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A. E. GESSLER ET AL

2,157,385

METHOD OF PRINTING

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Fig. 1.

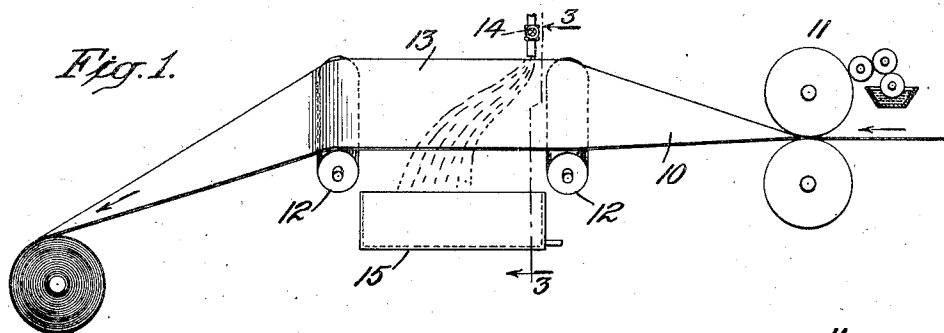


Fig. 2.

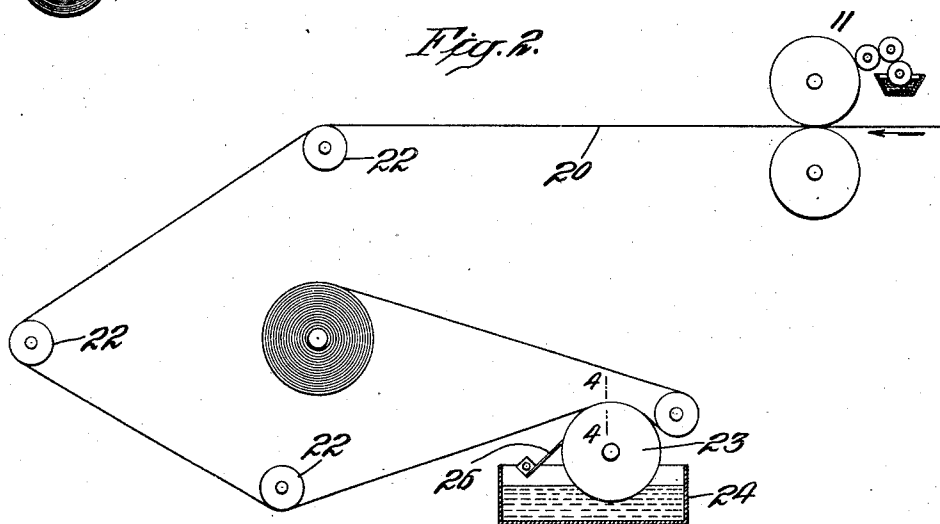


Fig. 3.

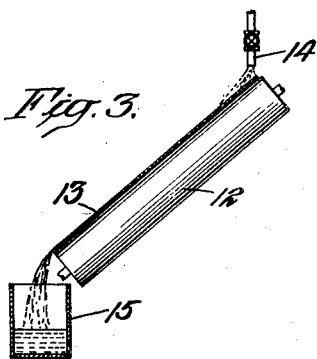
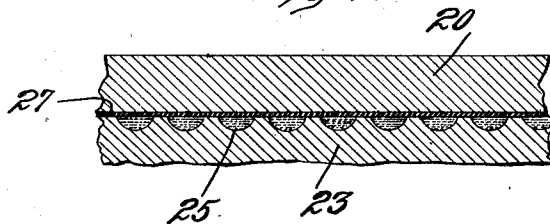


Fig. 4.



INVENTORS
 Albert E. Gessler
 Albert J. Gitteras
 AND Charles J. Carlson
 BY Robert W. Rye
 THEIR ATTORNEY

UNITED STATES PATENT OFFICE

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METHOD OF PRINTING

Albert E. Gessler, Ardsley-on-Hudson, and Albert F. Guiteras, New York, N. Y., and Charles F. Clarkson, Philadelphia, Pa., assignors to Interchemical Corporation, a corporation of Ohio

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23 Claims. (Cl. 101-416)

This invention relates to a method of printing and is directed to a rapid drying of printed matter printed with an ink which does not dry on the press.

In carrying out our method, we use a printing ink whose vehicle consists of a tendacious, solid binder or thickener dissolved in a solvent which is practically non-volatile at room temperature, so that the ink does not dry on the ink distributing parts of the press.

Our method for rapidly drying printed matter printed with such an ink consists in replacing the bulk of the non-volatile solvent in the printed film of ink with a volatile liquid which is miscible with the ink solvent but a non-solvent for the ink binder. This substitution not only precipitates the ink binder, but also leaves the ink film wet only with a volatile liquid which quickly evaporates at room temperature, leaving the printed matter dry without the long delay or the application of high heat which would have been necessary for drying had the original non-volatile solvent remained in the ink film.

The replacing of the non-volatile solvent with the volatile liquid is effected by diluting the non-volatile solvent with the volatile liquid and then removing all or the greater part of the mixture of non-volatile solvent and volatile liquid from the ink film so as to leave the film wet with a liquid which is wholly or mainly volatile at room temperature. The replacement is most desirably effected in such a way as to leave as small an amount of liquid as possible on the printed matter. This small amount of volatile liquid quickly evaporates at room temperature leaving the printed matter dry a few moments after it is printed.

The particular diluent used in the method depends upon the character of the solvent of the ink. For reasons of economy, it is desirable to use water as the diluent. To permit this it is necessary to use as the solvent in the ink a liquid which is miscible with water and which becomes a non-solvent for the binder of the ink on dilution with water. Solvents of this character include diethylene glycol, diethylene glycol monoethyl acetate, diethylene glycol monobutyl ether, and tetraethylene glycol monomethyl ether acetate. We give a few specific examples of inks which may be set by the method of our invention, using water as the diluent:

Example I

Parts
by weight

Permanent Peacock blue.....	30
RS nitrocellulose $\frac{1}{4}$ second viscosity (wet with 30% alcohol).....	30
Diethylene glycol monobutyl ether.....	40

Example II

Parts
by weight

Carbon black.....	14
Prussian blue.....	6
Ester gum.....	47
Diethylene glycol monobutyl ether.....	31
Syncera wax.....	2

These inks are dispersions of coloring matter in organic viscous vehicles consisting of a liquid component and a thickening agent or binder for the coloring material dissolved in the liquid component in sufficient quantity to give the ink the consistency of an ordinary oil-varnish printing ink. The liquid component, having a vapor pressure at 20° C. as low as the vapor pressure of diethylene glycol monobutyl ether at 20° C., is practically non-volatile at room temperatures, and the ink is stable under ordinary press room printing conditions. The liquid component is miscible with the diluent employed.

Another convenient diluent for use in our method is ethyl alcohol. Additional diluents may be suitable members of the hydrocarbon class or other solvents not dissolving the binder and being miscible with the solvent of the ink. A suitable hydrocarbon derivative is, for instance, dichloroethylene. Alcohol can be used with inks whose solvents are not water-miscible, but are miscible with alcohol. We have found that the solvent diethylene glycol monobutyl ether acetate is miscible with ethyl alcohol and becomes a non-solvent for cellulose compounds or resins when diluted with as little as 8% to 15% of alcohol. We give specific examples of inks which may be set by our method, using alcohol as the diluent:

Example III

Parts
by weight

Permanent Peacock blue.....	30
RS nitrocellulose $\frac{1}{4}$ second viscosity (wet with 30% alcohol).....	30
Diethylene glycol monobutyl ether acetate.....	40

Example IV

Parts
by weight

Carbon black.....	14
Prussian blue.....	6
Ester gum.....	47
Diethylene glycol monobutyl ether acetate.....	31
White petrolatum.....	2

Both the diluents mentioned, water and alcohol, are much more volatile than the solvents of the inks of Examples I to IV.

The particular manner in which the diluent is applied to the printed sheet and in which the mixture of diluent and solvent is removed from the printed sheet constitutes an important sub-

sidary part of our invention. Because the less volatile solvents and even plasticisers are employed as the fluid portion of the ink, they will remain behind if water and similar more volatile solvents are merely applied and allowed to evaporate. Our invention includes two alternative methods, specific examples of which are illustrated in the accompanying drawing in which Figs. 1 and 2 are diagrammatic elevations illustrating the two alternative methods, and Figs. 3 and 4 are enlarged sections on the lines 3-3 and 4-4 of Figs. 1 and 2.

One method consists in causing a stream of the diluent to flow or spray on and across, and then away from, the printed surface. This method is desirable when the diluent is inexpensive and when the character of the material on which the ink is printed is such that the material is not injured by a stream of diluent flowing across it. It may be used to advantage where the diluent is water and the material is "Cellophane," parchment, or a heavily glazed paper.

This method is illustrated in Figs. 1 and 3 which show a long strip of sheet material 10 passing through a printing press 11 which applies ink to its upper surface, and then over to roller supports 12 which hold a portion 13 of the sheet material in an inclined position. A spigot or spray nozzle 14 directs a stream of the diluent upon the printed surface of the inclined portion 13 of the sheet. The stream passes rapidly across the inclined portion 13, and off the lower edge of this portion and into a catch-pan 15. In passing across the printed matter, the stream of diluent dilutes the solvent in the ink so as to precipitate the binder, and carries the greater part of the diluted solvent into the catch-pan before any substantial evaporation of the diluent mixed with the solvent can occur.

The other method consists in distributing the diluent in closely spaced capillary cavities and moving each cavity into contact with a small area of the printed surface and then out of contact with the printed surface. This method is applicable where the material to which the ink has been applied is ordinary paper, as it involves little wetting of the material by the diluent.

This method is illustrated in Figs. 2 and 4, which show a long strip or web of sheet material 20 passing through a printing press which applies ink to the upper surface of the material, then around roller supports 22 which invert the web so as to place its printed surface downward. The web is then drawn over the upper portion of a cylinder 23 whose lower portion is in a trough 24 in which the diluent is placed. The cylindrical surface of the cylinder 23 is provided with closely spaced capillary cavities 25 shown in the magnified Fig. 4. These cavities may be made by etching, and the cylinder 23 may be either a grained cylinder such as is used in lithography, an etched copper cylinder like a uniform tone half-tone plate, or a roller covered by cloth or the like. The cylinder 23 is rotated so that its surface travels at the same speed as the traveling web to avoid rubbing action between them. As the cylinder rotates, the cavities in its lower side are filled with the diluent in the trough 24. The filled cavities pass under a doctor blade 26 which removes any liquid adhering to the raised portions of the cylindrical surface, but leaves the cavities full of the diluent which is held in them by capillary action. As the filled cavities pass across the top of the cylinder, the liquid in them comes in contact with small closely spaced areas

of the ink 27 on the lower surface of the sheet 20. Such contact may be insured by pressing the printed matter against the cylinder, either by the tension of the web, or by an impression roller placed above the web over the cylinder. The solvent in the ink is diluted by the diluent in the cavities so that the binder of the ink is precipitated on the sheet and the greater part of the solvent becomes mixed with, and diffused in, the liquid in the cavities. As the cavities pass out of contact with the sheet, they carry away from the precipitated binder the greater part of the diluted solvent. This is because each cavity, although small, retains a volume of liquid materially larger than the volume of solvent in the area of the ink with which it comes in contact.

In the arrangement illustrated, the solvent extracted from the ink becomes diffused in the diluent in the trough 24. By changing the liquid in the trough 24 or by providing for a circulation through the trough 24, the concentration of the solvent in the diluent in the trough is kept low so that the liquid carried out from the trough in the cavities does not contain a sufficient amount of the solvent to prevent it from diluting the solvent in the ink with which it comes in contact.

In this method some of the cavities necessarily come into contact with the surface of the web 20 between the areas to which ink has been applied. The volume of liquid held in the cavities is, however, so small that there is no substantial wetting of the web by the diluent.

In this specification and the claims which follow, we have used the words "solvent" and "non-solvent" to mean capable or incapable of forming with the binder of the ink a solution, in the ordinary sense of that term which includes both true solution and colloidal dispersions.

What is claimed is:

1. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent which is stable on the press, which consists in diluting the solvent of the ink on the printed matter with a more volatile non-solvent to precipitate the binder, and removing the greater part of the mixture of solvent and non-solvent from the precipitated binder before evaporation of the non-solvent.

2. The method of setting a printing ink whose vehicle comprises a colloid dissolved in a solvent which is stable on the press, which consists in causing a stream of a non-solvent liquid more volatile than the solvent and miscible therewith to flow across and away from the printed surface of the printed matter without coming in contact with the rear face of the printed matter.

3. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in placing the printed matter with its printed surface downward, filling an open-top receptacle with a non-solvent liquid miscible with the solvent of the ink and more volatile than that solvent, and moving said receptacle so as to bring the upper surface of the liquid therein into contact with the printed surface of the printed matter and then out of contact therewith.

4. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in distributing a non-solvent liquid miscible with the solvent of the ink and more volatile than that solvent in a plurality of closely-spaced cavities, and moving said cavities so as to bring the upper surface of the liquid in them into contact with the printed surface of the printed matter and then out of contact therewith.

5. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in distributing a non-solvent liquid miscible with the solvent of the ink and more volatile than that solvent in a plurality of closely spaced capillary cavities, and moving said cavities so as to bring them into contact with the printed surface of the printed matter and then out of contact therewith.

6. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in passing the printed matter printed side downward over the upper surface of a roller containing a plurality of closely spaced cavities, rotating said roller in synchronism with the movement of the printed matter, filling the cavities with a non-solvent liquid miscible with the solvent of the ink before the cavities reach the upper surface of the roller, and removing the mixture of non-solvent and solvent from the cavities after they pass the upper surface of the roller.

7. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in passing the printed matter printed side downward over the surface of a roller containing a plurality of closely spaced capillary cavities, rotating said roller in synchronism with the movement of the printed matter, and filling the cavities of said roller with a non-solvent liquid miscible with the solvent of the ink.

8. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in passing the printed matter printed side downward over the upper surface of a roller containing a plurality of closely spaced capillary cavities and having its lower surface in a trough, rotating said roller in synchronism with the movement of the printed matter, filling the trough with a non-solvent liquid miscible with the solvent of the ink which is carried to the printed matter in the cavities of the roller and returned to the trough mixed with the solvent of the ink, and changing the liquid in the trough so as to maintain a low concentration of the solvent therein.

9. The method of printing which comprises dissolving a binder in a solvent which is stable on the press, mixing a pigment in said solution, printing a film of said pigmented solution on a sheet, diluting the solvent in the film on the sheet with a non-solvent more volatile than the solvent to precipitate the binder on the sheet, and removing the greater part of the diluted solvent from the precipitated binder before evaporation of the diluent.

10. The method of printing which comprises dissolving a water-insoluble binder in a water-miscible solvent which is stable on the press and less volatile than water, mixing a pigment in said solution, printing a film of said pigmented solution on a sheet, diluting the solvent in the film on the sheet with water to precipitate the binder on the sheet, and removing the greater part of the diluted solvent from the precipitated binder before evaporation of the water.

11. The method of printing which comprises dissolving a water-insoluble binder in diethylene glycol monobutyl ether, mixing a pigment in said solution, printing a film of said pigmented solution on a sheet, diluting the solvent in the film on the sheet with water to precipitate the binder on the sheet, and removing the greater part of the diluted solvent from the precipitated binder before evaporation of the water.

12. The method of treating printed printing ink with a liquid without substantial wetting of the material on which the ink has been printed, which consists in distributing the treating liquid in a plurality of closely spaced capillary cavities and moving said cavities so as to bring them into contact with the printed surface of the printed matter.

13. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in bringing only the printed surface of the printed matter into momentary contact with a non-solvent liquid more volatile than the solvent and miscible therewith to extract the solvent from the ink on the printed matter without saturating the base of the printed matter.

14. The method of setting a printing ink whose vehicle comprises a binder dissolved in a solvent, which consists in bringing a non-solvent liquid more volatile than the solvent and miscible therewith into contact with only the printed surface of the printed matter, and immediately thereafter separating said liquid from said surface, whereby the binder is precipitated by extraction of the solvent without saturation of the printed matter.

15. The method of printing which comprises dissolving a binder in a solvent which is practically non-volatile at room temperature, mixing a pigment in said solution, printing a film of said pigmented solution on a sheet, bringing a non-solvent liquid more volatile than the solvent into contact with only the printed surface of the sheet to dilute the solvent in the film on the sheet to precipitate the binder on the sheet, and removing the greater part of the diluted solvent from said surface of the sheet before substantial penetration of the liquid into the sheet.

16. The method which comprises printing upon a continuously traveling web with an ink whose vehicle comprises a colloid dissolved in a solvent, causing approaching and separating movements between the printed surface of the web and a non-solvent liquid miscible with the solvent to bring each successive portion of only the printed surface of the traveling web into momentary contact with said liquid, whereby the solvent is extracted from the ink on the web to precipitate the binder on the web.

17. The method which comprises printing upon a continuously traveling web with an ink whose vehicle comprises a binder dissolved in a solvent, inclining a portion of the printed traveling web at an angle to the horizontal with one edge higher than the other and with its printed surface uppermost, and causing a stream of a non-solvent liquid more volatile than the solvent and miscible therewith to flow across and away from the uppermost surface of said inclined portion of the web.

18. The method which comprises printing upon a continuously traveling web with an ink comprising a coloring material and a vehicle therefor containing a binder and a solvent with a sufficiently low vapor pressure to make the ink stable on the press, and thereafter diluting the solvent by the application of a non-solvent diluent of higher vapor pressure to the web and thereby setting the ink by precipitation of the binder upon the web.

19. The method which comprises applying to a sheet by ordinary printing an ink having the consistency of ordinary printing ink and including a pigment and a vehicle therefor, comprising a binder dissolved in a solvent having sufficiently

low vapor pressure to make the ink stable on the press, thereafter momentarily contacting the printed surface of the sheet with a liquid which is miscible with the solvent, which is a non-solvent for the binder and pigment, and which is more volatile than the solvent, and immediately removing said liquid from said surface of the sheet, whereby the ink is set to a state of substantial dryness.

10 20. A method for rapidly drying printed matter carrying a film of ink containing a binder dissolved in a relatively non-volatile solvent, which comprises causing a stream of a relatively volatile non-solvent liquid miscible with the ink solvent to flow across and away from the printed surface of the printed matter to extract the relatively non-volatile ink solvent and leave the printed matter wet with relatively volatile liquid.

20 21. A method for rapidly drying printed matter carrying a film of ink containing a binder dissolved in a relatively non-volatile solvent, which comprises placing the printed matter with its printed surface downward, filling an open-top receptacle with a relatively volatile non-solvent liquid miscible with the solvent in the ink, and moving said receptacle so as to bring the upper surface of the liquid therein in contact with the printed surface of the printed matter to extract

the solvent from the ink film and leave the printed matter wet with relatively volatile liquid.

22. Method of printing and rapidly drying the printed matter which comprises printing a thin film of ink containing a binder dissolved in a non-volatile solvent on the surface of a sheet, momentarily contacting said film of ink on the printed sheet with a relatively volatile non-solvent which is miscible with said solvent, and immediately removing the bulk of the solvent and non-solvent from the presence of said film and sheet, whereby to avoid immersing and soaking the sheet, and also to avoid subjecting the sheet to the high temperature required for rapidly evaporating said solvent.

23. In the method which comprises printing on paper with an ink containing a binder dissolved in a non-volatile solvent, the steps which comprise momentarily contacting said film of ink on the paper with a relatively volatile non-solvent which is miscible with said solvent, and immediately removing the bulk of the solvent and non-solvent from the presence of the film and sheet, whereby the ink is rapidly set and immersion and soaking of the sheet are avoided.

ALBERT E. GESSLER.
ALBERT F. GUITERAS.
CHARLES F. CLARKSON.