

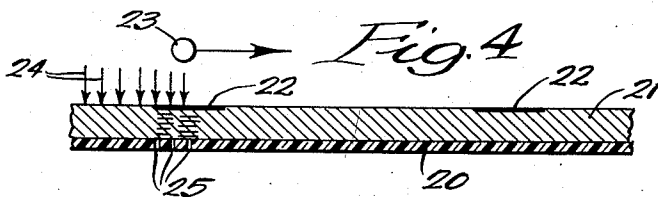
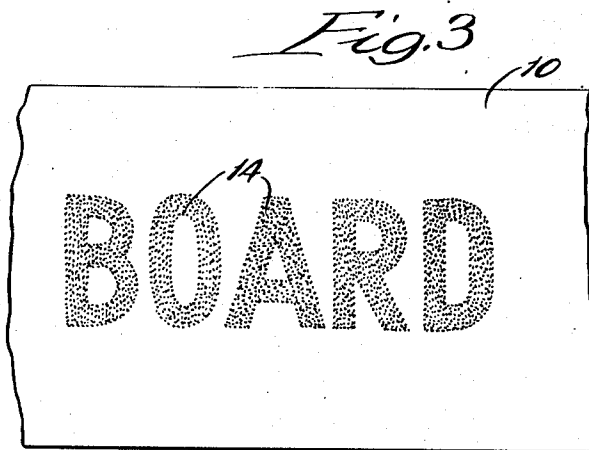
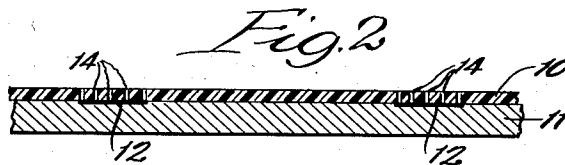
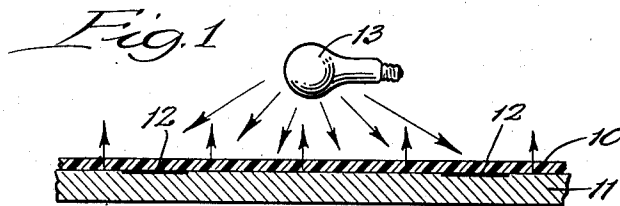
Jan. 11, 1955

K. S. HOOVER

2,699,113

METHOD OF MANUFACTURING STENCILS

Filed Aug. 8, 1950



INVENTOR:
Keith S. Hoover
BY
Dawson & Orms
ATTORNEYS.

1

2,699,113

METHOD OF MANUFACTURING STENCILS

Keith S. Hoover, Elmhurst, Ill., assignor to A. B. Dick Company, Niles, Ill., a corporation of Illinois

Application August 8, 1950, Serial No. 178,220

9 Claims. (Cl. 101—128.4)

This invention relates to stencils for use in ordinary duplicating processes and it relates more particularly to an entirely new technique for the manufacture of stencils.

In the past, stencil openings through which ink may pass have been formed in a stencil-base tissue by displacement of an impressionable composition that impregnates the stencil-base tissue and renders it impervious to ink compositions. Displacement of the relatively soft impressionable composition has been effected by application of force, as by a stylus, compression die, or by impact with a typewriter key. Such means for preparing stencils have restricted their use and has handicapped the adoption of stencil-duplicating processes in copy work, such as in office copy work and the like.

It is an object of this invention to provide a process for preparing stencils, a process which does not rely on the application of force in any form to produce the desired stencil openings.

Another object is to provide a process for preparing stencils which permits the advantageous use of stencil duplicating processes for copy work.

A further object is to provide a new process for producing stencils directly from an original copy whereby exact duplications thereof may be quickly and economically produced in large numbers.

A still further object is to provide a new method for producing stencils which makes use of heat developed by the materials in the original copy upon exposure to directed radiant energy for the purpose of developing corresponding stencil openings through an ink barrier for the passage of duplicating ink compositions in normal stencil duplicating processes, and it is a related object to produce a new and improved stencil of the type described.

A still further object is to provide a new technique for the preparation of a stencil in a very rapid and expedient manner making use of low cost and readily available materials and which may be carried out with simple and inexpensive equipment and which can be made available in practically any location and operated without experienced labor.

A still further object is to produce a stencil and to provide a method for producing same of an unsupported film of ink impervious material.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, embodiments of the invention are shown in the accompanying drawing, in which—

Figure 1 is a schematic view partially in section illustrating the practice of this invention;

Figure 2 is an enlarged sectional elevational view showing the arrangement of parts in the practice of this invention;

Figure 3 is an enlarged top plan view of a stencil prepared by the technique illustrated in Figures 1 and 2, and

Figure 4 is a schematic view partially in section illustrating a modified manner of practicing this invention.

In accordance with this invention, a stencil having openings corresponding to the dark letter outlines of an original copy and through which ink may pass in normal duplicating processes to produce a number of copies may be prepared by placing the original copy closely adjacent or in surface contact with a film of plastic material having the characteristics of rearrangement on local heating to form openings and then radiating the assembly. The radiant energy is substantially reflected or dissipated by the light areas of the original copy and substantially absorbed by the materials forming the dark or printed areas of the

2

original copy and thereby converted into heat. The heat generated in such radiated areas should be sufficient to cause the desired rearrangement of the resinous material in the corresponding areas of the plastic film to provide openings through which ink may pass in normal stencil duplicating work.

Radiant energy capable of the phenomenon of heat generation upon absorption in the materials comprising the dark areas on the copy may be derived from light sources rich in infra-red, which includes rays having a wave length ranging from 8,000 to 40,000 angstroms. These are above the visible range but below the extreme end of the infra-red range. Radiant energy capable of the phenomenon of the type described may be found in the rays of the sun and therefore exists in ordinary daylight but they may be developed in sufficiently high concentration by an ordinary flash bulb, or they may be generated by a tungsten filament light, carbon arc lamp, infra-red ray lamp, and the like. It has been found that the amount of heat developed depends chiefly upon the duration of exposure and the intensity of the usable radiant energy in the light beams. The amount of heat developed also depends upon the depth of the color in the copy and the character of the material of which it is formed, which might be referred to as the "radiation-absorbing—heat-producing" material.

Microscopic examination of the plastic film processed in the manner described and separated from the original onto which the radiant energy was directed, reveals a large number of openings arranged in a relatively uniform pattern throughout the area corresponding to the heat generating area of the copy. The openings are of sufficient dimension to permit stencil duplicating inks to pass in ordinary stenciling operations. The resinous material which formerly occupied the openings appears to have migrated and formed into globules or threads which provide a desirable lattice-work across the letter or stencil openings thereby keeping the loop letters intact and imparting greater mass integrity to the unsupported film.

It seems as though movement of the resinous material into areas of the higher concentration leaving openings therebetween may have resulted from the fact that the heated portion of the resinous film is reduced to fluid consistency and responsive to the surface forces operating in masses of the type described, the resinous film breaking to provide open areas and areas of greater resin concentration.

Films of plastic material impervious to ink compositions and having the characteristics of the type described may be fabricated of plastic materials based upon resins such as polyvinylidene chloride (Saran) and copolymers thereof with vinyl chloride or vinyl acetate, polystyrene, polyamides of the type formed by the reaction of a polybasic acid, preferably a dibasic acid, with a polyamine, preferably a diamine (Nylon), polytetrafluoroethylene (Teflon), polychlorotrifluoroethylene, polyethylene, rubber hydrochloride (Pliofilm), styrene-isobutylene copolymer, styrene-acrylonitrile copolymer, and resinous films formed of such film forming materials as polyvinyl chloride, vinyl chloride-vinyl acetate copolymer, polyvinyl acetals, cellulose ethers and esters, such as cellulose propionate-butyrate, ethyl cellulose, nitro cellulose and the like.

It appears also that elastic memory of a stretched or oriented film fosters the desirable rearrangement for separation of the resinous material into open areas and connecting threads of higher resinous concentration. It has been found that an improved stencil can be formed at a lower temperature with a stretched or oriented unsupported film than with normal plastic film. By the use of a stretched film, it is possible to achieve a greater proportion of openings per unit area. In many instances, the use of a stretched or oriented plastic film is to be preferred in the practice of this invention.

Orientation of the type described may be secured in films of the type formed with polyvinylidene chloride, polystyrene, polytetrafluoroethylene, polyethylene, rubber hydrochloride, styrene-isobutylene copolymer, and styrene-acrylonitrile copolymer.

There is also reason to believe that the desired stencil openings in the plastic film may be derived by way of a thermal action such as by decomposition or by chemical

change in the resinous material of which the plastic film is formed. It has been found that this may be the case especially with resinous materials formulated with a halogen group, such as in films formed of polyvinylidene chloride and copolymers thereof with vinyl chloride or vinyl acetate, polyvinyl chloride, vinyl chloride-vinyl acetate copolymers, chlorinated rubber, rubber hydrochloride, and the like, or by omission of stabilizer from the resinous material or by the addition of decomposition catalyst into the material of which the film is formed.

Film thicknesses in the range of 0.1 to 3.0 mils have been found most suitable but a plastic film having less thickness can be used if it is able to provide a barrier to the passage of ink. Greater film thicknesses may also be used, especially if the heated plastic becomes substantially fluid under processing conditions.

With the use of a photoflash lamp, it has been found possible to develop temperatures in excess of 400° F. in fractions of a second. With other systems of the type described it is more difficult rapidly and economically to develop temperatures in excess of 350°-450° F. by the phenomenon of radiating the original copy. Limited only by the ability to develop higher temperatures, the resinous material of which the plastic film is formed may be selected or else modified with softeners, plasticizers or the like to provide for a softening or liquefying point within the temperature range of 150° to 450° F. It will be understood that where the conditions for developing higher temperatures are achieved the softening range of suitable plastic material may be correspondingly broadened.

Suitable plasticizers, softeners and the like for specific resinous materials or cellulosic materials may be selected by those skilled in the art from the data available in the plastics and resinous fields. For example, polystyrene may be suitably plasticized with aryl phosphates such as tricresyl phosphate, chlorinated biphenyl, dibutyl phthalate, and the like. Usually an amount up to thirty-five percent by weight plasticizer is sufficient to impart the desired results, depending, of course, upon the molecular weight of the polystyrene.

Polyvinyl chloride and vinyl chloride-vinyl acetate copolymers may be plasticized with dibutyl phthalate, di-aryl phthalate, dioctyl phthalate, dibutyl cellosolve phthalate, tricresyl phosphate, and triglycol di-(2 ethyl hexanoate) and vinyl chloride-vinyl acetate copolymer may also be plasticized with glycerol esters, camphor, triacetin and the like. Amounts up to forty percent by weight may be successfully used with the above resins to impart the desired results.

Polyvinylidene chloride, which may be oriented while in the plastic-heated stage or while in a super-cooled stage, may be plasticized to the desired degree with any one of a number of plasticizers or combinations thereof including polychloro derivatives of aromatic hydrocarbons and ethers, such as polychloro biphenyl polychloro benzene, and polychloro diphenyl oxide, dibenzyl ether, aralkyl ethers, tricresyl phosphate, hexachloroethylene, styrene oxide, phenoxy propylene oxide and the like.

Acrylic acid ester polymers, such as butyl methacrylate, ethyl acrylate, methyl methacrylate and the like may be plasticized in amounts ranging up to forty percent whenever necessary with dibutyl phthalate, dibutoxy ethyl phthalate, chlorinated biphenyl, tricresyl phosphate, and the like.

Suitable polyamides, preferably formulated of a dicarboxylic acid and a diamine, are usually sufficient in themselves when selected of a polymer, having a low molecular weight and a melting point below 400° F., but the heat-sensitive point may be lowered by compounding with plasticizers such as the sulphonamides represented by p'-toluene sulphonamide.

In the practice of this invention, illustrated schematically in Figure 1, a plastic film 10 of the type described is positioned on top of an original copy 11 having the printed portion 12 uppermost and adjacent the plastic film.

A photoflash lamp 13 is exploded over the assembly described and the radiant energy developed and directed onto the original copy (arrows) is substantially reflected and dissipated by the light areas of the copy and absorbed by the material comprising the "radiation-absorbing-heat-generating" material of the copy (the darker areas of the copy) and converted into heat. The heat developed is of such proportion that rearrangement of the corresponding

areas of the plastic film is occasioned. Numerous openings 14 are formed throughout the heated area leaving the resinous material therebetween in the form of connecting fibers or webs.

The plastic film separated from the copy has the characteristics of a stencil from which a number of duplications of the original can be made by normal stenciling operations.

As shown in Figure 4, the plastic film 20 may be placed on the underside of the copy 21 with the printed portion 22 to be duplicated uppermost. By way of further modification, the assembly may be radiated by traversing the copy with an energized tungsten filament 23 to direct radiations 24 on to the printed side of the copy 21 whereby such radiations are dissipated or substantially reflected by the light areas of the copy and absorbed and converted into heat by material in the dark areas of the copy. The heat is transmitted through the copy and to the plastic film where it functions to cause formation of the desired stencil openings 25 through the corresponding areas of the plastic film. Upon separation, the plastic film may be used as a stencil in ordinary stencil duplicating processes.

Excellent results have been secured when the film 10 or 20 is compounded of a polyvinylidene chloride resin which is oriented while in a supercooled state or in a heated plastic state. The polyvinylidene chloride may be used as a copolymer with vinyl chloride or vinyl acetate, and the resin or the copolymer may be plasticized with up to forty percent by weight of a suitable plasticizer.

Instead of a polyvinylidene chloride, the film may be compounded of a rubber hydrochloride, preferably oriented, having a softening point of 205° to 250° F., or of styrene-isobutylene copolymer having a softening point of about 200° to 300° F. In the event that the film is based on a polystyrene, it is preferred to make use of resin having a molecular weight between 35,000 and 65,000. When such or higher molecular weight polymers are used the desired characteristics may be achieved without plasticizing the resinous materials but it may be plasticized with up to thirty percent by weight chlorinated biphenyl or tricresyl phosphate. Polyvinyl chloride having a softening point of about 200° to 300° F. may be used with or without plasticizer. Vinyl chloride-vinyl acetate copolymers having a melting point of between 200° to 300° F., with or without plasticizer, can also be employed as the film-forming plastic.

It has been found that best definition in the duplicated copy is produced when the stencil-sheet assembly is arranged in direct contact or in close face to face relation with the heat-generating areas of the film. It has also been found that definition is improved when sufficient heat is developed by the absorbed radiations in the minimum amount of time. If prolonged exposure is used to develop adequate heat to accomplish the desired changes in the stencil sheet, there is a tendency for this heat to flow sideways from the letter openings and consequently produce excessively bold and ragged copy. In order to accomplish the desired instantaneous but concentrated exposure, devices such as a photographer's flash lamp, as shown in Figure 1, is preferred. Instead, use may be made of devices in which the source of infra-red ray-bearing light is energized at high wattage by a capacitor similar to that which is used in industrial spot-welding machines. Another device for accomplishing the desired but short exposure to intense rays consists of a relatively long but thin source of infra-red radiation such as a hot wire or tungsten filament lamp (as shown in Figure 4), the radiation from which is focused on the original through the use of suitable lenses and reflectors and which may be adapted to traverse the original at constant speed so that the exposure of each line element is of substantially equal intensity throughout. A still further device for accomplishing the desired short but intense exposure consists of a point source of infra-red ray radiation, such as an incandescent lamp in which the radiation is focused to a relatively fine point through a system of suitable lenses and reflectors onto the surface of the stencil sheet which is mounted with the master copy on a rapidly rotating cylinder. During the rotation of the cylinder, the point source of light moves at constant speed in a direction parallel to the axis of the cylinder until each point element of the copy has been exposed to the concentrated radiation.

It will be apparent from the description that a stencil-

sheet assembly prepared in accordance with this invention will be capable of use for the production of a large number of copies that correspond exactly with the original. In view of the simplicity of the method of manufacture, coupled with the low cost of the materials involved, as well as the failure to injure the original in any way during the manufacture of the stencil, the master can be discarded after use since one or more may be easily prepared again from the original copy which may be filed away in usual office practice. If desired, however, the stencil sheet may be cleaned and preserved for subsequent use in the preparation of additional copies.

It will be apparent from the description that this invention provides a basically new method for preparing a stencil which conforms almost exactly with the copy. By the practice of directing the beams of light onto predetermined and specified areas, it is possible by this method to prepare stencils for duplication of minor parts of a particular drawing or writing. To the best of my knowledge, this is the first time that stencil duplication based upon a technique of this character has been made available for office copy work. It will be manifest that this same technique employing the phenomenon of heat generation from radiant energy absorbed by the copy and reaction with an unsupported plastic film may be used for other duplicating processes, such for example as in the production of hectograph masters or lithographic masters.

Although description has been limited to the use of an unsupported film of ink impervious material for the manufacture of the new and improved stencil, it will be understood that a physical support may be supplied with the film for the purpose of giving it greater strength for resisting the forces incident to normal handling and use and imparting more desirable characteristics for handling and packaging. Such support may be provided in the form of an interlayer sheet or screen or it may be a screen-like web or fabric substantially attached to or embedded in the plastic material.

The technique herein described suggests itself for many other uses and for many other variations, and it will be further understood that numerous changes may be made in the details of construction, arrangement, and operation, without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. In the method of producing a duplicating master from copy, the steps of positioning the copy in surface contact with a thin ink impervious unsupported, continuous film under stress of a film forming thermo-plastic resinous material, directing radiations rich in infra red upon the copy at an intensity and for a time to generate heat upon absorption sufficient when transferred to the thermo-plastic film to cause corresponding areas to be reduced to flowable condition for lateral displacement to form a plurality of interconnected openings in the corresponding areas through which ink may pass.

2. In the method of producing a stencil from copy, the steps of positioning the copy substantially in surface contact with a continuous, unsupported thin ink impervious film under stress of a film forming plastic material reducible to flowable condition at elevated temperature, directing radiations rich in infra red upon the copy at an intensity and for a time to generate heat upon absorption sufficient when transferred to the plastic film to cause corresponding areas to be reduced to flowable condition

for lateral displacement to form a plurality of interconnected openings in the corresponding areas through which ink may pass.

3. In the method of producing a stencil from copy, the steps of positioning the copy substantially in surface contact with an oriented, ink impervious film of a film forming thermo-plastic material, directing radiations rich in infra red upon the copy at an intensity and for a time to generate heat upon absorption sufficient when transferred to the thermo-plastic film to cause corresponding areas to be reduced to flowable condition whereby openings form in the film through which ink may pass.

4. The method as claimed in claim 3 in which the plastic film is based upon a halogen containing thermo-plastic resinous polymer.

5. The method as claimed in claim 3 in which the intensity of rays and time of radiation is maintained to provide a temperature of about 150-450° F. in less than a few seconds.

6. The method as claimed in claim 3 in which the copy is positioned on the thermo-plastic film with the side having the letter outlines to be reproduced as stencil openings in face to face relation with the plastic film.

7. The method as claimed in claim 3 in which the copy is positioned on a thermo-plastic film with the side having the letter outlines to be reproduced in the plastic film positioned away from the plastic film.

8. In the method of producing a stencil from copy, the steps of positioning the copy substantially in surface contact with a highly oriented film of thermo-plastic material characterized by heat sensitivity which causes rearrangement of heated portions of the film into a lattice work of resinous concentrations and openings therebetween through which ink may pass, directing radiations rich in infra red at an intensity and for a time sufficient to generate heat which when transferred to corresponding areas of the plastic film cause rearrangement to form openings through which ink may pass.

9. In the method of producing a stencil directly from a copy, the step of positioning the copy substantially in surface contact with an oriented ink impervious film of a resinous material selected from the group consisting of polyvinylidene chloride, polyvinyl chloride, vinyl chloride-vinyl acetate copolymer, chlorinated rubber and rubber hydrochloride, directing radiations rich in infra red onto the copy at an intensity and for a time to generate a heat pattern corresponding to that of the infra red absorbing-heat generating material in the copy sufficient when transferred to the resinous film to cause corresponding areas to be reduced to flowable condition whereby openings form in the film in corresponding areas through which ink may pass.

References Cited in the file of this patent

UNITED STATES PATENTS

1,238,906	Fuerth	Sept. 4, 1917
1,973,151	Murphy	Sept. 11, 1934
2,140,483	Schutte	Dec. 13, 1938
2,236,754	Gurwick	Apr. 1, 1941
2,256,093	Land	Sept. 16, 1941
2,317,789	Marriot	Apr. 27, 1943
2,351,696	Nichols	June 30, 1944
2,503,758	Murray	Apr. 11, 1950