Aug. 23, 1960 R. W. GUNDLACH 2,949,849

STENCIL MASTER MAKING

Filed July 27, 1955

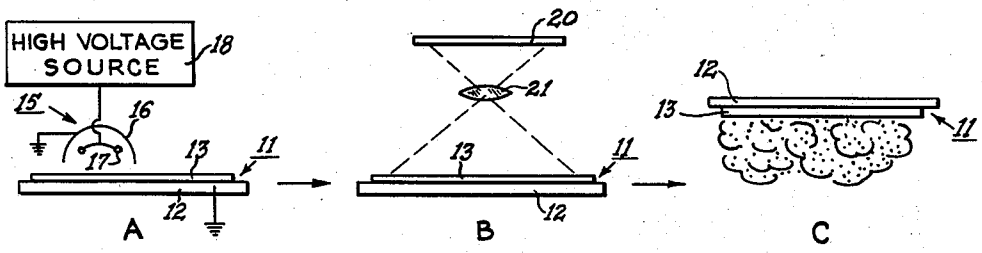


Fig. 1

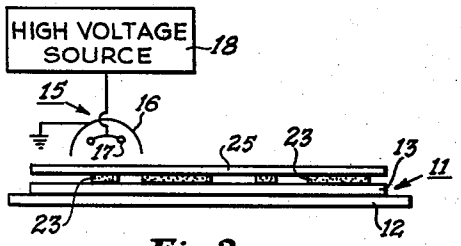


Fig. 2

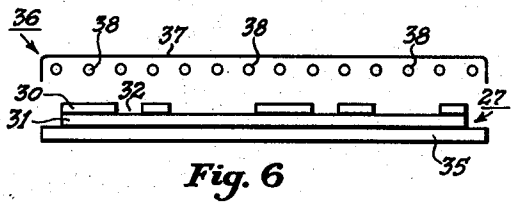


Fig. 6



Fig. 3

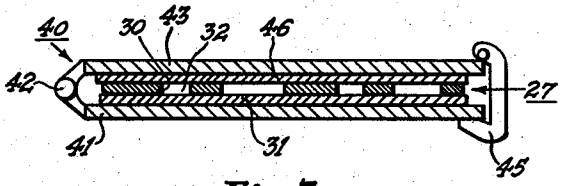


Fig. 7

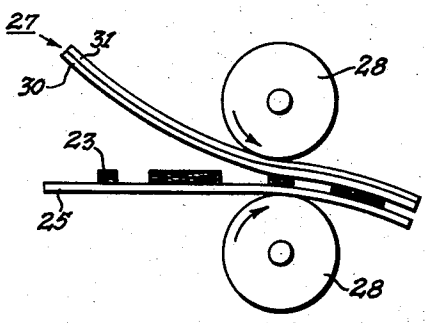


Fig. 4

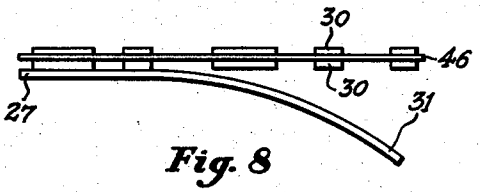


Fig. 8

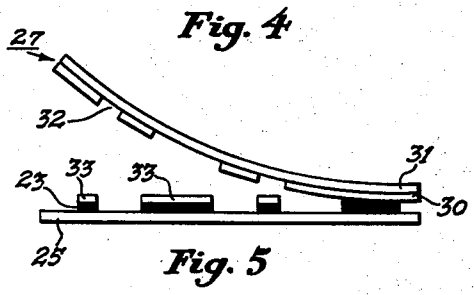


Fig. 5

INVENTOR.
ROBERT W. GUNDLACH
BY Frank A. Steinhilper
ATTORNEY

United States Patent Office

2,949,849

Patented Aug. 23, 1960

2,949,849

STENCIL MASTER MAKING

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

Filed July 27, 1955, Ser. No. 524,660

4 Claims. (Cl. 101—128.3)

This invention relates in general to master making for duplicating processes.

The present method for producing stencils for stencil duplicating processes involves the cutting of a wax impregnated, porous tissue paper. The cut stencil permits passage of an aqueous ink directly from a reservoir of ink to the final copy through the openings. Analogous processes have been evolved for the graphic arts wherein a silk screen is blocked by a manually applied binder or by photographically controlled gelatin layers. The screen is then used to control the flow of ink, paint, varnish, or the like from an applicator to the paper or other final support.

This invention presents a method whereby duplicating stencils may be prepared photographically. In particular, photographic processes are used to create a reproduction of the original in a tacky powder form. The softened powder image is pressed against a coated sheet, and on separation, the powdered image removes portions of the coating from the coated sheet which correspond to the original copy. The remaining coating which may be termed a "stencil matrix" is then transferred to a tissue or silk screen base and the base carrying the coating may be used as the master in the stencil duplicating or the silk screen duplicating process. The novel techniques of this invention provide for the use of existing documents as original copy and thus eliminate the disadvantages of manual preparation as, for example, typing, drawing, cutting, or the like. Although photochemical stencils exist, they are generally prepared using a high contrast photographic positive to which the stencil is exposed while clamped in close contact. This invention also overcomes the problems of contact exposure as well as the need for high contrast photographic positives.

Accordingly, it is an object of this invention to devise new methods of forming a master for duplicating processes.

It is a further object of this invention to devise new methods of forming stencil masters, silk screen masters, or the like through photographic techniques.

It is a still further object of this invention to devise new methods of forming stencil masters, silk screen masters, or the like through the use of a tacky image corresponding to an original to be reproduced.

Additional objects of this invention will in part be obvious and will in part become apparent from the following specification and drawings in which:

Fig. 1, A, B, and C, illustrates an embodiment of steps which may be used to form a powdered image corresponding to copy being reproduced;

Fig. 2 illustrates transfer of the powdered image;

Fig. 3 diagramatically illustrates an embodiment of tackifying the powder image;

Fig. 4 illustrates pressing of the tackified powder image against a coated sheet or web;

Fig. 5 illustrates stripping of the tacky image from the coated sheet;

Fig. 6 illustrates softening of the remaining coating on the coated sheet;

Fig. 7 illustrates in cross section a pressure applying device pressing the softened coating against the master base; and,

Fig. 8 shows transfer of the remaining coating to its new and final support base thereby forming a master for duplicating processes.

For a better understanding of this invention reference is now had to Fig. 1 wherein there is illustrated an embodiment of powder image formation. The particular technique described uses xerography to form the powder image corresponding to copy being reproduced, but it is to be understood that there is no intention to limit this invention thereto. Instead, any photographic method of powder image formation is intended to be encompassed herein.

The steps illustrated in this figure are Fig. 1–A, charging or sensitizing the plate, Fig. 1–B, exposure of a sensitive plate, and Fig. 1–C, development of a plate following exposure. The plate which is used in xerography, which in this figure is designated generally **11**, is composed of a photoconductive insulating layer **13** overlying a conductive backing member **12**. The photoconductive insulating layer may be any of a number of materials as, for example, sulphur, vitreous or amorphous selenium, zinc oxide in a resin binder, or the like. Functionally, it may be described as a material able to retain an electrostatic charge for a sufficiently long period to allow exposure and development of the electrostatic charges on its surface and as a material which on exposure to activating radiation rapidly dissipates charge.

In Fig. 1–A the charging or sensitizing step is illustrated using a corona discharge electrode generally designated **15** which comprises a grounded shield **16** and corona discharge wires **17**. The corona discharge wires **17** are connected to high voltage source **18** which supplies a potential in the order of from 6,000 to 10,000 volts. The voltage may be direct current, positive or negative, or alternating current. Techniques of control exist for causing deposition on the surface of the photoconductive insulating layer **13** which relate to the particular type of high potential used and which allow the use of alternating or direct current. Generally, the surface to be charged is charged to from 100 to 800 volts either positively or negatively. The corona grid **15** is, in this figure, illustrated as moving in the direction of the arrow and, desirably, relative movement should take place between the grid and the plate being charged when the grid only covers a portion of the plate surface. Movement may be brought about manually or a screw drive connected to a motor or the like may be used.

During charging, the backing member **12** of plate **11** is grounded and, generally, charging is carried out in darkness.

Fig. 1–B represents and illustrates the exposure step. In this figure, copy **20** to be reproduced is projected through lens **21** to the charged surface of photoconductive insulating layer **13** overlying backing member **12** of plate **11**. The backing member **12** of plate **11** need not be grounded during exposure but may, if desired, be held at a ground potential. Exposure causes dissipation of charge in those areas struck by light resulting in a charge pattern of electrostatic charges on the surface of the photoconductive insulating layer **13**.

Fig. 1–C illustrates one form of development which may be used to make visible an electrostatic charge pattern on the surface of photoconductive insulating layer **13** overlying conductive backing member **12** of plate **11**. The particular technique illustrated in this figure is generally known in the art as "powder cloud development."

In powder cloud development a cloud of developer particles in gas **22** is presented to the image bearing surface. The particles are electrostatically charged through the use of corona, frictional charging, or the like, and the electrostatic fields of force which exist between the charges on the particles and the charges on the surface of the plate cause particle deposition in conformity with the electrostatic charge pattern on the surface being developed. There is thus formed, following the steps in Figs. 1–A, B and C, a powder image on a surface conforming to an original being reproduced.

Although particular steps are illustrated in Fig. 1, it is to be realized that there is no intention to be limited thereto and that various modifications to accomplish the same purpose as is known to those skilled in the art are intended to be included herein. For example, although corona charging of the plate is illustrated in Fig. 1–A, it is to be realized that other techniques of charging may be used, as for example, a radioactive source, a modified corona discharge device such as the type described in Walkup application Serial No. 154,295, filed April 6, 1950, now U.S. Patent No. 2,777,957, for "Charging Device," a stationary grid positioned over the surface to be charged, or induction charging, or the like.

Also, although a form of projection exposure is illustrated in Fig. 1–B, it is to be realized that contact exposure, reflex exposure, or the like might be used and are intended to be encompassed by this invention. Further, there is no desire to limit this invention to powder cloud development as is illustrated in Fig. 1–C. Cascade development, sheet development, loop development, magnetic development, or the like are also intended to be included herein.

In Fig. 2 there is illustrated transfer of the powder image from the plate generally designated **11** comprising a photoconductive insulating layer **13** overlying a backing member **12**. The powder image designated **23** is transferred to transfer sheet **25** in this embodiment through the use of electrostatics. Electrostatic transfer is carried out by placing an electrostatic charge on the surface of sheet **25** using corona grid **15** comprising grounded conductive shield **16** and corona discharge wires **17**. Corona discharge wires **17** are connected to high voltage source **18** and may supply corona as described and discussed in connection with Fig. 1–A. Generally, in the art of xerography if a surface is charged positively in the first instance, negatively charged particles will be used during development to deposit on the positive charges making up the image. Similarly when the surface is originally charged negatively, positively charged particles will generally be used during development. The use of a corona charge on transfer sheet **25** corresponding in sign to the original charge used to sensitize the plate will cause transfer of the oppositely charged particles making up powder image **23**. It is to be realized that various other techniques of image transfer may be used or alternatively, the image transfer step may be omitted and the visible powder image **23** on the surface of plate **11** may be carried through the remaining steps of this invention. Generally in xerography a plate is re-usable and thus it is desirable to remove the powder image from its surface by transferring the image to a new support prior to carrying out the remaining steps of this invention. If, however, the plate is considered expendable, the image may remain in place on the plate surface during subsequent steps in carrying out this invention.

In Fig. 3 there is illustrated tackification of powdered image **23** on the surface of sheet or web **25**. Tackification is accomplished in this embodiment by exposing the powdered image to solvent vapors **26** for the image material.

Tackification of the dry toner image is accomplished when the powder image becomes a more liquefied adhesive unit. Although it is not desired to limit this invention to a particular mode of operation, it is now thought that tackification takes place due to the effect of vapors on the viscosities and surface tensions of the material making up the image. It is believed that exposing the image to proper vapors causes the surface tensions of the materials to decrease, thereby making particles more adhesive. This will cause the particles to stick to one another and at the same time cause the image itself to become adhesive. It is thought in general that solvents for image materials or, more particularly, vapors soluble in the image materials cause a lowering of surface tensions. Exposure to vapors also causes the viscosity of the materials making up the image to fall, thereby allowing the particles to flow more readily. Exposure to vapors causes the image to reach this tacky state by decreasing the viscosities and surface tensions of the materials comprising the image, thereby producing a more liquefied adhesive single image body. The image should be composed of materials which can be reacted on as indicated by proper vapors.

Although tackification has been described in terms of vapor tackification, it is also to be realized that heat tackification and the like are intended to be included herein. For example, applying heat to the toner image will also react on the viscosities and surface tension of the materials making up the image. Thus, applying the proper amount of heat will cause tackification of the image when the image materials are such that they will be reacted on by heat. Heat tackification by radiation and conduction are intended to be included herein.

When vapor tackification is used, the particular tackifying vapor will depend on the nature of the particular image material or powder. Various solvent vapors may be used, as for example, trichloroethylene, various halogenated lower hydrocarbons having at least one fluorine per molecule commercially available under trade names such as the Freons, Genetrons, and the like, chloroform, carbon tetrachloride, various chloromatic solvents, aromatic and aliphatic hydrocarbons such as benzene, toluene, gasoline, and gasoline fractions, oxygenated solvents such as ethanol, acetone, ethyl acetate and other alcohols, ketones, esters, and the like. In all cases, the particular solvent or solvent vapors should be appropriately selected to operate emperically with the particular image material or compositions of material being employed.

It is to be realized that softening or softened images generally which fuse or permanently bond themselves to a surface on hardening are intended to be encompassed herein. Thus, soft tacky images formed in a number of photographic copying processes in which image areas are selectively softened as compared to background areas which are selectively hardened are intended to be included herein and effectively produce quality masters when carried through the remaining steps of this invention.

In Fig. 4 there is illustrated pressing of the tacky image **23** on base **25** against a coated sheet generally designated **27**. Pressing base **25** against sheet **27** is carried out while powder image **23** is in a tacky state and, optionally, if sheet **25** or coated sheet **27** is porous to the vapors used to tackify the image or will allow the passage of heat, as is likely the case, then the tackification step and the pressing step may be combined. Rollers **28** which bring pressure to bear on the assembly are rotated in the direction indicated by the arows and illustrate one technique of pressing coated sheet **27**, comprising coating **30** on base **31**, against the tackified image **23** on sheet **25**. Other techniques may be used as, for example, pressing between two flat surfaces, rolling a roller across the assembly while the assembly rests on a flat surface, electrostatic tacking, or the like. When the image is not transferred to a transfer base but instead is allowed to remain on the plate, then **25**, which in this figure represents the transfer sheet, will instead represent the plate. After the coated sheet **27** has been pressed against the tacky image **23**, the image is allowed to dry or fuse while in contact with coated sheet **27** and transfer sheet **25** following pressing, and the coated

sheet 27 is then stripped away from the transfer sheet 25.

Although the coated sheet 27 will be discussed more fully hereinafter, it may be stated generally that it should have the characteristic of easily releasing coating 30 from base 31, and also the coating 30 should have the characteristic of releasing portions of coating without disturbing other areas of the coated layer. When the tacky image becomes fused while in contact with the coating of coated sheet 27 a bond is formed between the image and the coating and when sheet 25 is separated from sheet 27 the releasable coating is released in bonded areas only to the upper surface of the image 23.

In Fig. 5 there is illustrated stripping or separation of the coated sheet 27 from transfer sheet 25. The coated sheet, comprising coating 30 and base 31, shown being removed from contact with image 23, releases portions 32 from coating 30 on base 31 which adhere as coating 33 to fused image 23. Preferably, and to assure adhesion of a tacky image 23 to the transfer sheet 25 during the separation step, the surface of the sheet should be one to which the tacky image readily adheres. The principle of operation, to remove coating 33 in image areas to image 23, is that of binding firmly the fused image to both the coating 30 on support base 31 and to transfer sheet 25. Since coating 30 is a releasable coating, on separation of transfer sheet 25 from coated sheet 27, areas of coating are removed as indicated by 32 to areas of image 23 thereby forming coating 33 on image 23 which remains fused to both sheet 25 and the coating. Since coating 30 is releasable from base 31 and from adjoining areas of the coating and since it is released in image areas on separation, there is created on coated sheet 27 following separation a coating lacking in image areas.

In Fig. 6 there is illustrated softening or tackification of the remaining coating on the coated sheet following removal of image areas of the coating as described and discussed in connection with Fig. 5. In this figure, the coated sheet 27 comprising areas of coating 30 and areas of no coating 32 on a support base 31 is rested on a table or the like 35. Positioned over coated sheet 27 is a heating device generally designated 36 comprising a cover member 37 and heating element 38. Cover member 37 is provided to protect an operator from burns and to concentrate the heat in the direction of coated sheet 27. A typical type of heating device which might be used to soften the remaining coating 30 on the surface of coated sheet 27 is described in Sabel et al. U. S. Patent 2,586,484. Other devices, as for example, heated platens, heated rollers, or the like, which will generally occur to those skilled in the art are also intended to be encompassed within the scope of this invention. Heating of the coating will cause it to soften until the coating reaches a tacky state. Although it is desirable to bring about complete tackification or softening of the coating, it is desirable also to avoid a flowing into the areas of no coating 32 to thereby produce clean copy from the master formed according to this invention.

In Fig. 7 there is illustrated a pressure applying device 40. The pressure applying device comprises a flat plate 41 hinged by hinge 42 to flat plate 43. A clamp 45 extends from plate 43 and grips plate 41 to apply pressure. Positioned between plates 41 and 43 is an assembly of coated sheet 27 comprising areas of coating 30 and areas of no coating 32 on support base 31 pressing against master base 46. The master base 46 is pressed against, as illustrated, the coated surface of coated sheet 27.

It is to be realized of course that the softening step illustrated in Fig. 6 and the pressure applying step illustrated in Fig. 7 could be combined through the use of plates 41 and 43 which are in a heated condition. The plates will then apply heat and pressure at the same time resulting in a softened coating 30 in pressure contact with master base 46.

It is also to be realized that, instead of heat for softening, vapor may be used. The vapor should be solvent vapor for the coating material and steps of tackification discussed previously in connection with Fig. 3 are applicable in connection with this figure. Also, as in the case of heat, the vapor and pressure step may be combined to cause softening of the coated material and pressure contact with the master base. In such instance, however, it is generally necessary for one of the bases, the master base or the support base of the coated sheet, to be porous.

In Fig. 8 there is illustrated the last or final step in formation of masters according to this invention. In this step the master sheet 46 is separated from the support base 31 of coated sheet 27. On separation areas of coating 30 transfer to the master base 46. When separation is completed the master base 46 carries coating in all areas other than image areas thereby resulting in a formed or cut master for duplicating processes.

The pressing step described in connection with Fig. 7 results in intimate contact between the softened coating and the master support base 46. Before separation takes place, it is desirable to allow the coating to harden or refuse. On hardening the coating becomes imbedded into the master support base 46 and a permanent bond between the two is formed. Since the support base 31 of coated sheet 27 has the characteristic of releasing its coating, as described previously, on separation, since the relative bonding between the coating 30 and the master support base 46 is greater than the bonding between the coating 30 and the coated sheet support base 31, the coating transfers to the master support sheet 46. Most tissue papers and most silk screen bases exhibit desirable adhesive characteristics towards the coating materials, and also most tissue papers and silk screen webs have the porosity and strength required for a master base to be used in stencil duplicating or silk screen duplicating processes. The selection of the particular master base 46 used to transfer the coating to is dependent on the particular use to be made of the master formed according to this invention. When the master is to be used for silk screen printing, master base 46 comprises a proper silk screen base or support, whereas, when the master is to be used for stencil duplicating, master base 46 comprises a proper tissue support or the like.

A stencil master formed according to the techniques of this invention may be attached to a normal stencil duplicating machine for a normal stencil run. The ink is fed through the stencil pad and then through the porous areas of the tissue. The areas to which the coating material was transferred will block passage of ink and thus there will be printed on the copy sheet pressed against the master an ink image corresponding to the original. In the instance when the master is used for silk screen processes ink or paint is applied through the porous areas to the copy sheet and again a reproduction of the original will be reproduced.

The time necessary to make the powder image tacky or the coating material softened or tacky is dependent on a number of factors such as, for example, whether heat or vapor is being used, the particular vapor, if vapor is being used, the temperature applied when heat is being used, whether the heat or vapor contacts the powder image or the coating directly or through a covering sheet, humidity and other atmospheric conditions, and the like.

The amount of pressure necessary to accomplish transfer whether it be of the toner image carrying with it portions of the coating or whether it be of the remaining coating material will vary depending on many factors such as the particular coating material, the condition of the tackified image or the softened coating material, the particular toner material employed, the delay before placing the softened toner image or softened coating material into a pressure unit, humidity and other atmospheric conditions, and the like.

In experiments conducted using heat as the softening

or tackifying agent and using a wax coated paper to make a master for the stencil duplicating process a sandwich or assembly of a base carrying the powdered image was placed with a tissue paper covering sheet between heated platens. The temperature of the platens was maintained at 152° F. and the sandwich was allowed to remain between the platens for 1½ minutes. From 1 to 2 pounds of pressure per square inch was applied. When the sandwich was removed from between the platens a lapse of a brief interval in the order of 10 to 20 seconds took place before the transfer paper was separated from the paper carrying the image. Separation removed the wax coating from the coated sheet in image areas. The coated sheet was then placed against a sheet of tissue paper and the assembly was placed between the heated platens. The platens were at a temperature of 180° F. And the assembly or sandwich was allowed to remain between them for 4½ minutes. Again, 1 to 2 pounds pressure per square inch was applied. The sandwich was then removed from between the platens and, after a brief interval allowed for the fusing or re-hardening of the coating, the tissue was separated from the base of the coated sheet. The tissue carried with it the coating material which remained after removal of coating material in image areas. The tissue was then used on a stencil duplicating machine and produced high quality copy. It is to be realized that substantial modification may be made in the various specific figures given above. For example, with an increase in temperature the time interval is decreased for the sandwiches to remain between the platens. Likewise, an increase in pressure will result in a decrease in time. Also, the use of vapors for tackification causes modification of the specific figures given. The example of experiment has been included herein for illustrative purposes and various modifications which will be apparent to those skilled in the art are intended to be encompassed by this invention.

Although there is no intention to limit this invention and although various coated sheets may be used to supply the ink or pigmented varnish impervious material to the stencil or silk screen base it has been found generally that a high grade smoothly finished paper, cloth, metal, plastic, or the like will act as a proper support base for the coated material. Such a base provides the releasable characteristic desired. The coating on the smooth paper, smooth cloth, or the like should be hard waxes or hard wax compositions or waxes plus petrolatum, or the like, for use in making wax stencils. In the case of use of the coated sheet in making silk screen masters, the coating should be a lacquer or lacquer-like substance which is impervious to inks and varnishes and other similar materials used in the silk screen process. Various coated sheets have been tried and have generally worked well. The coated sheets were made using normal coating means as, for example, dipping, spraying, or the like. Included below in the interest of full disclosure and for illustrative purposes only is an example of the materials used in making up a coating for a coated sheet used in making a wax stencil.

Example I

20.8% carnauba wax (refixed, F. B. Ross Co., Inc.)
20.8% paraffin wax (Bioloid, embedding, Will Corp.)
20.8% petrolatum (white, USP Pureline—Sherwood Ref. Co., Inc.)
20.8% micro wax (Amprol 24, Atlantic Refining Co.)
16.8% calcium carbonate (Purecal M, Wyandotte Chem. Co.)

The various known xerographic developer materials have been tried and have been found to work well in this invention. Such materials are available under the trademark "XeroX" and are sold as "Developer" or "Toner" by The Haloid Company, of Rochester, New York. There are also disclosed valuable developer materials to be used with this invention in Walkup U.S. Patent 2,618,551 and Walkup and Wise U.S. Patent 2,638,416. Other developers and toners generally known to those in the art are also intended to be included herein.

An object of this invention is to make use of a formed tacky image which conforms to original copy to make a master. Techniques exist in xerography and in other arts whereby an electrostatic charge pattern of an image may be formed on a surface or transferred to a surface and the charge patterns may be developed with powder particles. Although in this invention there is illustrated a technique to form an electrostatic charge pattern corresponding to copy, there is no desire to be limited thereto. Instead, any technique for photographically forming a tacky image on a surface is intended to be included within the scope of this invention whether it be through transfer of an electrostatic charge pattern from one surface to another or through the selective deposition of charge on a surface or through the direct formation of a tacky image through selective hardening, or the like.

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 forming a stencil master comprising photographically forming on a first sheet a tacky image corresponding to an original, pressing the tacky image against a wax coated sheet, hardening the tacky image while in contact with the coated sheet and the first sheet, separating the first sheet from the coated sheet thereby removing image portions of the wax coating from the coated sheet, softening the remaining wax layer on the coated sheet, pressing the softened wax layer against a porous tissue stencil base, hardening the coating, and separating the stencil base from the base of the coated sheet thereby transferring the remaining coated material to the stencil base.

2. The method of xerographically forming a stencil master comprising sensitizing a xerographic plate, exposing the sensitized plate to a light pattern corresponding to the original being reproduced to form thereon an electrostatic charge pattern of the original, developing the electrostatic charge pattern with xerographic developing materials to thereby form a developed powder image on the plate surface, transferring powder image to a transfer base, tackifying the powder image and pressing the tackified image against a wax coated sheet, hardening the image, separating the transfer sheet from the wax coated sheet to thereby remove image portions of wax from the coated sheet, softening the remaining wax layer on the coated sheet, and pressing the remaining softened wax layer on the coated sheet against a porous tissue stencil base, hardening the wax layer, and separating the porous tissue base from the base of the coated base to thereby transfer the remaining wax layer to the porous tissue base, said wax coated sheet being characterized by its ability to release wax and the wax coating on said wax coated sheet being characterized by its ability to selectively release portions of the wax.

3. The method of forming a silk screen master comprising forming a powder image on a surface, tackifying the image, pressing the image while in a tacky state against a coated sheet, hardening the tacky image while in contact with the coated sheet, separating the image from the coated sheet to thereby remove image portions of coating from the coated sheet, softening the remaining coating on the coated sheet, pressing the softened coating against a silk screen base, hardening the coating, and separating the silk screen base from the base of the coated sheet thereby transferring the remaining coating to the silk screen base, said coated sheet being characterized by its ability to release the

coating material, the coating being an ink impervious material characterized by its ability to selectively release portions thereof.

4. The method of forming a stencil master comprising forming a tackifiable powder image on a first sheet, tackifying the image, pressing the image while in a tacky state against a wax coated sheet, hardening the tacky image while in contact with the coated sheet and the first sheet, separating the first sheet from the coated sheet and removing to said first sheet image portions of the wax coating from the coated sheet, softening the remaining wax layer on the coated sheet, pressing the softened wax layer against a porous tissue stencil base, hardening the coating, and separating the stencil base from the base of the coated sheet thereby transferring the remaining coating material to the stencil base.

References Cited in the file of this patent

UNITED STATES PATENTS

2,073,033	Szasz	May 9, 1937
2,738,727	Dorman et al.	May 20, 1956