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PRINTING INKS

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This invention relates to printing inks and more particularly to printing inks of the type designed to permit rapid drying or setting of the printed impression by the application of heat, steam, liquid water, or a combination thereof.

Modern printing methods, and especially the operation of high speed rotary, web-fed presses, require that the ink be rapidly dried and bound to the paper so that the paper may be immediately printed on the reverse side with no transfer of ink to the guide bars, guide rollers, or second side impression cylinders of the press.

In order to meet these requirements, it has previously been proposed to include volatile solvents in the printing ink and quickly vaporize the solvent following printing by the application of heat to the freshly printed web, leaving the ink substantially dry and bound to the paper.

A difficulty heretofore experienced with inks of that type is that where too volatile a solvent is used, the ink tends to dry prematurely on the ink distributing rollers and printing plates, resulting in the paper web being picked or ripped by adhering to the tacky, partially dried ink on the printing surfaces. On the other hand, if a solvent of low volatility is used, excessive drying temperatures are required in order to obtain the desired rapid rate of drying.

In order to avoid the necessity of using a solvent of too high volatility, and yet obtain the desired printing speed in processes of this type, it has usually been necessary to effect the drying by subjecting the printed matter to such high temperatures as tend to weaken the paper, usually of the order of 300° to 700° F., and frequently leads to interruption of the press-operation due to the breaking of the web. Such operations are also costly because of the large amount of fuel required for heating the web to those high temperatures.

Further difficulties encountered in the selection of a solvent of suitable volatility have been the tendency of some vehicles to produce inks which permit too great a penetration of the ink into the paper, or which have poor transfer properties with respect to the inking mechanism or to the printing surfaces or to the web, or which fly off from the rapidly rotating cylinders by centrifugal action, or in which the dried ink film tends to rub or scuff off the printed matter.

It has more recently been proposed to set the ink on the printed matter by the application of steam, superheated steam, or even liquid water. However, the inks now being used in the art which set by the application of steam, the so-called "steam-set" inks, cannot be used with half-tone plates for long runs without causing specking or "fill-up" and thus printing results of unsatisfactory quality.

It is an object of our present invention to provide inks having a nitrocellulose base and which are press stable, i. e., will not dry prematurely on the inking mechanism and printing plates, but which can be rapidly dried at substantially lower temperatures than those currently required with presently available inks.

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A further object is to provide inks which may be dried or set by application of either heat, steam, superheated steam, or liquid water, or a combination thereof, to give satisfactory prints, with no specking or "fill-up" when used with half-tone plates.

A further object is to provide inks having, in addition to the properties just noted, superior transfer properties and a lower penetration into the paper than the inks currently used, and by which the pigment is bound more firmly to the paper and will not rub or scuff off. A still further object is to provide an ink of the type described which, at high printing speeds, will cohere and adhere to the rapidly rotating surfaces with less flying, or misting, than currently available inks of this type.

These and other objects are attained by our present invention which provides an ink consisting essentially of a novel combination of ingredients and proportions thereof hereinafter fully described.

The inks of our present invention comprise a coloring material dissolved, or suspended, in a vehicle consisting essentially of nitrocellulose of the alcohol-soluble type, containing not more than 11.7% nitrogen, dissolved in an alkanediol having not more than 8 carbon atoms per molecule.

It has previously been proposed to use nitrocellulose of the ester-soluble type as a base for printing inks. However, nitrocellulose of the type previously proposed is not soluble in the alkanediols used in accordance with our present invention and is unsuited to our present purpose.

We have discovered, however, that nitrocellulose of the alcohol-soluble type, just noted, which has been nitrated to an extent not exceeding 11.7%, e. g., 10.7–11.7%, is readily soluble in these alkanediols, either with or without heating, and provides an ink vehicle which, when compounded with suitable coloring matter, results in an ink which is amenable to rapid drying or setting of the printed impression either by the application of heat, steam, superheated steam, liquid water, or a combination of these drying and setting methods, and which avoids the previously noted difficulties experienced with steam-set inks. The resultant ink also has excellent transfer properties, and has good flow characteristics and excellent printing properties in all other respects. Further, the resultant ink has good press stability, that is, it does not dry prematurely on the press. Nevertheless, the printed impression may be dried at drying temperatures much lower than those heretofore required.

We have obtained most advantageous results when using for this purpose an alcohol-soluble nitrocellulose of low viscosity and especially one having a viscosity of about $\frac{1}{4}$ second. However, nitrocelluloses of this type, having a viscosity of $\frac{1}{2}$ second, 5–6 seconds and 40–60 seconds have also been found to be soluble in the alkanediols previously noted and may be used, with advantage, in accordance with our present invention. The viscosity of the nitrocellulose does not appear to be critical so long as the particular nitrocellulose is soluble in the alkanediol or mixture of the alkanediols used.

The proportion of nitrocellulose used is also subject to considerable variation, depending upon the desired characteristics of the ink. Generally satisfactory results may be obtained using proportions of nitrocellulose within the range of 2% to 25%, based on the weight of the ink. Especially advantageous results have been obtained where the proportion of nitrocellulose is within the range of 2% to 10% by weight of the ink.

As the alkanediol, one may, for example, use 1,2-propanediol, or 2-methyl-1,2-propanediol, or 1,5-pentandiol or 2-ethyl-1,3-hexandiol, or 2-methyl-2,4-pentandiol. We have found the 2-methyl-2,4-pentandiol particularly advantageous for this purpose. However, other alkane-

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diols having not more than 8 carbon atoms, or mixtures thereof, may be used with advantage.

We have found that solutions of the nitrocellulose and these alkanediols have excellent pigment-wetting properties and that the inks resulting from incorporating pigments, or other coloring material, therewith gives excellent results in printing with half tone plates over long runs without causing specking or "fill-up," regardless of the particular method used in drying or setting the ink.

Where desired, the nitrocellulose film may be modified by including in the ink a substantial proportion of a high boiling material of the type known to the art for their ability to modify such films. For instance, we may incorporate in the ink substantial proportions of dioctylphthalate, tricresylphosphate, castor oil, camphor, dibutylsebacate, or other esters, ethers, ether-esters or related materials.

We have, with particular advantage, incorporated in the ink for this purpose a substantial proportion, of the order of 5 to 20%, based on the weight of the ink, of a mixture of high molecular weight alcohols, ethers, and esters, the alcohols of the mixture containing 8 or more carbon atoms per molecule and the esters and ethers of the mixture containing 16 or more carbon atoms per molecule, the mixture boiling within the range of about 210° to 360° C. Such mixture of high boiling alcohols, ethers and esters have been used, with particular advantage, in conjunction with nitrocellulose of ¼ second viscosity, and of 10.7% to 11.2% nitrogen content, and 2-methyl-2,4-pentandiol as the alkanediol solvent.

The invention will be further illustrated by the following specific examples. It will be understood, however, that these examples are by way of illustration and are not intended to be limitative.

Example I

A wet-process Peacock Blue ink has been prepared, as hereinafter described, from the following ingredients and proportions thereof:

	Parts
¼ second nitrocellulose (10.7-11.2% nitrogen) ---	5.4
2-methyl-2,4-pentandiol -----	58.1
Pigment -----	36.5

In preparing the ink, the nitrocellulose, which has been wetted with 30% ethanol for safe handling, is dissolved in the alkanediol and the pigment, or other coloring material, uniformly dispersed therein. The solution of the nitrocellulose in the alkanediol may be effected by conventional means, for instance, by placing these ingredients in a ball mill, or other suitable container equipped with a stirrer, and agitating until a homogeneous, clear, viscous fluid results. The solution of the nitrocellulose may be aided by heating, where desired, but usually heating is not necessary. Following solution of the nitrocellulose, the pigment may be added and mixed with the vehicle as by stirring in a conventional mixing device. The resultant mass is then passed over an ink mill until a smooth homogeneous ink results.

An ink in which a modifier for the nitrocellulose film was incorporated is illustrated by the following example of a wet-process channel black ink.

Example II

	Parts
¼ second nitrocellulose (10.7-11.2% nitrogen) ---	5.6
Tricresylphosphate -----	1.6
2-methyl-2,4-pentandiol -----	50.0
2-ethyl-1,3-hexandiol -----	17.4
Pigment -----	25.4

The compounding of the several ingredients may be effected as previously described, the tricresylphosphate being added with the alkanediol.

Where desired, other resins, soluble in the alkanediol, or mixture of these alkanediols, may also be included in the ink, as illustrated by the following examples:

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Example III

A wet-process chrome yellow ink has been prepared from the following ingredients in proportions thereof:

	Parts
¼ second nitrocellulose (10.7-11.2% nitrogen) ---	4.0
Zein -----	5.0
2,3-butylene glycol -----	30.5
2-methyl-2,4-pentandiol -----	25.5
Pigment -----	35.0

Example IV

A wet-process Phloxine Red ink has been prepared from the following ingredients and proportions thereof:

	Parts
¼ second nitrocellulose (10.7-11.2% nitrogen) ---	4.4
A rosin-maleic adduct -----	9.6
2-methyl-2,4-pentandiol -----	35.5
1,5-pentandiol -----	21.5
Pigments -----	29.5

Example V

A particularly advantageous ink in which the nitrocellulose film is modified by the inclusion in the ink of a mixture of high molecular weight alcohols, ethers, and esters, of the type previously described herein, has been prepared as follows.

By the procedure previously described, an ink varnish was prepared from the following ingredients and the proportions thereof:

	Parts
¼ second nitrocellulose (10.7-11.2% nitrogen) -----	33
Alcohol-ether-ester mixture -----	13
2-methyl-2,4-pentandiol -----	53

To the foregoing varnish, the pigment and additional alkanediol were added, in accordance with the following formula:

	Parts
Above varnish -----	23
2-methyl-2,4-pentandiol -----	42
Pigment and pigment extender -----	35

As the pigment extender, we may, for instance, use calcium carbonate, China clay, blanc fixe, or the like. Where desired, the pigment may be used without extender.

The invention is not restricted as to the type of pigment used. Where a blue ink is desired, the pigment may, for instance, be Peacock Blue, or Milori Blue, or phthalocyanine blue. Where a yellow colored ink is required, the pigment may, for instance, be chrome yellow, benzidine yellow, or Hansa yellow. For a red ink, the pigment may, for instance, be phloxine, lithol rubine pigment scarlet, or the like. For black ink, the pigment may, for instance, be channel black, furnace black, or lamp black.

The proportions of solvent, pigment and other binders, where used, may be varied over a considerable range depending on the properties of the ink desired, such as shade, viscosity, gloss, tinting strength, and the like, as is understood by the art. Where desired, the ethanol added with the nitrocellulose may be eliminated during the compounding of the ink, for instance, by solvent interchange. However, its presence in the finished ink is not usually objectionable.

We claim:

1. A printing ink comprising a coloring material dispersed in a vehicle consisting essentially of nitrocellulose of the alcohol-soluble type containing not more than 11.7% nitrogen, dissolved in an alkanediol from the group consisting of 1,2-propanediol, 2-methyl-1,2-propanediol, 1,5-pentandiol, 2-ethyl-1,3-hexandiol, 2-methyl-2,4-pentandiol and 2,3-butylene glycol, the proportion of nitrocellulose being within the range of from about 2% to 25%, based on the weight of the ink.

2. The printing ink of claim 1 in which the nitrocel-

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lulose is of $\frac{1}{4}$ second viscosity having a nitrogen content within the range 10.7% to 11.2%.

3. The printing ink of claim 2 in which the nitrocellulose is present to the extent of 2% to 10% by weight of the ink.

4. The printing ink of claim 3 in which the alkanediol is 2-methyl-2,4-pentandiol.

5. The printing ink of claim 4 in which there is also incorporated a substantial proportion of a mixture of high molecular weight alcohols, esters and ethers, the alcohols containing at least 8 carbon atoms per molecule and the esters and ethers containing at least 16 carbon atoms per molecule the mixture boiling within the range of 210°-360° C.

6. The printing ink of claim 1 in which there is also incorporated a substantial proportion of a mixture of high molecular weight alcohols, esters and ethers, the alcohols containing at least 8 carbon atoms per molecule and the esters and ethers containing at least 16 carbon atoms per molecule the mixture boiling within the range of 210°-360° C.

7. The printing ink of claim 1 in which there is also

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incorporated a resinous material soluble in the alkanediol.

8. The printing ink of claim 1 in which there is also incorporated a high-boiling film-modifier for the nitrocellulose:

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