STENCIL DUPLICATING INKS

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This invention relates to stencil duplicating inks and it relates more particularly to a water base stencil duplicating ink adapted for use with stencil duplicating machines or for use in other stencilling operations wherein an ink composition is transferred through stencil openings to an impression medium.

This application is a continuation-in-part of our co-pending application Ser. No. 93,414, filed May 14, 1949, and now abandoned.

As in a stencil duplicating machine of the rotary type or the like, the stencil duplicating ink is supplied in substantially continuous fashion to an ink pad or other like reservoir or distributing medium. The ink is transferred from the pad through the openings of a stencil to the impression medium on the other side, in effect, in response to forces existing at the point of contact between the rotating cylinder and an impression roller. Drying of the applied ink occurs usually by absorption of the vehicle or carrier into the impression medium or into interstices between the fibers of which the copy sheet is formed.

Characteristics which are desirable in a stencil duplicating ink are manifold and, in many respects, non-analogous to ink compositions commonly used for printing or for writing. For example, in order properly to function in a duplicating machine, the ink should have sufficient binding to minimize leakage from the cylinder and from the ink pad and to prevent flooding of the stencil. On the other hand, in order to produce uniform copy of good quality, the ink should have sufficient flow to provide for satisfactory transmission through the stencil openings to the impression medium and to enable uniform and rapid distribution of the ink composition through the ink pad. The ink composition should also be capable of meeting another set of contrasting conditions. For example, the ink should be sufficiently slow drying while in the machine to minimize premature hardening on the ink pad or undesirable clogging of the stencil openings. On the other hand, the ink should be sufficiently quick drying when applied to the impression medium, otherwise it is necessary to resort to special devices or other costly practices in order to handle copy within a reasonable time and eliminate setoff. Other general qualifications desired in a stencil duplicating ink include drying without feathering or without forming an oily or colored letter outline generally referred to in the industry as “halo,” and it should not be subject to “slow-through” which is defined as visibility from the opposite side of the impression medium. The ink should also be stable under conditions of storage and use and it should be non-corrosive to the machine parts with which it might come in contact. Upon drying, it should be resistant to moisture, the common solvents and other substances with which the copy might come in contact as well as to normal use.

Many of these desirable characteristics are incapable of being secured in stencil duplicating inks which have heretofore been produced. Preparation of acceptable stencil duplicating inks has, in the past, been limited because of the presence of large amounts of oil deemed necessary to impart flow of the desired character and simultaneously to function as the carrier for the coloring agent. The greater proportion of the oily substances which have been used are of the non-drying type, such as castor oil, palm oil, coconautoil and the like. When such non-drying oils are present in large amounts, they permit a highly objectionable degree of setoff and smear unless special devices such as slip-sheeting are used in the handling of the copy. The problem of drying may be alleviated to some extent by using, as the impression medium, highly absorbent paper stock which rapidly absorbs the vehicle but the use of such absorbent medium limits the possibility of obtaining sharply defined copy because of feathering.

The high oil content is also directly responsible for the presence of objectionable letter outlines or “halo” in the copy. Stencil duplicating inks of the oil base type are further burdened by the fact that they are limited in use to impression media of a highly absorbent nature and cannot successfully be used with hard or highly filled paper such as card, ledger bond or enamel stock.

In order to avoid the objectionable features characteristic of oil base stencil duplicating inks, emulsion inks still using oil as the base have been formulated but many of the limitations inherent in the oil base inks remain. Emulsion inks which have heretofore been produced introduce a number of additional operating problems because of their lower stability which often causes separation to occur at some stage in its use prior to transmission through the stencil whereby the ink composition becomes incapable of use or whereby the ink pad or stencil may become clogged to prevent uniform ink distribution and further complicate the production of copy of good quality. In addition, the inner phase of the ink emulsion is frequently formulated to contain sulfonated glycerides or other sulfonated compounds which are corrosive to the machine parts or other elements in which the ink might be contained.

It is an object of this invention to produce a stencil duplicating ink which embodies the desirable characteristics previously described for an ink composition.

Another object is to produce a stencil duplicating ink which is substantially free of oil and is thereby not limited to restrictions imposed by the presence of oily substances.

A further object is to produce a stencil duplicating ink having a desirable balance in flow characteristics for operation successfully in stencil duplicating machines and in other stencilling operations for the production of copy of good quality.

A still further object is to produce an oil-free stencil duplicating ink which embodies a desirable balance of slow drying while in the stencil duplicating machine and rapid drying upon transmission to the impression medium.

A still further object is to produce a stencil duplicating ink which may be used in the production of copy on hard, filled or highly finished impression medium without requiring the use of special devices for handling.

Another object is to produce a stencil duplicating ink which is quick drying and permits handling of the copy almost immediately after duplication without setoff or smear and which becomes substantially impervious to moisture, many hydrocarbons and solvents upon drying.

A still further object is to produce a low viscosity stencil duplicating ink having flow of the desired character, which is substantially non-corrosive, non-inflammable, safe, stable and easy to manufacture and use.
An important object of this invention is to compound a stencil duplicating ink composition which is substantially free of oily substances. We have succeeded in producing a stencil duplicating ink free of oil by the formulation of a water base ink having characteristics capable of surpassing ink compositions which have here-tofore been produced. As used herein, the term "water base" defines ink compositions prepared in accordance with this invention having water present as the major diluent and carrier wherein bodying agents are dissolved to impart flow of the desired character. In the practice of this invention, the water content of the ink composition may range as high as 75–85 percent by weight of the composition and generally is present in amounts greater than 50 percent by weight.

Body and flow of the desired character may be achieved in the water base stencil duplicating ink by solution therein of a water soluble alkylene glycol polymer such as polyethylene glycol, polypropylene glycol and the like polymers of polyglycols preferably having a molecular weight above 1000 and which may range to a molecular weight of 15,000 or more. Such compounds are marketed at the present time under the trade name "Carbowax" by Carbide & Carbon Chemical Corporation of New York city or under the trade name "Polyglycol P" by Dow Chemical Company of Midland, Michigan.

Proper concentration of the alkylene glycol polymers and derivatives thereof required to impart the desired flow characteristics to the ink composition has been found to depend largely upon the molecular weight of the compound, the constituent groups of which the monomers are formed and the materials with which the glycol polymers are associated in solution. To avoid inconvenience at the present time, to define the concentration of the bodying agent as an amount capable of introducing a viscosity into the ink composition equivalent to a measurement of 35–150 seconds with a Stormer Viscometer measured under a 200 gram load at 20°C with a water baffle and thermometer well and using a standard cup. The viscosity range should not be taken by way of a specific limit in defining the concentration of the bodying agent which may be used because the flow requirements for ink compositions may vary with changes in duplicating machines and in the printing associated with their use. By way of specific illustration, flow of the desired character may be secured by the use of alkylene glycol polymers and derivatives thereof in concentrations ranging from 30–60 percent by weight of the ink composition depending upon the molecular weight. Amounts in the higher range will be required with the use of the lower molecular weight compounds and less of the higher molecular weight compounds will be required to secure equivalent viscosity conditions.

As the coloring agent, use may be made of dyes or pigments soluble or dispersible in the aqueous medium. Representative of the class of dyes which have desirable solubility characteristics are the nigrosine dyes, the triphenylmethane dyes, rhodamine dyes, thioflavine dyes, auramine dyes, quinon-imide dyes, xanthene dyes, sulfonated triphenylmethane dyes, and nitro dyes. These include the acid dyes such as the mono-, di- and sodium sulfonates of the nitro, azo, pyrazoline, quinoline, azine, xanthene and anthraquinone groups. Suitable pigments include lamp black, carbon black, malachite green, iron blue, cadmium yellow, lead chromate and the like. Pigments are usually dispersed as a discontinuous phase in suitable carriers such as water, solutions of the resin, or solutions of the bodying agent.

The amount of dye in the ink composition depends upon the characteristics of the coloring material. Such dyes, even when used in small quantities, are capable of imparting sufficient color to lend legibility to the copy. With others, it is necessary to use higher concentrations of dye to secure the desired effect. The lower limit of dye concentration is determined by its tinctorial strength which may vary widely from compound to compound. The upper limit is often influenced by economic factors or by solubility factors. We have found that generally more than 0.2 percent by weight are suitable for water base stencil duplicating inks. Other dyes may be used in corresponding ratio in accordance with their characteristics, as pointed out above. When pigments are used, it is often desirable to use concentrations of higher than 3 percent by weight but the upper limit generally is about 15 percent by weight.

In view of the fact that speed of drying is directly related to penetration of the ink composition in the impression paper, it is desirable to increase the penetrability of the ink composition into the copy sheet. In order to improve penetration and to facilitate distribution of the ink composition through the ink pad, it is desirable to incorporate a wetting agent as an ingredient in the ink composition. Suitable wetting agents may be selected from a large number of well known materials such as the aliphatic sulfonated esters of the type diocetyl esters of sodium sulfosuccinates (Aerosols), fatty acid quaternary ammonium compounds and salts (Duponols), aromatic sulfonates such as dibutylphenol sodium disulfonates (Areskelene) and sulfonated others such as Tensol. Less than 2 percent but generally more than 0.2 percent by weight of the wetting agent is sufficient to impart the desired wetting characteristics although more may be used if desired.

Another important improvement in stencil duplicating ink compositions which may be secured in accordance with the practice of this invention comprises the possible addition of a humectant which operates to reduce the rate of evaporation of the diluent to prevent inadvertent drying in the machine and which also appears to impart some degree of viscosity. Such modification in viscosity resulting from the incorporation of a humectant is not necessarily measurable by viscosimeters operating at high shear but appears to exist at least superficially and minimizes leakage of the ink composition from the ink pad whereby operation of the duplicating machine is beneficially affected. Liquid polyhydric alcohols such as ethylene glycol, diethylene glycol, glycerol and polyglycols appear to impart these desirable characteristics. Use may also be made of alkololamines such as diethanolamine, triethanolamine, triethanolamine sulfamates and the like. In view of the similarity between the humectant and the bodying agent, the amount of one which is incorporated is substantially unlimited although it is preferred to limit the concentration thereof in the ink composition to from 10–40 percent by weight.

It has also been found that the alkylene glycol polymers may be converted upon drying of the ink composition to a less soluble phase which increases the resistance of the copy to attack in use. In order to prevent instability in the ink composition by insolubilization in the alkylene glycol polymers in solution, it is desirable to make use of materials capable of the aldehyde reaction which are latent in aqueous medium but active to effect the desired insolubilization upon drying. Representative of such latent aldehyde compounds are glyoxal, pyruvic aldehyde and the like. Glyoxal may be used in amounts ranging from 5–20 percent by weight of the bodying substance while substantially larger amounts of pyruvic aldehyde are necessary to give comparable results. To a water extent, it is believed that the aldehyde is also capable of reaction with the polyhydric alcohols used as a humectant to further insolubilization thereof in the copy.

By way of illustration, but not by way of limitation, the following examples are given as representative of compositions embodying features of this invention:

**Example 1**
5.0 percent nigrosine water soluble dye
47.0 percent polyethylene glycol (6000 M. W.)
flow in the ink cylinder is substantially eliminated without reducing the ability of the ink composition to pass through the stencil openings in normal duplicating operations; and simplicity in the manufacture of the ink compositions responsive chiefly to the use of water soluble elements as ingredients and the possible elimination of grinding or other means for incorporating the colors into the ink composition.

It will be understood that the basic substances may be prepared with a minimum amount of water incorporated therein for marketing in concentrated form as a paste or without water incorporated therein for marketing in dry form for subsequent dilution at the station of use with aqueous medium to the desired viscosity. It will be further understood that miscible solvents, such as the lower alcohols may be substituted in part for water as the diluent in the ink composition. Numerous other modifications and substitutions may be made with respect to the materials and amounts and method of incorporation without departing from the spirit of the invention, especially as defined in the following claims.

We claim:

1. A stencil duplicating ink consisting essentially of water as diluent, a tintorial agent present in sufficient quantity to impart legibility to the copy, a water soluble alkylene glycol polymer present in an amount within the range of 30-60 percent by weight having a molecular weight greater than 1000 selected from the group consisting of a polyethylene glycol and a polypropylene glycol for bodying the ink composition and to provide an adherent base upon drying, and a liquid polyhydric alcohol present in an amount up to 40 percent by weight.

2. A water base stencil duplicating ink composition consisting essentially of water as diluent, a tintorial agent present in sufficient quantity to impart legibility to the copy, a water soluble alkylene glycol polymer having a molecular weight greater than 1000 and selected from the group consisting of polyethylene glycol and polypropylene glycol present in amounts ranging from 30-60 percent by weight, and an aldehyde selected from the group consisting of glyoxal and pyruvic aldehyde present in amounts up to 20 percent by weight of the ink composition.

3. A stencil duplicating ink composition consisting essentially of water as diluent, a tintorial agent present in sufficient quantity to impart legibility to the copy, a water soluble alkylene glycol polymer selected from the group consisting of a polyethylene glycol and a polypropylene glycol having a molecular weight greater than 1000 present in amounts ranging from 30-60 percent by weight, a liquid polyhydric alcohol present in amounts ranging up to 40 percent by weight, and an aldehyde selected from the group consisting of glyoxal and pyruvic aldehyde present in amounts up to 20 percent by weight.

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