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METHOD OF MAKING DUPLICATE COPIES

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This invention relates to improvements in methods of making duplicate copies, and more particularly to improvements in offset duplication methods of making duplicate copies of type-written matter, hand written matter, and the like.

Heretofore several methods have been employed for producing copies of matter of the foregoing character, all of which methods result in the production of duplicate copies of master images, which copies are usually produced on paper contacted in some manner with a master having thereon an image of the work to be duplicated, which master contains material quantities of strong dyestuff adapted to be transferred to the copies in the steps followed in the different processes.

In one method, use is made of what is known to the art as a hectograph pan. In this method a gelatin compound is disposed in a pan. A normal master sheet is typewritten, written, or drawn, with an ink strongly colored with basic dyestuff, usually crystal violet, the master being usually in the form of a sheet of paper or the like. Crystal violet is ordinarily used since this dyestuff is more powerful and is more quickly soluble than other dyestuff. The master is laid on the top surface of the gelatin compound in the pan and permitted to remain in contact with the surface thereof until the compound absorbs locally sufficient of the dyestuff to produce at least one hundred copies of the matter to be reproduced. The absorption of dyestuff from the master is in accordance with the lines of the image on the master so that in effect a mirror reverse copy of the matter to be reproduced is formed in the compound. Sheets of copy paper are then contacted with the surface of the compound, resulting in the transfer of sufficient dyestuff from the compound to the copy sheets as to produce copies of the matter desired.

This principle has been further extended to a process in which the gelatin composition is thickly coated on a backing sheet, usually as a roll of considerable length fastened to the drum of a two cylinder machine. The same procedure for causing absorption of dyestuff is followed out so that the composition contains absorbed therein a mirror reverse copy of the original matter and the surface of the gelatin becomes a printing medium. Copy sheets are fed between the master cylinder (having the gelatin surface) and a platen cylinder causing transfer of dyestuff to the copy sheets and thereby producing legible copies of the desired matter.

In still another process, use is made of a method known to the art as spirit duplication. In this process, a master copy in strong soluble basic anilin dyestuff is produced by typewriter, writing or drawing, as in the case of the gelatin processes, except that the typewriting, writing, or drawing is in mirror reverse. Ordinarily, use is made of a special carbon paper whose active surface is placed in contact with one side of the master sheet on which the original typewriting, writing, or drawing is imposed. When the image to be reproduced is imposed on one surface of this master sheet, the other surface thereof, which is in contact with the carbon paper, acquires a deposit of the coating material of the carbon paper according to the lines of impress on the blank surface thereof. Thus a mirror reverse copy of the matter to be reproduced is formed on one surface of the master sheet by the transfer of the coating material from the carbon paper to the master sheet. This mirror reverse copy is attached to the drum of a spirit duplicator and sheets of copy paper are fed thereto in succession. Means are provided for moistening the sheets of copy paper immediately prior to their contact with the master sheet, and since the basic anilin dyestuff in the composition on the master sheet is highly soluble, the moist surface of the copy sheets when contacted with the mirror reverse copy on the master sheet cause the transfer of coloring matter to the copy sheets. In this process, use may be made of any desired solvent, but preferably the solvent used is ordinarily more volatile than water, the practice having been to make use of alcohol, methanol, acetone, or other similar solvents or combinations of solvents. By the use of such solvents, more copies can be produced from a single master, and the copies so produced are sharper than those produced by the use of water. Moreover, the copy so produced dries almost immediately at normal temperature.

In the practice of all of the foregoing processes, certain faults are present which serve to limit the use thereof. Since the processes have required the use of dyestuff which is highly water soluble, it follows that the handling of the dyestuff in most instances results in stains both to the person and the clothing of the user. For example, the moisture of the hands of the user alone is sufficient to transfer material quantities of the dyestuff to the hands, and consequently clothing also readily becomes stained, all of which is highly undesirable. The ribbons, carbons, or fluids which have been used all contain large quantities

of basic dyestuffs, such as crystal violet, rhodamine, Victoria blue, or Victoria green, all of which are water soluble colors. It is evident, therefore, that any process which requires the handling of ribbons, carbon paper, or ink of this character will produce the objectionable results before set forth.

An object of the present invention is to provide new methods for producing duplicate copies, which methods are free from the objectionable results before described.

Another object of the invention is to provide methods of making duplicate copies, which methods involve the use of transfer material which in itself and before further treatment possesses substantially no objectionable color transfer value.

Another object of the invention is to provide methods of producing duplicate copies wherein master copies of the matter being reproduced are formed through the agency of matter having no appreciable color transfer value and wherein such masters are subsequently treated to cause such material to have high color transfer value.

In carrying out the foregoing and other objects of the invention, the present invention contemplates the use of material which in itself possesses no appreciable color transfer value and which material is of a character as to be insoluble in water. Consequently, this material may be handled in any manner required by the processes hereinafter described without incurring the liability of staining the person or clothes of a user.

The basic anilin colors which have previously been used in connection with carbon paper and ribbons are in the form of organic salts or esters of highly complicated organic radicals. The present invention makes use of the desirable qualities of these basic dyestuffs without incurring the undesirable qualities thereof. To this end, instead of using the basic colors themselves, use is made of the bases of such basic colors such as the bases of crystal violet, methyl violet, rhodamine, Victoria blue, Victoria green, Bismarck brown, and auramine or combinations of these bases. Bases of these basic dyestuffs can be manufactured in any suitable manner either as an intermediate step in the normal production of the basic dyestuffs, or as the result of processing basic dyestuffs in solution. For example, when basic dyestuff in solution is treated with dilute alkalies, as for example, sodium carbonate or sodium hydrate, a precipitate of water insoluble basic color base is formed which is the hydrate of the water bearing radical. Such precipitate may be filtered and dried, and the powder so formed may readily be obtained on the market as crystal violet base, rhodamine base, etc.

As a further step in making possible the practice of the processes within the scope of this invention, ribbons or carbons may be made which incorporate, instead of basic dyestuff, the base of such basic dyestuff which is combined with some binding material or vehicle of a character which is substantially free from any acid solvent which would react with the base of the basic dyestuff to convert it into basic dyestuff. Transfer material such as ribbons and carbons so made form the subject-matter of my copending application S. No. 127,170, filed February 23, 1937, and accordingly, illustrative examples of the composition thereof and claims thereto have been incorporated in such copending application.

Ribbons or carbons in accordance with the foregoing can be handled without incurring the liability of staining the person or clothing of a

user since the material which is to be utilized as color transfer material has of itself no appreciable color transfer value and is water insoluble, but must be further treated to cause it to acquire high color transfer value.

Use of the present invention therefore can be made in duplicate processes involving the use of gelatin, either in a pan or on a roll. In such processes the normal image of the matter to be duplicated, if typewritten, can be made on a sheet of paper through the agency of a ribbon of the character before described. The gelatin, either in the pan or on the roll, can be either impregnated or the surface thereof washed with a dilute acid in aqueous solution; as for example, a ten per cent solution of lactic acid. The acid, either on the surface of the gelatin, or impregnated therein serves to react with the base of the dyestuff absorbed from the sheet of paper, having the normal image thereon, to convert such base of the dyestuff into basic dyestuff. Copies may then be made in the usual manner.

In the adaptation of the present invention to spirit duplicating processes, again the normal steps followed in such processes are carried out with the exception that use is made of carbons, or of powdered ink, which have no appreciable transfer value, but which must be subjected to a reaction to acquire such transfer value. A mirror reverse copy of the matter to be duplicated is formed on a master sheet in any of the usual manners such as for example, by making use of a coated carbon containing the base of the dyestuff combined with a suitable vehicle. A mirror reverse image of the matter to be reproduced may be activated by a small amount of a relatively weak acid in a number of ways, of which three are hereinafter set forth.

1. An activated sheet specially prepared is made up of a sheet of paper coated with a saturated solution of solid acid, such as benzoic, in a volatile solution such as alcohol. To such solution is added an alcohol soluble gum such as shellac, which diminishes the tendency of the acid to crystallize on the sheet.

After the master sheet, having the image in mirror reverse thereon, has been fastened to the drum of the spirit duplicator machine, and prior to the preparation of any copies therefrom, an activating sheet, or a series of activating sheets, are fed slowly through the machine. The surface of the activating sheet is moistened by the alcohol or other solvent of the duplicating machine, and this moistened acid bearing surface is firmly pressed by the machine against the master image, thereby transferring sufficient acid to the base of the dyestuff in the master image as to carry out the proper reaction to convert this base of the dyestuff into basic dyestuff. The result of this procedure is that the image on the master sheet is now soluble substantially as if originally made with the objectionable carbons heretofore employed, and copies may be made in the usual fashion.

2. The specially prepared activating sheets may be dispensed with and in lieu thereof any acid soluble in or miscible with the solvent used in the duplicating machine may be added to the solvent in the tank of such machine. For this purpose it has been found that the addition of ten per cent of lactic acid causes the solvent in the tank to have sufficient acidity as to carry out the proper reactions.

When such a solution is used in the duplicator tank, the practice of making copies is followed

out as before with these differences in operation. The acidified solution is supplied to the surface of the copy sheet in such minute but sufficient quantity as to provide sufficient acid to react with the matter of the master image to cause the conversion of limited quantities of such matter into the desired basic dyestuff. This conversion, depending on the quantity of acidified solution supplied to the surface of the copy sheet, is more or less of local nature, but eventually the entire quantity of material in the master image will be converted into the proper dyestuff.

3. In a still further method of performing the necessary chemical reaction, a master sheet having the image in mirror reverse thereon in water insoluble dyestuff is prepared as before, but prior to being attached to the duplicator machine, such sheet is subjected to acid fumes. For example, a closed box may be provided, such box having a felt bottom on which a few drops of acetic acid are placed. A sheet may be introduced into the box and permitted to remain therein for a sufficient length of time to permit the acid fumes to accomplish the desired reaction. In practice it has been found that about five minutes of such treatment will suffice.

The foregoing has been used to describe the present invention in the preferred form. However, there are other methods which may be utilized for securing the water insoluble image on the master copy. One of such methods is to substitute an insoluble "acid" color for the color base hereinbefore described and to activate the master by the use of an organic chemical having a basic reaction, preferably triethynol ammine instead of the mild acid previously described.

Another method is to convey to the master, preferably by ribbons or carbons, an image in color material which is insoluble in water but which is soluble in a particular solvent more volatile than water. In this event the chemical reaction before described is not required since the solvent for any spirit duplication is sufficient to cause the transfer of the coloring material; and in the event of the gelatin processes, such solvent can be incorporated in the gelatin. A variety of such dyestuffs are being made and sold by various dye makers and these dyestuffs particularly are those insoluble in water but soluble in alcohol and acetone respectively. These special dyestuffs, while not preferred in the practice of the present invention, may be used with satisfactory results.

As a still further embodiment of the invention, it is contemplated that ribbons or carbons may be manufactured to contain a material which will react with another material contained in either the spirit solvent or the hectograph gelatin mass to develop color. For example, these steps can be followed for obtaining the reaction between gallotannic acid and iron salts to produce black coloring material and also the reaction between ferrocyanide and ferricyanide for the development of blue coloring matter.

The term "offset duplication processes" in this specification and in the claims is used to define the types of duplication processes described hereinbefore which have the common element that the desired image is produced by dyeing the copy locally as distinguished from lithography (direct or offset) printing, mimeographing, or multigraphing, all of which involve the deposit of a pigment on the copy. The term "hectographic process" has also been used herein to define any process in which the normal image is transferred in mirror reverse to the surface of a gelatin or

other suitable compound from which copies are taken by dyeing the paper locally at such transferred image. The word "hectograph" is used to define devices employed in the above described hectographic process whether such devices be simple pads containing the hectographic composition or machines involving rolls or strips of similar type.

From the foregoing it will be seen that the present invention provides methods of producing duplicate copies by offset duplication, which methods overcome the objection heretofore raised thereagainst due to the extreme solubility of the coloring matter which renders the material, necessarily used in connection with such offset duplication processes, objectionable due to staining of the users' person or clothing. It is to be understood that the invention is capable of modification beyond those examples heretofore set forth and accordingly the limitations to be imposed thereupon are to be such only as are set forth in the following claims.

What is claimed is:

1. The method of preparing a master image for use in offset duplication processes which comprises forming a master image of material which in itself has no appreciable transfer color value and subsequently reacting with said material, a suitable reagent for converting said material into matter having a high transfer color value.
2. The method of preparing a master sheet for use in offset duplicating machines which comprises forming a master image with water insoluble color material and submitting such image to the action of a reagent capable of making such color material water soluble.
3. The method of preparing a master image for hectographic processes which comprises forming a master image of water insoluble material, transferring said material to the compound of the hectograph, and reacting with said material while in said compound a reagent capable of converting such material into water soluble matter having high transferable color value.
4. The method of preparing a master sheet for hectographic processes which comprises forming a master image containing a basic color base and reacting with said base an acid while said base is incorporated in the hectographic composition.
5. The method of preparing a master image for use in offset duplication processes which comprises forming a master image of water-insoluble material which in itself has no appreciable transfer color value and subsequently reacting with said material, a suitable reagent for converting said material into water-soluble matter having a high transfer color value.
6. The method of preparing a mirror reverse image for use in spirit duplicators which comprises forming a master image from color material insoluble in water, and subjecting the material of said image to a reagent to convert such material into water soluble matter.
7. The method of preparing a master image for hectographic processes which comprises forming a master image of water insoluble material and transferring the image material to the compound of the hectograph having associated therewith a reagent capable of converting such water insoluble material to water soluble or transferable color matter.
8. The method of preparing a mirror reverse image for use in spirit duplicators which comprises forming a master image containing basic

color base insoluble in water, and contacting with said image a reagent carrying prepared sheet to convert said basic color base into basic color matter.

5 9. The method of preparing a mirror reverse image for use in spirit duplicating machines which comprises forming a master image with water insoluble color material and submitting such image to the action of a reagent capable of making such color material water soluble, said reagent being included in the liquid supply for the

machines and being supplied to copy sheets passing through the machines.

10. The method of preparing a master image for hectographic processes which comprises forming a master image of material which in itself has no appreciable transfer color value absorbing said material into a hectograph compound and subjecting the absorbed material to a reagent to convert it into matter having high transfer color value. 10

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