying times and the following specific example is only included herein for illustrative purposes. It is to be realized that varying times may be used, depending upon the liquid dispersion being used, belt material being used, and the like, and equal results may be obtained. In this particular instance a suspen- 75 sion composed of three parts charcoal to sixteen parts

water was used, and the belt or tape of material was immersed in this suspension for six minutes and resulted in a highly uniform and dense load or impregnation of powder particles in the cotton flannel napped cloth. The load accepted by the belt was found to be 528 mgms. per foot. Using a similar suspension made up of four parts charcoal to sixteen parts water, it has been found that the tapes on drying tend to have caked particles on the surface of the tape material. These particles may be removed by brushing the surface lightly or by shaking the material. However, it is presently believed that it is desirable to avoid formation of caked particles on the surface in that less agglomerates appear in the print produced when a belt without caked particles is used. Using the suspension made of three parts charcoal to sixteen parts water, no caking was noticed. Less dense suspensions, such as one part charcoal to sixteen parts water, require a longer loading time or result in less of a load to the belt material. Neither of these elements is undesirable, but are stated here to fully and clearly disclose the methods of carrying out this invention. Experiments have also been conducted using isopropyl alcohol as the liquid in which the suspension is formed. In such an instance, a suspension of ten parts charcoal to sixteen parts isopropyl alcohol was found to produce highly dense and uniform loads of powder particles in the belt materials. On the other hand, using a solution composed of twelve parts charcoal to sixteen parts isopropyl alcohol resulted in caking on the tape material, requiring shaking or brushing off of the caked particles before the belt could be used without producing too many agglomerates in the developed prints. Using suspensions of isopropyl alcohol having lesser amounts of charcoal particles produces less dense loads of charcoal particles on the belt material, or requires more immersion time than six minutes.

After immersion of the belt in the liquid dispersion, it is necessary to completely dry the belt material and the xerographic developer powder particles before using the loaded or impregnated belt in a belt powder cloud generator. This may be accomplished by hanging the belt loaded with powder particles in a room and allowing it to dry, or it may be accomplished by playing a heated blast of air on the belt material. Such procedures have been found to result in varying drying times depending on the liquid for the dispersions, the developer, the belt material, and the like. For example, when a belt which has been immersed in a dispersion of particles in water for six minutes was hung to dry in the path of a hot air blast, it was found to take from an hour and a half to four hours for complete drying. When a hot air blast was not used, it has taken as long as twelve hours to dry such a belt. When using a volatile liquid to form the dispersion, it has taken from as little as fifteen minutes to a few hours. When a hot air blast had been directed at a belt which had been soaked in isopropyl alcohol for six minutes, it was found to take thirty-one minutes to dry the belt.

A technique which has been found to dry the belts faster without resulting in any detrimental effects to the powder particles loaded to the belt material which will subsequently be produced into an aerosol of powder particles for development of xerographic electrostatic images, involves first, blotting the belt carrying particles after it is removed from the liquid dispersion, and then hanging the belt for drying purposes. Specifically, the belt loaded with powder particles may be placed between two blotters and then passed through a conventional set of wringers as is found, for example, on ordinary wringer-type washing machines. Sufficient pressure was applied to wring out excess liquid from the belt material and the drying time was found to be cut substantially. For example, when a belt had been soaked in a water dispersion for six minutes and then positioned in an area of hot air flow, it was found to take some twenty-three minutes to

dry the belt when blotting took place. Likewise, a belt that had been positioned in isopropyl alcohol for six minutes was found to take some nine minutes to dry after being blotted.

It is presently believed that open contact of the liquid suspension with all areas of the belt is desirable to accomplish uniform and quick loading. This may be accomplished by keeping the belt in an open or unrolled or stretched-out position while immersed in the liquid suspension.

Depending on the particular xerographic developer powder particles being used, it is sometimes desirable to create the liquid dispersion and allow large particles or agglomerates to settle before inserting a belt for loading purposes. In this way, loading of large particles and agglomerates of powder particles is avoided to a large extent. It is also sometimes desirable to add to the liquid dispersion a material which will aid in keeping the xerographic developer powder particles thoroughly suspended, such as for example, cellulose gum, gum tragacanth, gum arabic, or the like.

Belts described according to this invention, when used in powder cloud generators, have the advantage of consistency and uniformity between belts with similar characteristics. Two belts of similar material loaded through immersion in a similar liquid dispersion for the same amount of time will produce highly consistent and uniform cloud outputs when used in similar powder cloud generators. Also it has been found that since belts tend to stop loading at a point of saturation, there is no need to exercise great care with the liquid dispersion to assure that the particles are uniformly dispersed throughout. Although the particles may tend to load less uniformly than in the instance when such care is exercised, if the particles are allowed to load to all areas of the material to a point above the saturation, then particles above saturation may be shaken loose, resulting in a uniformly loaded belt to saturation and when used in a powder cloud generator, such a belt will produce uniform and high quality pictures because of a consistent and uniform aerosol of powder particles output. Belts also have the advantage of being able to produce fine and high quality aerosols of xerographic developer powder particles which may be used directly for development purposes without other elements between the powder cloud generator and the development zone, such as settling chambers or the like. Another advantage of belts loaded according to this invention is that they are compact and also they may be stored, producing convenient sources of powder for powder cloud generators to be called upon when needed. Loading, according to this invention, also has the additional advantages of efficient use of powder particles. That is, although only some of the powder particles are removed from the liquid dispersion with each belt loading, none of the powder particles are wasted. A further advantage of belt loading through immersion is the speed possible to obtain uniformly and densely loaded belts of material. It is also noted that loading as accomplished according to this invention is less cumbersome than in the instance of loading using aerosols. When using aerosols, it is necessary to have an aerosol generator to feed particles to a loading zone, at which point the particles are loaded to the tape material. Such loading requires an aerosol generator, and may tie up quite a bit of other equipment, such as compressors and the like. The ease and convenience and minimum requirements for apparatus for loading purposes according to this invention result in a substantial improvement over prior-known techniques.

Such words as tape, belt, band, ribbon, have been used throughout interchangeably, and are intended to describe equivalent articles. Similar articles are also intended to be encompassed by these words.

While the present invention as to its objects and advantages, as has been described herein, has been carried

out in specific embodiments thereof, it is not desired to be limited thereby, but is intended to cover the invention broadly within the spirit and scope of the appended claims.

What is claimed is:

1. The method of creating a uniform dispersion of fine dry developer powder particles in gas for image development in xerography comprising forming a liquid suspension of xerographic developer powder particles in a volatile nonsolvent liquid, immersing a substantially uniform tape of porous material into the liquid suspension, removing the tape of material from the liquid suspension and drying the tape to thereby form a tape impregnated with releasable developer particles, and then feeding the impregnated tape at a substantially uniform linear rate through a substantially uniform gas stream producing a uniformly constant and dense dispersion of powder particles in gas.

2. The method of creating a uniform dispersion of fine dry charcoal powder particles in gas for image development in xerography comprising forming a liquid suspension of charcoal xerographic developer powder particles in water, immersing a substantially uniform tape of napped cotton material into the liquid suspension, removing the tape from the liquid suspension and drying to thereby form a dry tape of material impregnated with dry releasable developer particles, and then feeding the impregnated tape at a substantially uniform linear rate through a substantially uniform gas stream producing

a uniformly constant and dense dispersion of dry charcoal particles in gas.

3. The method of developing an image pattern on a xerographic plate comprising forming a liquid suspension of xerographic developer powder particles in volatile nonsolvent liquid, immersing a substantially uniform tape of porous material into the liquid suspension, removing the tape of material from the liquid suspension and drying to thereby form a dry tape impregnated with dry releasable developer particles, feeding the impregnated tape at a substantially uniform rate through a substantially uniform gas stream to produce a uniformly constant and dense dispersion of dry powder particles in gas, and feeding the particle-in-gas dispersion to the surface of the plate to develop the image pattern.

References Cited in the file of this patent

UNITED STATES PATENTS

20	1,803,409	Shur	May 5, 1931
	1,872,581	Haroldson	Aug. 16, 1932
	1,910,391	Howard et al.	May 23, 1933
	1,916,333	Rose et al.	July 4, 1933
	2,338,480	Auxier	Jan. 4, 1944
25	2,443,782	Barnard	June 22, 1948

FOREIGN PATENTS

672,148	Great Britain	May 14, 1952
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