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XEROPRINTING MASTER

Filed March 27, 1967

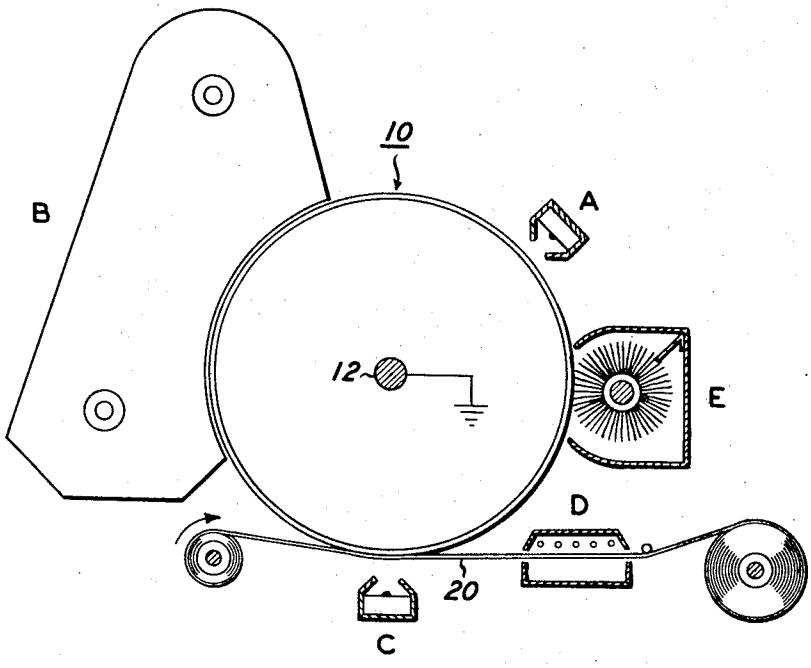


FIG. 1

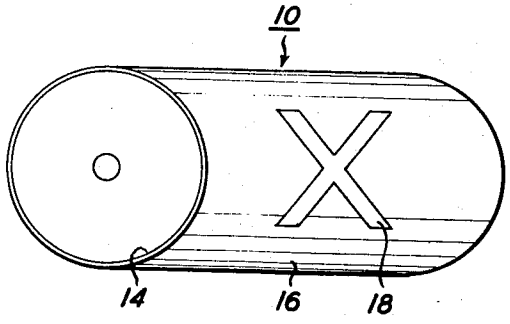


FIG. 2

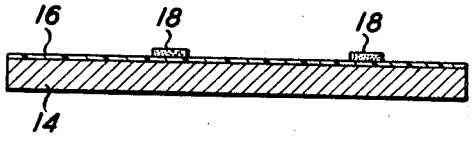


FIG. 3

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XEROPRINTING MASTER

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ABSTRACT OF THE DISCLOSURE

A xeroprinting master and method of fabrication. The master comprises a conductive substrate with a thin layer of polytetrafluoroethylene, or the like, fused thereover and insulating toner fused into the layer in an image-wise configuration for improved development and cleaning capabilities of the master.

This case relates to improved duplicating systems and more particularly, to improved xeroprinting duplicating systems.

In the practice of xerography, as described in U.S. Pat. 2,297,691, to Chester F. Carlson, a xerographic surface comprising a layer of photoconductive insulating material affixed to a conductive backing is used to support electrostatic images. In the usual method of carrying out the process, the xerographic plate is electrostatically charged over its surface and then exposed to a light pattern of the image being reproduced to thereby discharge the charge in the area where the light strikes the layer. The undischarged areas of the layer form an electrostatic charge pattern in conformity with the configuration of the original light pattern. This electrostatic light pattern, or latent electrostatic image, as it is sometimes called, is then developed by contacting the xerographic surface with finely divided electrostatically charged toner particles. The resultant powder image is then transferred to a support material such as a sheet of paper, and then fused thereto by suitable heating means to form the final copy.

In the conventional process, the five basic steps are charge, expose, develop, transfer, and fuse. These steps are repeated in sequence for each reproduction of an original document. This well-known process has already been demonstrated by use in many commercial machines for ordinary office copying functions. This multiple step process, however, does not readily lend itself for high speed duplicating requirements. Consequently, various techniques have been devised for eliminating one or more of the above-indicated xerographic processing steps. These new techniques, known as xeroprinting, have generally eliminated at least one of the above-indicated xerographic processing steps.

Among the ways in which one of the xerographic steps may be eliminated is retaining the latent electrostatic image on the xerographic surface after the transfer of the powdered image so that the surface can be developed again without the intermediate steps of recharging and reexposing. Another way to eliminate one or more of the steps is to develop the latent electrostatic image with a heavy layer of powder material so that each of a series of transfers will only take off a thin layer of the powdered image from the xerographic surface. Additional toner layers will be removed during each subsequent transfer operation. In this manner, charging, exposing, and development may be eliminated.

A preferred arrangement and method for xeroprinting is disclosed in U.S. Pat. 2,576,047 to Roland M. Schaffert. In this arrangement, a developed insulating toner image is transferred to an electrically conductive plate and fused thereto. The plate which may be in the form of a drum is thus formed with permanent insulating image areas and conductive background areas. During the charging of this plate, the grounded conductive background areas retain no charge while a charge pattern remains on the plate surface in the electrically insulating toner portions. The image can then be developed with electrostatically attractable charged toner particles. The developed image is then transferred to a suitable backing material for fusing thereto. The drum is then cleaned and recharged in a continuing cycle of operation wherein the exposure step is eliminated.

During the development of such a xeroprinting master, charged toner particles brought into contact with the surface are electrostatically attracted to oppositely charged image areas which are made up of fused toner particles. Since there is no charge on the background areas, there should be no attraction of toner particles to the background areas. In practice, however, the Van der Waals-type forces cause some toner particles to mechanically adhere to the uncharged background areas. Van der Waals forces are mechanical forces tending to attract two bodies together due to their molecular interaction. These forces are separate and distinct from the electrostatic attractive forces which cause charged toner to adhere to the image areas. The Van der Waals forces existing between toner particles and image areas to be developed are not undesirable since they assist toner deposition and retention in image areas. On the other hand, Van der Waals forces between toner particles and background portions of the master being developed are detrimental since they tend to create background in the developed image, and, resultantly, on final copy.

During the cleaning of the master, residual toner remaining on background areas of the surface after image transfer must be removed from the surface. This is especially important with respect to background areas, since a build-up of background toner could lead to increased background in subsequent copies being developed. In plate cleaning, as by a rotating brush or the like, the Van der Waals forces must be overcome to effect toner removal if the plate surface is to be kept clean for high quality copies. This requires complete and firm contacting of the residual background toner particles by the brush bristles. The criticality of removing residual toner from image areas is not so critical in xeroprinting as it is in conventional xerography since toner on image areas may be transferred to the copy on a later transfer cycle.

It is, therefore, an object of the instant invention to overcome the above-noted disadvantages.

It is a further object of the instant invention to improve xeroprinting masters.

Another object of the instant invention is to prepare improved xeroprinting masters in accordance with a novel method.

Another object of the instant invention is to minimize toner deposition in background areas of a xeroprinting master during development.

Another object of the instant invention is to facilitate the cleaning of residual toner particles from background areas of xeroprinting masters.

Still a further object of the instant invention is to increase xeroprinting speed and efficiency.

These and other objects of the instant invention are obtained by a xeroprinting master comprising a conductive substrate overcoated with a thin layer or coating of a lubricous resin of such thickness that the conductive properties of the substrate are retained. An insulating toner image permanently fixed to the lubricous layer thus results in the improved xeroprinting master. When this improved xeroprinting master is used for the creation of copies, there is a reduced tendency of toner particles to be retained in background areas during development. The

cleaning of residual toner particles from the background areas is also facilitated due to the lubricous nature of the coating overlying the substrate.

For a better understanding of the invention, as well as other objects and further features thereof, reference is had to the following detailed description of the invention to be read in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates schematically a xeroprinting machine capable of continuous and automatic operation employing the master of the instant invention.

FIG. 2 is a perspective view of a xeroprinting master constructed in accordance with the principles of the instant invention.

FIG. 3 is a side cross-sectional view of a portion of the master illustrated in FIG. 2.

Shown in FIG. 1 is an embodiment of the instant invention constructed for continuous and automatic xeroprinting operation. The elements of this machine, as shown schematically, are all conventional in the xeroprinting art, with the exception of the drum-shaped master. For the purpose of the present disclosure, the several processing stations in the path of movement of the master may be briefly described as follows:

A charging station A at which a uniform electrostatic charge is deposited on the surface of the master, and wherein the charge is there retained on electrically insulating portions corresponding to image areas but not retained on the electrically conductive portions corresponding to background areas;

A development station B at which xerographic developing material, including toner particles having an electrostatic charge opposite to that of the electrostatic charge in the image areas, are moved into contact with the master, whereby the toner particles adhere to the electrostatic charge pattern on the master to form a powdered image in the configuration of the copy to be reproduced;

A transfer station C at which the xerographic powder image is electrostatically transferred from the drum surface to a transfer material or a support surface such as paper;

A fusing station D at which the toner image on the support surface is fused thereto for creating a final copy, and

A master cleaning station E at which the master surface is brushed to remove residual toner particles remaining thereon after image transfer.

The xerographic master of the illustrated embodiment is designated generally by numeral **10**. The drum-shaped master **10** is adapted for rotation about shaft **12** for sequentially bringing the various sections of the master surface past the several xerographic processing stations in a continuous cycle of operation. The master surface is comprised of an electrically conductive surface **14** as of aluminum or the like which is grounded. The entire conductive surface **14** of the drum **10** is first coated with a lubricous resinous coating as for example polytetrafluoroethylene, commonly referred to as Teflon. Teflon has been found to be desirable due to its excellent abrasion resistance and extremely lubricous nature.

Any suitable lubricous resinous coating may be used in the practice of the instant invention, so long as it meets the requirements of the instant invention in that it has lubricating properties and is capable of being bonded to the substrate thinly enough so that the conductive properties of the substrate are not lost. The coating of such a substrate is disclosed, for example, in U.S. Pat. 3,146,145 to John J. Kinsella. Typical resinous materials include polyethylene, polyethylene terephthalate, polyacrylonitrile, polyamide, polyurethane, and polyvinyl chloride.

An unfused toner image is then transferred onto the coated substrate. The toner image may be formed as by conventional xerographic or non-xerographic techniques. An intermediate transfer from an original xerographic plate to an intermediate backing and then a subsequent

transfer to the master of the instant invention may be required to insure the right reading of copy to be produced by the instant xeroprinting apparatus. Such techniques are discussed, for example, in U.S. Pat. 2,990,278 to Chester F. Carlson. Any other method of transferring an image to the coated substrate may be employed so long as the toner image transferred to the master has electrically insulating properties. The image area elements designated by numeral **18** are then fused into the Teflon coating to render the xeroprinting master permanent.

The resulting xeroprinting master is thus constructed of electrically insulating elements **18** capable of retaining an electric charge in image areas and electrically conductive portions corresponding to background areas which are more lubricous than image areas.

The composite xeroprinting master can be fabricated as by coating, spraying, painting, or otherwise permanently fixing the Teflon film over the conductive substrate **14** so as the layer is sufficiently thin to permit the conductive properties of the substrate to be retained by the laminate. A Teflon layer of about 6 to 12 microns has been found suitable. A toner image may then be formed in the Teflon layer by conventional xerographic or mechanical steps. The toner may be any of the commercially available chargeable resins as described for example in U.S. Pat. 2,618,551 to Lewis E. Walkup. Typical of such resins are polystyrene, phenol-formaldehyde, and the like. The toner is then fused to the Teflon as by vapor fusing, radiant fusing, oven fusing, or the like. This toner layer should be thick enough so that insulating properties result.

A preferred method for fabricating the xeroprinting master of the instant invention includes spraying a thin layer of about 8 microns of polytetrafluoroethylene over the conductive substrate and permitting to solidify. The layer is then briskly rubbed or polished to produce a thin continuous and smooth layer of Teflon over the substrate. The toner image is then transferred to the laminate, over fused at about 280° F. for about 3 minutes and then air cooled. During the fusing, the toner particles soften and cohere to each other. The Teflon also softens so that adhesion between the toner and Telflon occurs adjacent their interface upon subsequent cooling and solidification.

While it has been disclosed that the xeroprinting master be fabricated immediately onto a drum shaped surface, it should be understood that such a xeroprinting master can be created by performing these steps on a flexible conductive sheet and then securing the sheet around the periphery of a drum. It should be likewise understood that the instant invention is equally applicable to flat plate operations and flexible belt operations as much as it is to the disclosed drum-shaped master.

Reference is now had again to the disclosed machine embodiment of FIG. 1 in order to understand the use of the above described improved xeroprinting master. The machine of FIG. 1 is first set into operation by a general cycle initiating means, not shown, to rotate the surface of the master **10** through the various processing stations described above. The surface of the drum is provided with the improved xeroprinting master of the instant invention.

As the master passes beneath the charging station A, a corona discharge acts to spray the entire surface with a flow of ions. The charge falling upon the conductive areas of the master is conducted away since it acts as a grounded conductor. The ion flow falling upon the insulating image areas, however, is retained there to render the surface charged in a configuration corresponding to the image to be reproduced. Other charging methods, as for example by air breakdown, can also be used for charging the master.

The master surface then passes adjacent the development station wherein toner particles, charged to a polarity opposite from that on the image area to be developed, are cascaded across the surface. Other development systems

are readily usable. The electrostatic charge difference between the toner particles and the image areas to be reproduced cause toner particles to adhere to an image-wise configuration on the master surface.

Toner particles moving or cascading across uncharged background areas have a slight tendency to be deposited there due to the mechanical attraction therebetween. Since, however, these toner particles are moving across an uncharged Teflon surface, their tendency to be retained thereon is minimized in comparison to what it would be if the Teflon layer were not employed. The absence of a Telflon coating over the image areas has a further advantage since toner electrostatically attracted to the image areas will still have the usual mechanical forces tending to hold toner particles thereto.

The developed toner image is then moved to the transfer station C wherein it is electrostatically transferred to to backing material such as a paper web **20**. The paper is moved in synchronism with the tangential speed of the drum at the transfer station to eliminate smearing. The paper is then moved past the fusing station D where the paper and toner image are fused together to make a final copy.

The surface is then moved past a brush cleaning station E wherein residual toner particles are mechanically removed from the xeroprinting master surface prior to recharging at station A in its continuing cycle of operation.

As can be understood, the properties of the master are advantageously utilized at the cleaning station. Since the background areas of the master are of a lubricous nature, brush cleaning thereof is more easily accomplished since residual toner particles on the lubricous background areas are more easily removed by brush cleaning. In this respect, cleaning of the master is more completely accomplished by the instant invention. As a practical matter, when a xeroprinting operation is adapted for less than unusually long runs, the cleaning process may be eliminated inasmuch as background toner deposition will be minimized to a substantial degree over former devices. In longer runs, however, the cleaning operation is desirable to eliminate toner build-up in background areas. As will be understood from the foregoing, xeroprinting with the master of the instant invention permits a faster speed of operation since the development and cleaning steps are rendered more efficient.

While the present invention as to its objects and advantages, has been described herein as carried out in a specific embodiment thereof, it is not desired to be limited thereby; but it is intended to cover the invention broadly within the scope of the appended claims.

What is claimed is:

1. A xeroprinting master consisting essentially of

an electrically conductive substrate,

a continuous lubricous resinous coating of polytetrafluoroethylene having a thickness between 6 and 12 microns bonded to said substrate and

insulating xerographic toner particles fused onto portions of said coating in areas thereof corresponding to image areas to be developed, said insulating toner particles being fused into said coating in such thickness so as to permit the retention of sufficient electrostatic charges thereon for xerographic development of the master.

2. A method of producing a xeroprinting master including the steps of

providing an electrically conductive substrate,

bonding onto said substrate a continuous lubricious resinous coating of polytetrafluoroethylene having a thickness between 6 and 12 microns,

polishing said coating,

applying insulating xerographic fusible toner particles in an imagewise configuration to portions of the coating corresponding to image areas to be developed, said toner particles being of such thickness so as to permit the retention of sufficient electrostatic charged thereon for xerographic development of the master and

permanently fixing said toner particles to said coating by oven fusing the toner particles to the coating on the substrate at about 280° F. for about 3 minutes.

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