Oct. 8, 1968 A. G. GULKO 3,404,994

THERMOGRAPHIC COPYING PROCESS UTILIZING RECORDING MEMBER WITH DISPERSED OIL PARTICLES

Filed Feb. 11, 1965

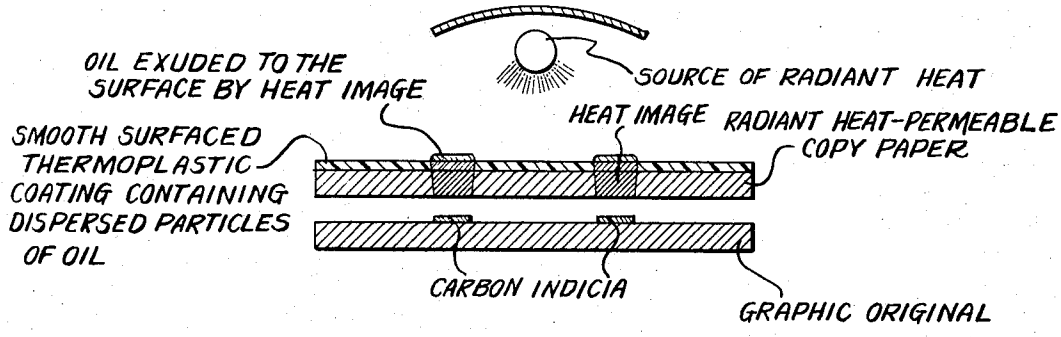



Fig. 1.

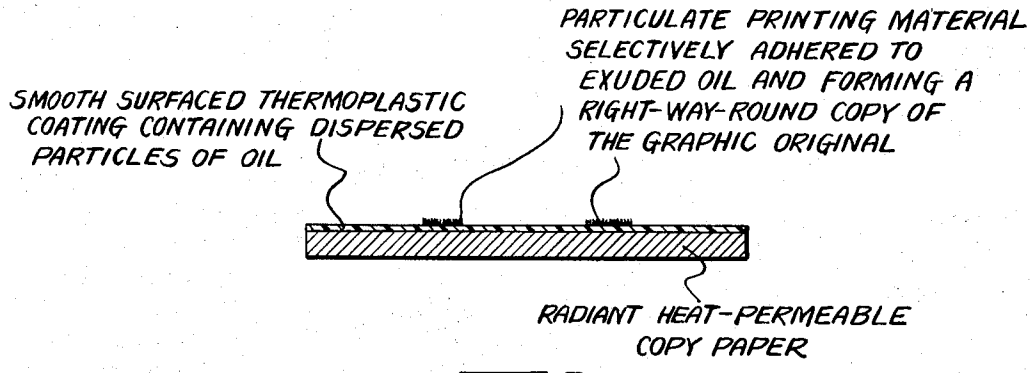



Fig. 2.

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United States Patent Office 3,404,994 Patented Oct. 8, 1968



3,404,994

# THERMOGRAPHIC COPYING PROCESS UTILIZING RECORDING MEMBER WITH DISPERSED OIL PARTICLES

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Filed Feb. 11, 1965, Ser. No. 431,952
7 Claims. (Cl. 117—1.7)

## ABSTRACT OF THE DISCLOSURE

Right-way-round copies are produced by superimposing a radiant heat-permeable sheet carrying a thermoplastic coating containing dispersed oil particles over a graphic original bearing radiant heat absorptive indicia. Radiant heat is directed through the heat-permeable sheet to heat the indicia and the heat image is transmitted through the heat-permeable sheet to the thermoplastic coating which causes the oil particles to be exuded to the surface and form a stable oil image which can be developed by adhering particulate printing material thereto or by other appropriate means.

The present invention relates to the utilization of radiant energy in the form of radiant heat for the copying of a graphic original.

In accordance with the present development, a sheet especially paper permeable to radiant heat, is surfaced with a smooth coating of thermoplastic containing dispersed oil particles.

When a heat image is imposed upon the coated paper, the thermoplastic is melted or softened and some of the oil blooms to the surface in a pattern which corresponds to the heat image to provide portions thereof which are receptive to printing dust, e.g., solid particles of pigmented material. Ordinary printing dusts include some thermoplastic particles so that the printing particles can be permanently affixed to the surface of the paper in conventional fashion.

It is essential that the thermoplastic coating be smooth and non-tacky since, and prior to the application of a heat image to the plastic surface, this surface must be non-tonable, e.g., resist adhesion of the printing particles thereto. In this connection, it is helpful, though not essential, that the plastic coating include a surface active agent to reduce electrostatic charge build-up which might tend to produce limited background toning which is undesirable.

It is preferred to employ thermoplastics which are soluble in water since this simplifies application to the paper and it also simplifies the production of emulsions, but water solubility is not an essential of the invention.

Similarly, it is preferred to employ as the dispersed oil a material which is normally liquid and which is of low volatility. On the other hand, volatile liquids may be used and, indeed, these have the advantage that any particle of the volatile oil at the surface removes itself by volatilization over a period of time whereas, when the heat image is applied in the invention, the printing dust can easily be applied to the surface before the oil has completely volatilized. Similarly, normally solid waxes can be liquified for limited periods using the elevated temperature of the heat image and used in this fashion. However, normally liquid oils are preferred to minimize heat requirements.

It is particularly convenient to apply the dispersion of emulsion of oil in thermoplastic continuum in the form of a simple emulsion, though it is permissible to use coascervated capsules as taught in United States Reissue



Patent No. 24,899, dated Nov. 29, 1960, so long as a smooth surface is retained. When using encapsulated particles of oil and when surface roughness interferes, the surface can be overcoated to provide the desired smoothness.

When employing ordinary emulsions some few oil droplets appear at the surface of the film which is deposited. When these are volatile, it is permissible to simply permit then to volatilize and be removed in this fashion. Where non-volatilizing or very slowly volatilizing oils are used, then these droplets can be driven from the top surface portion of the film to, in effect, form a surface skin thereon as taught, for example, in Example 1 of United States Patent No. 2,548,366, dated Apr. 10, 1951.

Any sheet material may be broadly used in accordance with the invention, but it is preferred in the invention to produce a surface image which is right-way-round. In order to do this, one must first eliminate any possibility of transfer of any material from the indicia on the original copy by relying, instead, upon the heat which is transferred through the copy paper to the surface thereof remote from the original to be copied. Secondly, one must employ copy sheets which are permeable to radiant heat so that radiant heat may be passed through the copy sheet directly upon the indicia to be copied.

It is preferred in the invention to employ cellulosic sheets of the nature of tracing paper which, even prior to the application of a thermoplastic film thereon possess smooth, substantially non-tonable surfaces. As is known, these sheets of paper are permeable to radiant heat and are composed of pressure-compacted hydrolyzed cellulose fibers. On the other hand, it is possible to use papers possessing considerable opacity since these, in many instances, are significantly penetrated by radiant heat.

The invention will be more fully described in connection with the accompanying drawing in which FIG. 1 shows a copy paper permeable to radiant heat being exposed to radiant energy in order to provide a reproduction of underlying indicia upon an original to be copied. The shadowed areas immediately overlying the indicia identify the heat image which is generated and conveyed to the smooth oil-containing thermoplastic coating by conduction. FIG. 1 also shows the oil image which is produced by the exposure as a result of blooming of the oil to the surface of the thermoplastic coating.

FIG. 2 shows the finished copy in which particles of printing dust have been adhered to the oil by simply contacting the dust against the oil pattern formed by the heat pattern referred to hereinbefore and then removing the non-adhered printing dust in conventional fashion. The pattern of printing dust which is formed by adherence to the exuded oil is then conventionally set in any desired fashion, e.g., by exposure to radiant heat in order to selectively heat the printing pattern via the carbon pigment contained therein and the thermoplastic particles forming a part thereof.

Numerous materials may be used to constitute the thermoplastic coating such as gum-dammar, gelatin, polyvinyl alcohol, animal glue, and polymers rich in heat-softenable monomers such as methyl vinyl ether and 2-ethylhexyl acrylate. These are illustrated by copolymers of methyl vinyl ether and ethyl acrylate in weight proportions of 90/10 and copolymers of ethyl acrylate and 2-ethylhexyl acrylate in weight proportions of 70/30. The copolymers referred to are solution copolymers so as to possess only moderate molecular weight and extensive solubility. The preferred water solubility in accordance with the invention in the acrylic copolymers can be achieved using unsaturated acids such as acrylic acid and nitrogenous bases such as ammonia, e.g., a copolymer of

60/30/10 ethyl acrylate, 2-ethylhexyl acrylate/acrylic acid dissolved in water to pH 9–10 with ammonia.

The invention is illustrated by the specific example which follows:

EXAMPLE

Dissolve 1 part, by weight, of gelatin (isoelectric point of pH 8 and a jelly strength of of 275 grams as measured by the Bloom gelometer) in 3 parts, by weight, of water at 150° F. To this add 4 parts of an oily liquid with agitation. The oil used is chlorinated diphenyl (chlorine content 48%) which is added hot. The emulsion is applied hot and is dried on the paper under normal atmospheric conditions. The dried coating is treated to drive the droplets into the interior of the film by wetting the surface of the dried film with water at room temperature and which may contain 1% of formaldehyde and a wetting agent such as dioctyl ester of sodium sulfosuccinate. The paper is wet for several minutes and then dried in a low humidity atmosphere. This may be accomplished by carrying the coated paper around a partially submerged drum with the coated surface facing outwardly.

It is of interest to observe that the above example corresponds closely with Example 1 of United States Patent 2,548,366 with the exception that dyes are unnecessary and are not used. It is also of interest to note that the oily material does not have to be liquid at room temperature since heat is used to liberate the oil and the dust to be adhered to the liquid oil while it is still soft. Moreover, the material liberated as a liquid oil via the elevated temperatures employed possess the capacity of adhering printing dust merely as a result of their surface tackiness, e.g., they would be semi-liquids and, in this connection, low melting waxes are useful and are intended to be embraced within the term oil as used herein.

The invention is defined in the claims which follow.

I claim:

**1.** In the reproduction of copy, the method comprising radiantly heating the radiant heat absorptive indicia of a graphic original while said indicia are in thermal contact wth the undersurface of a sheet having a smooth upper surface provided by a layer of thermoplastic material containing oil particles dispersed therein to cause said oil to be exuded to said smooth surface wherever said sheet is heated by thermal contact with said heated indicia to provide an oil image corresponding in pattern to the pattern of said heat absorptive indicia.

**2.** In the reproduction of copy, the method comprising superimposing over a graphic original bearing radiant heat absorptive indicia, a sheet of paper permeable to radiant heat, said sheet of paper being surfaced on the side thereof remote from said indicia with a smooth-surfaced layer of thermoplastic material containing oil particles dispersed therein, directing radiant heat energy through said sheet of paper to selectively heat said indicia and thereby selectively heat those portions of said sheet of paper which contact the same whereby the heat conducted through said paper will cause said oil to be exuded to said smooth surface in a pattern corresponding to a right-way-round reproduction of said indicia.

**3.** In the reproduction of copy, the method comprising radiantly heating the radiant heat absorptive indicia of a graphic original while said indicia are in thermal contact with the undersurface of a sheet having a smooth upper surface provided by a layer of thermoplastic material containing oil particles dispersed therein to cause said oil to be exuded to said smooth surface wherever said sheet is heated by thermal contact with said heated indicia, and then dusting said smooth surface with finely divided particles of printing material to selectively adhere said printing material to those portions of said smooth surface having said oil exuded thereon.

**4.** A method as recited in claim **3** in which said dispersed oil is liquid at room temperature.

**5.** A method as recited in claim **3** in which said layer is provided by the application of an emulsion of said oil dispersed in a water solution of said thermoplastic material.

**6.** In the reproduction of copy, the method comprising superimposing over a graphic original bearing radiant heat absorptive indicia, a sheet of paper permeable to radiant heat, said sheet of paper being surfaced on the side thereof remote from said indicia with a smooth-surfaced layer of thermoplastic material containing oil particles dispersed therein, directing radiant heat energy through said sheet of paper to selectively heat said indicia and thereby selectively heat those portions of said sheet of paper which contact the same whereby the heat conducted through said paper will cause said oil to be exuded to said smooth surface in a pattern corresponding to a right-way-round reproduction of said indicia, and then dusting said smooth surface with finely divided particles of printing material to selectively adhere said printing material to those portions of said smooth surface having said oil exuded thereon.

**7.** A method as recited in claim **6** in which said printing material includes heat absorptive material and thermoplastic material and the selectively adhered printing material is fixed to said radiant heat-permeable sheet by exposing the same to radiant heat energy.

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