An improved image control means comprising a typing sheet particularly adapted for use in a thermal duplicating process. The typing surface of the sheet is formed by a substantially uniform mixture of oil receptive particles and oil resistive particles. The typing sheet has a thickness not in excess of about 2.5 mils and is used in conjunction with a backing sheet having a thickness of at least about 2 mils.
FIELD OF THE INVENTION

The present invention generally relates to image duplicating and more particularly to thermal duplicating processes and improved image control means for use therein.

BACKGROUND AND SUMMARY OF THE INVENTION

Various types of thermal duplicating processes, that is, processes which involve the thermal transfer of heat-sensitive material, are well known in the art. See, for example, those processes described in U.S. Pat. Nos. 3,122,997 and 3,122,998 issued to Racynski et al., as well as U.S. Pat. Nos. 1,514,677, 2,501,495, 2,611,313, 2,808,777, 2,939,009, 3,109,748, 3,181,965, 3,260,603, 3,262,386, 3,267,848, 3,283,708, 3,293,055, 3,304,015, 3,384,015 and 3,706,276.

In the typical thermal duplicating process, an original is placed on conventional typing paper with a typewriter or the like. This typed original is then duplicated by placing it in an assembly with a transfer sheet substrate carrying a fusible layer of heat sensitive material and an image-receiving sheet which has its receiving surface in contact with the fusible layer. Since the typing ink which is used to form the typed image on the original is infrared absorptive, the areas on the original which bear the typed image absorb more infrared radiation than do the image-free areas of the original. Exposure radiation in the infrared region is converted to thermal energy in the original so that the image areas of the original acquire a higher thermal energy content than the image-free areas, and provide a thermal pattern corresponding to the visible image pattern. The thermal pattern is conducted through the substrate of the transfer sheet to the heat sensitive layer to selectively fuse the fusible material thereof in a pattern corresponding to the visible image. The fused material is transferred to the image-receiving sheet, which then serves as the desired duplicate or is used as a master in a solvent duplicating or lithographic printing process.

In spirit duplicating systems, the heat-sensitive layer contains waxes, or the like fusible material, mixed with an alcohol-soluble dye to produce the image color in the ultimate copy. The waxy material is thermally transferred to the image-receiving, master sheet after which the master is placed on a drum and contacted successively with sheets of copy paper wet with volatile alcohol solvent for the dye. The solvent dissolves part of the dye in the master image and transfers it to the copy sheet.

In a second type of spirit duplicating process, the transferred image material contains a chemical reagent which reacts with a second reagent in the copy sheet to form the visible image. In offset lithographic printing, the image-receiving sheet serves as a printing plate. Each such process depends on thermal image transfer at some stage in order to form a master from which copies can be made.

Although thermal image transfer processes usually are relatively inexpensive and effective, they generally yield images of poor resolution. This is also true with impact master duplicating systems. The latter systems employ a special typing sheet which becomes the master when typed upon. Any mishap in the duplication process which destroys or damages the master necessitates completely retrying the impact master. Furthermore, storage of the original for future use is inconvenient since the dye transfer tendency of such masters requires that special storage drawers be used so that the masters can be isolated from other documents. This is not the case with thermal duplicating processes, since the original is not utilized as the duplicating master.

Despite the advantages of thermal duplicating processes over impact master duplicating processes, the latter are more frequently used, possibly because of the slightly better image resolution of the latter. In this regard, thermal duplicating processes provide copies which exhibit more non-uniformity in the depth, clarity and completeness of type characters, so that in some cases the hollow outlines of the characters are seen. Moreover, edge sharpness of the characters is less so that overall image appearance has less contrast.

One reason for the inferior quality of the thermally transferred image is the poor quality of the original image for thermal copying purposes. While the typed image on the original typing paper may appear on the naked eye to be sharp and uniform, such image may be incapable of being accurately duplicated by the thermal process. In this regard, most original typing papers are uncoated and have surfaces roughly structured by randomly distributed paper fibers. A typed image on such a surface does not make even and smooth contact with the back of the transfer sheet, thus adversely affecting the flow of the heat pattern and the visible pattern formed therefrom. Moreover, during typing the impact of the typing keys on the original paper causes indentation of the paper. During thermal imaging, the indented image-bearing area of the original cannot make direct contact with the transfer sheet, so that there is a void or air gap therebetween. This also impedes transfer of the thermal pattern and may distort the pattern.

A further reason for inadequate image duplication in thermal duplicating processes is the lack of uniformity of filling of the typed characters on the original typing paper. The typing ink does not wet the paper fibers of the original typing paper well enough to stick uniformly. Instead, the ink tends to collect in the crevices formed by the interstices of the paper fibers. Accordingly, the heat pattern generated from the typed characters of the original sheet is uneven and has unsharp edges.

A still further, more recent, reason for inadequate thermal image duplication is the commonplace use of plastic typing ribbons, such as those formed of Mylar, wherein a combination of dye and wax is used in place of ink. Such images tend to transfer to the back of the master during thermal duplication processes.

The present invention solves the described problems encountered by conventional thermal duplicating processes by providing a typed original which features uniformly inked typed characters with sharp edge definition and absence of indentations in the area of the typed characters. When a Mylar type ribbon is used, the image is anchored and secured in original position. The type characters are broken up into a large number of sub-units which exhibit a greater heat loss than large solid typed areas, and therefore require a greater exposure time to infrared radiation to provide the desired thermal pattern. However, since the sub-units are all small and there is no large solid area in the original typed sheet, regardless of the size and shape of the
typed characters, all image areas can be given the same exposure to infrared radiation in order to produce uniform and sharp thermal images and subsequent sharp and uniform duplicated visible images.

In accordance with the present invention an original typing sheet is provided which has a typing surface formed by a substantially uniform mixture of oil receptive particles and oil resistive particles. Thus, the typing surface is divided into small regions which are alternately oil receptive and non-receptive (oil resistive). Moreover, the typing sheet is thin (not in excess of about 2.5 mils) and compliant and backed in use with a movable smooth backing sheet of at least 2.0 mils in thickness, so that when it is typed upon, no appreciable indenting occurs. Instead, energy transmitted to the typing sheet upon impact thereof by the typing keys is transferred to and absorbed by the backing sheet.

As a result of the described surface division, ink and dye-wax combinations are strongly anchored to the oil receptive particles resulting in a reticulation of the image and retention of the image on the typing sheet during thermal processing. Image spread is markedly decreased as a result of heat dissipation through the oil resistive regions. The result is a typed original which retains its relatively smooth highly uniform surface while providing inked characters forming a visible pattern which can be more accurately thermally transferred. The resulting thermal transfer copies are clearer, sharper and of higher overall quality than heretofore obtained by thermal duplication.

The improvement in duplicating processes, provided through the use of the novel original typing sheet and backing sheet combination, can be effected inexpensively and without additional processing steps. Moreover, the novel original typing sheet and backing sheet can be readily fabricated of conventional materials. Further advantages are set forth in the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an enlarged schematic cross-section of an embodiment of the improved image control means of the invention;

FIG. 2 is an idealized schematic view of one type of surface of a typing sheet utilized in the embodiment of FIG. 1, taken on the line 2—2 of FIG. 112; and

FIG. 3 is an idealized schematic view of the surface of a second type of surface of a typing sheet which can be utilized in the embodiment of FIG. 1.

DETAILED DESCRIPTION

The present invention is most advantageously utilized in conjunction with a backing sheet and with certain thickness parameters. Referring to FIG. 1, the typing sheet is one component of a control means comprising an original typing sheet 12 which includes a paper base sheet 14 having a coating 16 on one surface thereof which preferably is calendered. The coating 16 is the backing sheet 20. The thinner the sheet 12, within practical limits of resistance to cutting by typing keys and handling without damage, the more efficient will be the energy transfer.

It will be noted that the base sheet 14 can be fabricated of any cellulosic fibrous material so as to be of sufficient strength, compliance and thickness. Usually, relatively thin typing paper or the like will be satisfactory. Tissue typing paper is one suitable example. Others include capacitor paper and Onion skin paper. Usually, the base 14 will have a thickness of between about 1 and about 1.5 mils, with the coating 16 comprising the remaining thickness of the sheet 12.

The coating 16 is generally from about 0.1 to about 0.4 mils in thickness and comprises a particulate mixture of inorganic pigments or whiteners in a dry adhesive binder. Specifically, the particulate mixture comprises a substantially uniform mixture of oil receptive particles (A) and oil resistive particles (B) in a volume ratio of A:B about 0.5:1 to about 8:1.

The term "oil receptive" is meant to define particles having an oil absorption of at least 30 weight percent. The term "oil resistive" is meant to define particles having an oil absorption of less than 20 weight percent. It will be appreciated that many materials will be oil receptive or oil resistive depending upon a number of physical factors such as particle size, method of formation, heat treatment if any, etc. Since a particular material can be either oil receptive or oil resistive, designation of that material as one or the other is meant to refer to the compound in such physical state, as known to the art, as to have that property. In this regard, for any particular material, the smaller the particle size the greater will be its capacity to absorb oil. Therefore, in the practice of the present invention, it is found to be desirable to use as oil receptive particles inorganic salts and oxides having a diameter of about less than 4 microns, preferably in the range of about 0.1 micron to about 4 microns, and to use as oil resistive particles inorganic salts and oxides having a diameter of at least 8 microns, preferably in the range of about 8 microns to about 100 microns.

Subject to the foregoing criteria, the inorganic particulate material used in the coating 16 includes such inorganic salts and/or inorganic oxides as, for example, glass beads, clays, such as calcite clay, kaolin or attapulgite, bentonite, hydrated aluminum silicate, silica, magnesia, titania, alumina, calcium carbonate, magnesium carbonate and the like. A suitable mixture of such components can be mixed with a powdered or liquid adhesive binder, such as a water-soluble or organic solvent-soluble resin, for example, acrylic emulsion, polyvinyl acetate, starch, polyster resin, alkyl resins, polystyrene, melamine-formaldehyde, urea-formaldehyde, polyvinyl chloride or the like, in a suitable solvent.

The coating formulation, as specifically illustrated by the Examples herinafter, can be obtained by simple mixture of the particles in desired ratio in the chosen binder and solvent. The coating can be formed by applying the formulation in the wet state on a tissue paper (1.5 mil thickness) base sheet so as to form a layer about 0.3 mil thick after drying and calendering. The coating is calendered, e.g., with a smooth steel face roller at 1000 pounds per square inch to obtain a coating having the desired distribution of oil receptive and oil rejective regions.
Referring to FIG. 2, there is illustrated, in idealized schematic fashion, the surface coating 16 of the sheet prepared with a 3:1 ratio of oil receptive particles 24 to oil resistive particles 26. Referring to FIG. 3, there is similarly illustrated the surface coating 16’ of a sheet prepared with a 1:1 ratio of oil receptive particles 24’ to oil resistive particles 26’. The result in each case is a surface division into alternate oil receptive and oil resistive regions. As a result, ink, dyes-wax combinations and the like become strongly anchored to the oil receptive particles A while not adhering to the oil resistive particles B resulting in a reticulation of the image and breaking-up of the image into small parts, albeit the image, to the eye, appears uniform. As a further result, when thermally processed, heat dissipation through the B particle regions prevents image spread.

Referring again to FIG. 1, the second component of the novel image control means comprises the backing sheet 20. The sheet 20 is sufficiently smooth, at least at its surface abutting the typing sheet, so as to closely contact the typing sheet and thus readily receive and absorb the typing key impact force transmitted thereto through the typing sheet. While any suitable material can be used, it has been found that resilient polyethylene terephthalate sheet material is particularly suitable. Such sheet material must be sufficiently thick yet resilient so as to readily absorb and dissipate the energy transmitted thereto.

The sheet 20 is movably positioned, i.e., abutted, against the back of the sheet 12 before typing begins of the surface 18. After typing is completed, the backing sheet is removed, and a thermal transfer duplicating process is carried to completion in the conventional manner, as previously described.

Thus, the typed surface of the original is positioned against a conventional thermal transfer sheet substrate carrying a fusible layer of heat sensitive material on the opposite side and an image-receiving sheet is positioned on said opposite side of the heat transfer sheet. Exposure to infrared radiation is then carried out to form a visible, transferred image on the image-receiving sheet. This imaged sheet is then used as the desired duplicate or as a master for providing the desired number of duplicate imaged copies, as by the spirit master or other solvent process or the like. The duplicate and copies show a high degree of resolution, edge sharpness, uniformity and clarity and are substantially better than copies provided by conventional thermal duplicating processes or impact transfer processes.

The following specific Examples, in which all parts are by weight, illustrate further features of the invention:

EXAMPLE 1

Thirty parts of a hydrated aluminum silicate, sold by the Georgia Kaolin Co. under the trademark “Hydrite 10,” 10 parts of glass beads averaging 40 microns in diameter and about 17 parts of an acrylic emulsion, sold by Rohm & Haas Co. under the trademark “Rhoplex AC-61” are mixed together in about 50 parts water. The Hydrite 10 is oil receptive, having an average particle diameter of about 0.5 microns and 42 weight percent oil absorption. The glass beads are oil resistive. The Rhoplex AC-61 forms a binder for the particles and contains 46 weight percent acrylic solids.

The mixture is coated on tissue paper of about 1.5 mil thickness and calendared and dried to a thickness of about 0.3 mil to form a sheet of typing paper. The coated typing paper is then backed by a 5 mil thick sheet of smooth Mylar (polyethylene terephthalate) while inked characters are placed on the typing surface by typing with a standard typewriter utilizing a conventional inked typing ribbon. The resulting typed image is found to be of uniform color, density and distribution and to exhibit character break-up (microscopically) into a uniform distribution of small sub-units. The typed original exhibits no appreciable indenting by the typing keys and provides clear, uniform and sharp copies when subjects to a thermal duplication process.

In the duplication process, the typed surface of the original is overlaid with a conventional thermal transfer sheet, in turn overlaid with a conventional image-receiving sheet. The composite is then exposed to infrared radiation to form a thermal image from the image on the original and to form a visible image in the image-receiving sheet by transfer from the transfer sheet. This visible image, when compared with the original image, is found to be of very high quality.

EXAMPLE 2

Fifty-one parts of a calcite clay, sold by the Georgia Kaolin Co. under the trademark “Glamox HE,” 78 parts of Hydrite 10, 70 parts of a calcium carbonate, sold by the Georgia Marble Co. under the designation “no. 10 white”, 27 parts of a polyvinyl acetate solution, sold by the National Starch Co. under the trademark “Resyn 1105” and 19 parts of starch sold under the trademark “Cato Kote 485” are mixed together. The Glamox HE is oil receptive, as is the Hydrite 10, having an average particle diameter size of about 1 micron or less and about 65 weight percent oil absorption. The No. 10 white calcium carbonate is oil resistive, having an average particle diameter of about 10 microns or higher and about 7-9 weight percent oil absorption. The Resyn 1105 forms a binder for the particles and contains about 4.7 weight percent polyvinyl acetate solids. The mixture is spread as a wet coating on a substrate comprising 1.5 mil thick paper and calendared at 1000 p.s. with a smooth steel roller to provide a finished dry coating having a thickness of 0.5 mil. The coated paper sheet is then backed by a smooth plastic sheet of cellulose acetate about 5.0 mils thick and the coated surface is imprinted with inked type characters, as set forth in Example 1. The typed sheet is then processed as in Example 1 to provide a duplicate. The duplicate image, when compared with the original image, is found to be very accurate, sharp, uniform and of overall high quality.

What is claimed is:

1. An improved image control means for a thermal duplicating process, comprising, in combination:
   an original compliant typing sheet having a thickness of about 1.5-2.5 mils, said sheet having a typing surface receptive to typing ink and resistant to ink transfer therefrom, said surface being coated with a substantially uniform mixture of oil receptive particles having an average diameter of less than 4 microns and having an oil absorption of at least 30 weight percent, and oil resistive particles having an average diameter of at least 8 microns and having an oil absorption of less than 20 weight percent,
said particles being selected from the group consisting of inorganic salt, inorganic oxide and mixtures thereof dispersed in a dry adhesive binder, the volume ratio of said oil receptive particles to said oil resistive particles being about 0.5:1 to about 8:1; and

a smooth resilient backing sheet abutted against the back of said typing sheet, said backing sheet having a thickness of about 2-5 mils.

2. The improved control means of claim 1 wherein said typing sheet comprises paper stock bearing said mixture as a thin calendered coating thereon.

3. The improved control means of claim 1 wherein said typing sheet comprises polypropylene plastic.

4. The improved control means of claim 1 wherein said backing sheet comprises cellulose acetate plastic.

5. An improved typing member comprising a compliant sheet having a thickness of about 1.5-2.5 mils, said sheet having a typing surface receptive to typing ink and resistant to ink transfer therefrom, said surface being coated with a substantially uniform mixture of oil receptive particles having an average diameter of less than 4 microns and having an oil absorption of at least 30 weight percent, and oil resistive particles having an average diameter of at least 8 microns and having an oil absorption of less than 20 weight percent, said particles being selected from the group consisting of inorganic salt, inorganic oxide and mixtures thereof dispersed in a dry adhesive binder, the volume ratio of said oil receptive particles to said oil resistive particles being about 0.5:1 to about 8:1.

6. The improved typing member of claim 5 wherein said typing sheet comprises paper stock bearing said mixture as a thin calendered coating thereon.

7. In a thermal duplicating process wherein an original typing sheet is typed to provide an image to be duplicated and thereafter a thermal duplicate is prepared from said typed original, the improvement which comprises typing on an original compliant typing sheet having a thickness of about 1.5-2.5 mils, said sheet having a typing surface receptive to typing ink and resistant to ink transfer therefrom, said surface being coated with a substantially uniform mixture of oil receptive and oil resistive particles, said oil receptive particles having an average diameter of less than 4 microns and an oil absorption of at least 30 weight percent and said oil resistive particles having an average diameter of at least 8 microns and an oil absorption of less than 20 weight percent, said particles being selected from the group consisting of inorganic salt, inorganic oxide and mixtures thereof dispersed in a dry adhesive binder the volume ratio of said oil receptive particles to said oil resistive particles is about 0.5:1 to about 8:1, said typing being carried out while said typing sheet is backed by a flexible smooth resilient backing sheet having a thickness of about 2.0-5 mils and including the step of thereafter removing said typing sheet from said backing sheet.

8. The improvement of claim 7 wherein said typing sheet comprises paper stock bearing said mixture as a thin calendered coating as said typing surface.