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METHOD OF PRINTING

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4 Claims. (Cl. 101-426)

This invention relates to a method of letter press printing.

This application is a continuation-in-part of my co-pending application Serial No. 544,060, filed October 31, 1955, now abandoned.

In the method of this invention a printing medium such as printing ink is applied to a printing form and heated thereon at a temperature and for a time sufficient to dry the medium on the form, that is, the medium becomes dry to the touch. The heated medium is then transferred from the form to a stock, such as paper and the like, by pressing the form and heated medium against the stock. Upon this pressing of the form and medium against the stock, the dry medium is completely transferred from the form to the stock.

The principal feature of this invention therefore is to provide a method of letter press printing in which the liquid printing medium is dried to a dry film condition on a form by heating and is then pressed against the stock while in this heated condition whereupon the dry medium is completely transferred from the form to the stock. Thus, the printing method of this invention is a dry method as contrasted to the ordinary wet method in which the fluid or plastic printing medium or ink is applied to a form and then applied to the stock by pressing the coated form against the stock while the medium is still in liquid or fluid condition. Further, my new printing method involves a complete transfer of the printing medium or ink onto the stock, in distinction to the mere splitting of an ink layer effected in conventional printing.

Other features and advantages of the invention will be apparent from the following description thereof taken in conjunction with representative embodiments of the invention.

Any ordinary printing medium can be used in the practice of this invention so long as the medium is initially in a liquid or fluid state and can be dried by heating to the dry film that is completely dry to the touch, in other words, non-tacky. A vast number of different types of printing media have been tested with the method of this invention without failure, so long as they fulfill these requirements, that is, so long as they are initially liquid or fluid which includes thick semi-plastic media and as long as they can be dried on a form to provide an unbroken film that is dry to the touch and somewhat thermoplastic when subjected in heated condition to printing pressure. In commercial practice it is preferred that the medium be drible at a temperature not lower than about 140° F. Similarly, for commercial printing, it is preferred that the temperature required for drying be not over 350° F. primarily because of the added expense of maintaining such a high temperature. On a commercial basis it is preferred that the printing medium be drible to a dry film (that is, that it has no surface wetness or tackiness) in not more than one minute. Actually, for practical purposes, this time which may be up to one minute should be not more than a few seconds, such as 5 or 6 seconds and, preferably, a small fraction of a second. The printing pressure that is employed in pressing the heated dry film against the stock can be the ordinary printing pressure. The time of contact of the form with the heated printing medium film thereon, or dwell time, against the stock can vary from a very small fraction of a second up to several seconds. However, for commercial use, it is preferred that this dwell time be not more

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than about one second. At the end of the dwell time when the form is withdrawn from the stock it will be found that the dry medium film has been transferred completely from the form to the stock. This is true whether the form is a smooth polished surface or has a rough surface such as is produced by sand blasting.

The printing medium that can be used may be any of the heat set printing inks customarily used in the printing industry. By this is meant both thermosetting inks and thermoplastic inks that become dry to the touch on the printing form or die. Thus, where the ordinary type of printing is practiced, the medium may contain a vehicle including a solvent and a film forming solid material and, optionally, a pigment or pigments. The film forming material may be any of the ordinary resins and may contain modifying agents such as dryers and addition agents. Typical film forming vehicles may contain resins such as cellulose esters (nitrate, acetate or butyrate), alkyd resins, urea-formaldehyde resins, melamine resins, aryl sulfonamide resins, rosin and its esters and soaps, coumarone-indene resins, vinyl and acrylic resins, and other resins conventionally used in coating compositions. All of these and others are well known in the printing industry and all are usable in compounding the printing medium such as inks usable in the methods of this invention.

The printing media that can be used in this invention can also contain ordinary solvents including ketones, ethers, esters, alcohols, ether alcohols, hydrocarbons, chlorinated hydrocarbons, nitroparaffins and others. Other solvents may include furfural and esterified terpenes and others. Again, such solvents and their use in the printing industry is well known. For commercially practical printing media it is preferred that the solvents used have a boiling point between about 140-450° F. Where pigments are used in making the printing media usable in this invention these pigments may be any of those commercially used in the printing industry to give the desired characteristics of color, opacity, body or consistency and the like. Thus, the normal pigments are powders possessing coloring or hiding properties and are capable of being mixed or ground with a vehicle to form a homogeneous mixture. As is customary in the printing industry, certain pigments are more correctly designated as extenders but are customarily included in the pigment class. All such pigments and extenders are well known and widely used in the printing industry.

As can be seen from the above discussion of the printing media ingredients the media that are used in the method of this invention are those customarily used in ordinary heat set printing. A full discussion of such printing inks and printing media is given in "Printing and Litho Inks" by H. J. Wolfe, 5th edition, copyright 1957 by MacNair-Dorland Co.

The printing medium used in the method of this invention has some thermoplastic quality in the heated dry film when subjected to printing pressure. This property is possessed by heat set printing inks generally in spite of the fact that the heated dry film is dry to the touch and cannot be smeared with finger pressure.

The printing method of this invention is not necessarily limited to printing characters on paper or the like. Thus, the method of this invention can be employed for coating stock such as paper stock. In the coating process the liquid coating material is applied to a heated form of large extent and dried on the form in the manner previously described. The heated dry film is then pressed on the stock under ordinary printing pressure in the manner described, whereupon the film is transferred completely from the form to the stock. Thus, wherever the word "printing" is used herein and in the claims, it is intended to include such coating processes.

The method of this invention is of course different

from conventional printing processes wherein the printing medium or ink image dries or begins to dry after it has been transferred to the printing stock and subsequent to the completion of the printing operation. In the present invention, of course, the printing medium is dried on the form to the condition where it feels dry to touching or rubbing before being transferred to the stock. In other words, the film of dry medium is not affected by physical touch or rubbing or marking. It is a necessary requirement of the present invention that the printing medium be thusly dried on the form, and this is most conveniently done by applying the medium to the form that has previously been heated to a temperature sufficient to dry the coating medium thereon to produce the heated dry film having the above characteristics.

The present invention in which the printing medium is transferred in a substantially dry state lends itself to embossing simultaneously with the printing step because the dry impression is not subject to smearing or blurring of outline upon the stock, while the latter migrates into the recesses of the type or engraving during the imposition of pressure. Instead, the ink image will conform to the movement of the stock without detriment or damage to the appearance, finish, or precision of image definition.

This novel procedure of combining the printing and embossing steps not only obviates difficulties heretofore encountered in achieving registration between printing and embossing but effects a great saving in printing and embossing dies. In other words, conventional printing type and plates may be employed without requiring the use of special locking embossing dies.

The invention also lends itself to combining the steps of laminating and printing when lamination of the stock is desired. In such a case the lamina, or the stock, may be coated with a temperature sensitive adhesive and the stock and lamina brought together and superposed at the same point at which the printing step is performed. The heated printing form is applied to the laminae, or vice versa, and simultaneously achieves the dual function of transferring the printing medium to the stock and adhering the laminae together by the transfer of heat from the form through the laminae to the heat sensitive coating. This simultaneous combination of dry laminating and printing steps has not heretofore been feasible with inks that require drying after transfer thereof.

The printing medium as mentioned above may be dried on the form merely by using a heated form preheated to the drying temperature. However, if desired, a hot air blast against and across the medium coated form may also be used to aid the drying. This, however, is not required. The surface of the form is preferably a white metal such as steel, zinc, aluminum, manganese, nickel, chromium and the like in order to aid in the complete transfer of the dry medium film from the form to the stock. Non-white metals such as copper or brass can be used but a larger dwell time is required. The form may be heated by any means desired and conventional equipment such as ink rollers and the like are used in the customary manner to deposit ink or other printing mediums on the form.

The stock to be imprinted may be paper (including coated paper), regenerated cellulose, paper board (including coated board), textiles (including coated textiles), sheets or films of synthetic or natural resins or plastics, metal foils such as aluminum foil, various laminates (including paper-metal foil, plastic-paper, textile-plastic, etc.) and the like. One of the important advantages of the invention is that the stock need not be heated or preheated in the printing. Thus the stock immediately before printing may be at room temperature.

Although the printing medium may consist only of a film forming material and a solvent, particularly where the printing is a coating operation, the medium may also contain modifying ingredients such as a separating com-

pound, preferably a paraffin, wax or fatty acid, although other compounds of a waxy or oil character such as silicones, soaps, or fatty acids and alkyl esters of fatty acids have been employed successfully. The function of such a separating compound is to act as a lubricant or releasing agent to reduce the adhesion between the ink and the form so that the dried ink medium separates from the form or printing plate and becomes adhered to the stock. As long as the form is made from the materials noted above, the affinity of the medium for the form will always be less than its affinity for the stock or the coating thereon. More accurately, the gums or resins in the ink which constitute the adhesive have a greater tendency to adhere to the coating on the stock by heat sealing or to the surface of paper, paper-board or any other type of printable stock than to the form.

It is also possible to include in the inking medium a plasticizer such as dimethyl phthalate to cause plastic flow of the dried ink during the printing step. Dimethyl phthalate also has separating properties, but its main function is to render the solid medium pliable and subject to plastic flow.

Example 1

One formula for an ink that has been tested with success is as follows, with ingredients expressed in terms of percentage of total weight:

	Percent
Carbon black	7.6
Milori Blue	2.2
Cellulose acetate vehicle.....	75.5
Dimethyl phthalate	8.2
Linseed oil fatty acid	3.7
"Santolite" resin MHP	2.8

The preferred form of cellulose acetate vehicle is as follows:

	Percent
Low viscosity cellulose acetate	9.2
"Santolite" MHP	3.9
Triacetin	65.9
Ethyl lactate	21.0

The materials are adequately mixed and milled in the customary way for at least fifteen minutes on an open type mill. The carbon black and Milori Blue are of course included for color only and do not enter into the present invention except insofar as they have characteristics common to the remaining ingredients, in which case a change in their amounts will dictate changes in the amounts of other ingredients. The "Santolite MHP" is a condensation product of formaldehyde and toluene sulfoamide.

The above medium may, for example, be employed to print on white patent coated newsboard coated with cellulose acetate lacquer. The lacquer begins to soften at about 180° F. and if the temperature exceeds about 225° F. signs of deterioration appear and delamination and other defects result. Higher temperatures cause bubbling and extreme tackiness in the coating. A printing rate of one impression per second and an operating temperature of the ink of from 180 to 225° F. produces satisfactory results. Upon increasing the printing speed, a high temperature is desirable and upon lowering the printing speed, a lower temperature can be employed.

If it is desired to emboss the stock as well as print on it, it is merely necessary to reduce the speed (to allow for necessary dwell time) and increase the printing pressure or substitute more resilient backing up materials for the stock.

If it is desirable, in addition, to incorporate a laminating step, it is necessary to coat the laminae or the stock to which it is to be adhered with a suitable conventional temperature sensitive heat sealing adhesive for the temperature range involved. The lamina or tissue to be printed is then merely interposed between the other lamina and the form before the printing step is carried out.

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From the above description it will be seen that the present invention differs most radically from prior art methods of printing in that the ink is dried before imprinting on the stock occurs. Although the medium is transferred in a solid state to the stock, it is plastic and pliable.

Inasmuch as printing by the present invention takes place in a dry state without absorption of the printing medium into the body of the stock, greater economy is effected than has heretofore been possible because all of the ink is efficiently employed in creating an image and none is lost by absorption.

Because of the fact that no drying is required after the printing step takes place, different colors may be added in rapid succession regardless of the type of stock employed. In other words, it is never necessary to slow down the printing operation to permit drying.

Another advantage of complete transfer printing with a dried ink medium is that it is not necessary to resort to many different kinds of inks for the infinite variety of stocks available for printing. In fact, utilization of complete transfer dry printing can result in standardization of compositions so that a universal composition can be employed for practically every purpose of letter press printing.

It will also be apparent that a change-over from one type of stock to another can be successfully accomplished merely by adjustment of the form temperature.

The simple adjustment of form temperature also permits variation in the finish of prints, whether mat, lustrous or of an intermediate degree. For example, when printing from a form surface that has been brought to a high polish, the result will be prints of the same glossy finish. By merely adjusting the temperature to a somewhat lower level, a mat finish may be obtained. This is due to the fact that complete transfer printing employs the technique of press polishing.

The present invention contemplates not only complete transfer printing and embossing by dried ink media, but also the combination of such printing with the step of lamination as described above.

The process by which drying of the ink medium is effected is not restricted to evaporation as it is obvious that the same result may be achieved by evaporation, oxidation, polymerization, gelation, etc.

Although complete transfer dry printing finds its greatest application in use with type or plate forms, it is obvious that it may be employed for coating the stock through the use of a smooth form.

In addition, since the transferred ink medium has heat sealing characteristics, the printed stock may be coated with a thin film of paper or the like that may be adherently secured to the printed stock without the addition of heat sealing material.

In the above Example 1 and in the following examples the ink was applied to a printing form that had been heated to a temperature near the boiling point of the solvent and permitted to stand until the ink coating had formed a film that was dry to the touch. The heated form with the dried film thereon was then pressed against the paper stock for about one second. This caused the film to be transferred from the form to the paper stock.

The following examples present different ink formulations that were used in the above process.

Example 2

The ink consisted of 100 grams of vehicle, 10 grams of finely divided carbon black and 3 grams of Milori Blue. The vehicle was made up of 20% of half-second viscosity cellulose butyrate and 80% carbitol acetate boiling at 248° C. All percentages used herein are by weight.

Example 3

The formulation here was made up of 100 grams of

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the vehicle of Example 2 and 100 grams of titanium dioxide.

Example 4

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 15% 3-second cellulose acetate and 85% ethyl lactate boiling at 154.5° C.

Example 5

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 24% half-second cellulose butyrate and 76% ethyl lactate boiling at 154.5° C.

Example 6

The ink consisted of 100 grams of vehicle, 10 grams of carbon (Magula) and 3 grams of Milori Blue. The vehicle was made up of 25% half-second cellulose butyrate and 75% carbitol acetate boiling at 217° C.

Example 7

The formulation was made of 100 grams of the vehicle of Example 6, 10 grams of carbon (Bead Black) and 3 grams of Milori Blue.

Example 8

The formulation was made up of 100 grams of the vehicle of Example 6 and 100 grams of titanium dioxide.

Example 9

The formulation was made up of 100 grams of the vehicle of Example 6 and 100 grams of gold.

Example 10

The formulation was made up of 66.6 grams of the vehicle of Example 6 and 33.3 grams of titanium dioxide.

Example 11

The formulation was made up of 200 grams of the vehicle of Example 6 and 100 grams of Chrome Yellow.

Example 12

The formulation was made up of 200 grams of the vehicle of Example 6 and 50 grams of Iron Blue.

Example 13

The formulation was made up of 100 grams of the vehicle of Example 6 and 25 grams of gold.

Example 14

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 15% 3-second cellulose acetate and 85% carbitol acetate boiling at 217° C.

Example 15

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 25% half-second cellulose butyrate and 75% diacetone alcohol boiling at 169° C.

Example 16

The formulation was made up of 100 grams of the vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 25% half-second cellulose butyrate and 75% butyl lactate boiling at 188° C.

Example 17

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 25% half-second cellulose butyrate and 75% butyl cellulose acetate boiling at 191.6° C.

Example 18

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle

was made up of 25% half-second cellulose butyrate and 75% DM Dowanol 16 (a polyglycol ether) boiling at 194.1° C.

Example 19

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 25% half-second cellulose butyrate and 75% Ansol Ether #161 boiling at 216° C.

Example 20

The ink consisted of 100 grams of vehicle, 10 grams of carbon black and 3 grams of Milori Blue. The vehicle was made up of 25% ethyl cellulose and 75% carbital acetate boiling at 217° C.

Example 21

The ink consisted of 67% vehicle (Heatset Varnish I), 18% carbon black, 5% Iron Blue and 10% Petroleum Solvent. The vehicle was made up of 50% zincated rosin and 50% Petroleum Solvent which has a boiling range of 475-550° F. and has a KB volume between 20 and 30.

Example 22

The ink consisted of 70% vehicle (Heatset Varnish II), 18% carbon black, 3% Victoria Blue and 9% Petroleum Solvent II. The vehicle was made up of 50% Pentalyne K (pentaerythritol rosin ester) (Hercules Powder Co.) and 50% Petroleum Solvent II which has a boiling range of 425-500° F. and a KB volume between 20 and 30.

The printing medium that is applied to the form or die is preferably a thick and viscous paste. This has two advantages, first, in this condition there is less solvent to be driven by the heat from the form and, second, an excess amount of solvent is avoided that can cause a film to break on the form and give an imperfect impression.

The printing medium used in this invention may contain any thermoplastic or thermosetting film former that will result in a continuous film on the form or die and that is dry to the touch. The film former must also flow under the pressure and temperature conditions of the printing step. The solvent used must be one that will dissolve the film former and that can be driven off by the heat of the form in a reasonable time.

The set time or the time that the printing medium remains on the form or die is important. Thus, it should be sufficiently short so that the printing can be done efficiently so far as time is concerned yet must be long enough so that the film on the form is dry to the touch but is plastic under the pressures and temperatures of printing. The set time which can be determined quite easily empirically by anyone skilled in the art is determined by a number of factors including the amount of solvent used, the thickness of the desired film and the drying of the film so that an adequate transfer from the form to the stock is achieved.

The dwell time or the time the form or die is pressed against the stock can also be determined quite easily empirically by those skilled in the art. The dwell time is of course long enough to transfer the film from the form or die to the stock.

In typical conditions of practicing the invention by

using the printing medium or ink of Example 2, the die temperature was 290° F. with the result that the set time varied between 3 and 5 seconds for most efficient printing and the dwell time between 2 and 15 seconds. Within these ranges excellent results were produced with a set time of 1½ seconds and a dwell time of 3 seconds when the die temperature was 315° F. As is obvious, the set time and dwell time may be decreased by raising the die temperature and increased by lowering the die temperature. Under conditions of relatively high die temperature the set time has been reduced safely to about ¼ second while the dwell time has been reduced to about 0.2 second.

Having described my invention as related to the embodiments set out herein, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the accompanying claims.

I claim:

1. The method of letter press printing, comprising: applying a heat drible liquid printing medium to a printing form; heating said medium on the form for not more than about six seconds at a temperature sufficient to dry the medium to the touch on the form; and applying the heated medium while said medium is still hot to a stock that is substantially at room temperature by pressing the form and hot medium against the stock, said method resulting in the complete transfer of the dry hot medium from the form to the room temperature stock.

2. The method of claim 1 wherein said pressing of the form to the stock is for not more than about one second.

3. The method of letter press printing, comprising: applying a heat drible liquid printing medium to a printing form previously heated to a temperature sufficient to dry the medium to the touch on the form in a period of not more than about six seconds; maintaining the medium on the form for not more than said period to thusly dry the medium; and applying the heated medium while said medium is still hot to a stock that is substantially at room temperature by pressing the form and hot medium against the stock, said method resulting in the complete transfer of the dry hot medium from the form to the room temperature stock.

4. The method of letter press printing, comprising: applying a heat drible liquid printing medium to a white metal printing form previously heated to a temperature sufficient to dry the medium to the touch on the form in a period of not more than about six seconds; maintaining the medium on the form for not more than said period to thusly dry the medium; and applying the heated medium while said medium is still hot to a stock that is substantially at room temperature by pressing the form and hot medium against the stock, said method resulting in the complete transfer of the dry hot medium from the form to the room temperature stock.

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